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# Chapter 1

# Introduction and Overview

## Table of Contents

# Chapter 1
# Introduction and Overview

## Chapter Overview

This chapter provides an overview of the State Wildlife Action Plan Update (SWAP or Plan). It includes discussion on the background and purpose of the plan, how this update differs from the first version completed in 2005, and reviews the key components.

## Background and Purpose

Washington's State Wildlife Action Plan (SWAP) is a comprehensive plan for conserving the state's fish and wildlife and the natural habitats on which they depend. It is part of a nationwide effort by all 50 states and 5 U.S. territories to develop conservation action plans and participate in the State and Tribal Wildlife Grants (SWG) Program. The purpose of the SWG Program is to support state actions that broadly benefit wildlife and habitats, but particularly "Species of Greatest Conservation Need (SGCN)" as identified by each individual state.

Washington's first plan was completed in 2005 and was called the Comprehensive Wildlife Conservation Strategy or CWCS. The CWCS has since become known as the State Wildlife Action Plan. The United States Fish and Wildlife Service (USFWS) requires these plans be updated every 10 years in order to remain eligible for State Wildlife Grants funding. This document represents Washington's 2015 update. It assesses the status of the state's wildlife and habitats, identifies key problems they face, and outlines the actions needed to conserve them over the long term. A guiding principle of the SWAP planning process is to identify actions needed to conserve wildlife and their habitats before species become too rare and restoration efforts too costly. Our intent is that the SWAP serves to inform conservation priorities and actions statewide, and provide tools and informational resources to support collaborative conservation initiatives across a range of organizations and entities.

### Eight Essential Elements

Congress established eight elements that were required to be addressed for approval of the original CWCS. The USFWS subsequently developed policy regarding what constitutes a major or a minor revision to the plan. During the Washington Department of Fish and Wildlife's (WDFW) required review of the 2005 CWCS, it was determined that sufficient changes to the plan (including changes to Washington's Species of Greatest Conservation Need list) would be proposed, thus meeting the definition for a major revision. This required WDFW to ensure that all eight elements were addressed during the review and revision process.

| | |
|---|---|
| **Element 1** | Identify distribution, abundance and status of species of greatest conservation need |
| **Element 2** | Identify condition of key habitats types essential to the conservation of SGCN. |
| **Element 3** | Identify problems and threats that affect SGCN and their habitats. |
| **Element 4** | Determine and prioritize actions to conserve SGCN and their habitats. |
| **Element 5** | Provide for periodic monitoring and adaptive management of SGCN and their habitats |
| **Element 6** | Provide for review and revision of the State Wildlife Action Plan. |
| **Element 7** | Coordinate development and revision with appropriate federal, state, local agencies and tribes. |
| **Element 8** | Provide for necessary public involvement in the development, revision, and implementation of the SWAP. |

## Guiding Principles

WDFW established an interagency team early in the action plan revision process to ensure that the revised Plan would be useful and relevant across the agency and to our conservation partners. The interagency team reviewed the strengths and weaknesses of the 2005 CWCS as a first order of business, identifying what worked well, what aspects could be improved, and areas that needed significant updating. The team determined that it would be helpful at the start of the revision process to outline the intended use of the product, in the interests of developing a SWAP that would deliver maximum benefit.

The team established a set of guiding principles as a way to be explicit about our goals for the State Wildlife Action Plan (see Figure 1). After internal review, these principles were then introduced to, and approved by the Wildlife Diversity Advisory Council, a committee convened by WDFW to advise the agency on a number of issues related to managing at risk species in the state. More information about the engagement of the Wildlife Diversity Advisory Council can be found in Appendix D – Outreach.

Figure 1

**Guiding Principles**
***2015 State Wildlife Action Plan***

1. Design the State Wildlife Action Plan to guide WDFW conservation planning. It should also serve to inform and benefit conservation partners to advance conservation priorities.

2. Focus Species of Greatest Conservation Need on *biological* conservation needs; address *socioeconomic* factors in prioritization.

3. Recognize the importance of ecosystem based management in accomplishing conservation.

4. Include Cross Program expertise and perspective. The SWAP will aim for a final product that is consistent and relevant to agency values.

5. Engage conservation partners. A goal is to use the SWAP to facilitate collaborative conservation, including cross-state and regional approaches.

6. Create a document that is concise, readable, informative and available to a wide range of publics and stakeholders.

7. Be Efficient. Conduct the SWAP revision in a manner that matches available resources for planning and implementation.

## Audience

One of the most important outcomes of the interagency team's review of the CWCS, which is codified in the guiding principles, was to clarify that the primary audience for the State Wildlife Action Plan is WDFW. The previous CWCS was developed and written to address a broadly defined conservation community across Washington. While we fully recognize that conservation is a collaborative endeavor, and that engaging conservation partners is critical, we learned that implementation becomes more difficult if the primary audience or owner of the plan is not clearly identified. For these reasons, and because we wanted to advance implementation and use of the products developed through the SWAP, we were explicit that WDFW is the primary audience, with the recognition that the document will also be useful to the full breadth of our conservation partners. Chapter 7 - Implementation, discusses opportunities for others outside the agency to benefit from a number of the products created through the SWAP. Where appropriate, some of the actions that have been identified in the species Fact Sheets have WDFW identified as the likely owner of that action, whereas conservation partners are suggested as likely resources for addressing other actions. It is our hope that these products will advance our collective understanding of conservation needs across the state, and contribute to our effectiveness at addressing them.

## A Word about Prioritization

The actions needed to address the conservation issues for the 268 Species of Greatest Conservation Need and 28 Ecological Systems of Concern outlined in this document are significant, from population assessment and inventory, to habitat protection, acquisition, and restoration. It is clear that WDFW does not have the financial capacity to adequately address all of these needs, and that we must prioritize where to invest; in which species, landscapes, or conservation tools. We also recognize that the criteria by which we prioritize investment will change depending on the specific funding source, the specific conservation partners involved, or other factors. Consequently, WDFW has adopted a flexible approach to prioritization in the SWAP, one that allows the agency to prioritize conservation activity in response to changes in internal priorities, organizational capacity, targeted funding opportunities, or the availability of other resources. In 2014 we developed a prioritization matrix (see Chapter 7 and also Appendix E), which includes a range of factors and criteria for determining priority for implementation. Our SGCN list is larger than in 2005, in part because of an explicit recognition that, while the agency doesn't currently have capacity to adequately fund the conservation actions for all SGCN identified, other resources may become available or conservation partners may be able to address those needs. Thus, inclusion of a species as an SGCN or inclusion of an ecological system as an ecological system of concern doesn't necessarily imply WDFW will initiate action; rather that the need for conservation action exists and that we will work collaboratively with our partners to address unmet needs as capacity allows.

## Engaging Conservation Partners

Input and feedback from our conservation partners was solicited early in the SWAP update process, through email announcements, surveys, workshops, and webinars. Our interest was to determine how the SWAP could be developed in such a way as to contribute to the shared goals of conservation partners and others. Appendix D includes a full discussion of our outreach plan, specific activities, and results.

## How the 2015 SWAP Differs from the 2005 CWCS

While we drew extensively from the products created for the CWCS, we recognized that the last ten years have brought significant changes in terms of data availability, updated tools and new methodologies, as well as shifts in the landscape of conservation partners and priorities. These new developments, combined with our interests in developing a document more clearly focused on implementation, made it clear that we needed to develop a new document, rather than simply editing the 2005 CWCS. However in doing so we also committed to using as much information as possible from the previous edition.

Another notable shift in the last ten years has been a rapidly growing body of research focused on understanding the impacts that a changing climate may have on the distribution and health of our fish and wildlife resources. Chapter 5 includes a full discussion of how climate change is expected to affect the Species of Greatest Conservation Need and the habitats on which they depend. Appendix C includes additional material to support the climate change information presented in Chapter 5.

The table below highlights key differences between the two documents.

| What Changed | Rationale | Implications for the 2015 SWAP |
|---|---|---|
| **SGCN Criteria:** The criteria for inclusion as a Species of Greatest Conservation Need was modified from 2005.<br><br>Modifications included using NatureServe ranks as a criterion, based in part on the guidance document, "Best Practices for State Wildlife Action Plans" produced by | **Increased Transparency:** The criteria used in 2005 was unnecessarily complicated and proved difficult to easily explain to a non-technical audience. We simplified the criteria to address only biological conservation need, with the understanding that socioeconomic needs would be addressed in prioritization processes. The use of | **Larger SGCN list:** The SGCN list is almost 30 percent larger than in 2005 (from 186 to 268). This number reflects a much larger number of invertebrates and fishes, as well as updated information for the other taxa. |

| What Changed | Rationale | Implications for the 2015 SWAP |
|---|---|---|
| AFWA[1]. | the NatureServe ranks was recommended in the AFWA Association of Fish and Wildlife Agencies Best Practices guide. | |
| **Habitat Classification:** Habitats were classified and described differently; we adopted the National Vegetation Classification System (NVC) to represent habitat needs for SGCN. | **Standardized and Mappable:** Ecological systems (part of the NVC) are mapped across the west. Use of ecological systems to describe habitat provides an important spatial component to the SWAP, allowing us to translate conservation priorities to specific landscapes. | **Chapter 4** in the SWAP addresses Habitats of Greatest Conservation Need and this is entirely new material. |
| **Defining Stressors and Actions:** Based in part on the Best Practices for State Wildlife Plans document (AFWA 2012), we adopted a nationally accepted lexicon for defining threats and actions (TRACS). | We selected the Wildlife TRACS system of classification which was not available in 2005. TRACS is the tracking and reporting system for conservation and related actions funded by the USFWS. | When stressors and actions are discussed in the SWAP, they are described by TRACS categories. This change will facilitate our ability to identify projects appropriate for funding through SWG. |
| **Range and Habitat Distribution Maps:** These maps are included for a subset of the SGCN for which we had sufficient data. | The CWCS did not include spatial representation of range and distribution for SGCN. | Appendix B includes range and potential habitat distribution maps for SGCN. |
| **Agency-wide Participation:** Increased engagement by the WDFW Fish and Habitat programs resulted in a more robust SGCN fish and invertebrate lists and also ensured relevancy to the entire agency. | The WDFW Conservation Initiative, adopted in 2012, emphasizes the importance of cross-program engagement in key initiatives. | The SGCN list is larger, there is greater awareness of SWAP across the agency, and there are increased opportunities for implementation. |
| **Climate Change:** Other than being identified as a threat, climate change was not discussed in the 2005 CWCS. | The last ten years have brought a growing recognition of the emerging threat that climate change poses to our fish and wildlife and the need to build our understanding regarding specific risks and vulnerabilities. | Chapter 5 discusses projected impacts and introduces a list of species and habitats most at risk from climate change. Appendix C includes the full assessment of climate vulnerability for all SGCN. |

[1] Association of Fish & Wildlife Agencies. November, 2012. Best Practices for State Wildlife Action Plans, Voluntary Guidance for States for Revision and Implementation.

## Document Overview

**Chapter 2 – State Overview**
Chapter 2 provides background information on the biological and physiographical characteristics of the state and discusses the distribution of fish and wildlife resources across the state. It also provides an overview of the primary stressors and challenges for fish and wildlife, and outlines the state framework for addressing them.

**Chapter 3 – Species of Greatest Conservation Need**
Chapter 3 reviews the Species of Greatest Conservation Need. It describes the criteria and process used to identify the revised list and describes differences from 2005, including a list of species that dropped off the list and why. Summaries of the conservation status and concerns for all of the SGCN are presented in taxa groups; mammals, birds, reptiles and amphibians, fish, and invertebrates. Each of the SGCN also has an associated fact sheet which provides more detail on habitat needs, distribution, and conservation threats and actions. These fact sheets can be found in Appendix A.

**Chapter 4 – Habitats of Greatest Conservation Need**
Chapter 4 discusses Habitats of Greatest Conservation Need. In this section, we have used the National Vegetation Classification to describe habitats important to SGCN, using two levels of the NVC hierarch; vegetation formations and ecological systems. We describes threats generally for each major habitat in the entire state (using vegetation formations) and then focus on those ecological systems considered most imperiled (Ecological Systems of Concern). Fact sheets for each of the ecological systems of concern include a description, lists of SGCN for which this is a crucial habitat, key stressors, and actions needed.

**Chapter 5 – Climate Change: Which species and habitats are most at risk?**
In Chapter 5 we provide a summary of how climate change may affect the SGCN and the habitats on which they depend. We also highlight the summary findings from an analysis assessing the relative vulnerability to climate change of all of our SGCN, and our ecological systems of concern. From this analysis we identified a Climate Watch List – those species most at risk because of climate change effects. These species and the reasons why they are more sensitive to climatic change are outlined in Chapter 5. Additional detail from this analysis is provided in Appendix C.

**Chapter 6 – Monitoring and Adaptive Management**
In this chapter we discuss the agency's commitment to monitoring and adaptive management and profile a couple of examples. We focus on population assessment monitoring, and compliance or effectiveness monitoring.

**Chapter 7 – Implementation**
Chapter 7 considers specific products, either prepared in support of the SWAP or part of the SWAP itself, and discusses how they can inform activities and initiatives, both internal and external to the agency. We also outline future needs to fully implement the SWAP.

**Appendix A – SGCN Fact Sheets**
A1 – Fact sheets for SGCN Mammals
A2 – Fact sheets for SGCN Birds
A3 – Fact sheets for SGCN Reptiles and Amphibians
A4 – Fact sheets for SGCN Fishes
A5 – Fact sheets for SGCN Invertebrates

**Appendix B – Range and Potential Habitat Distribution Maps**
Range and potential habitat distribution maps for selected SGCN are presented in Appendix B, as well as a description of methodology and considerations for use.

**Appendix C – Climate Change Background Information**
This appendix includes supporting information regarding the climate change findings presented in Chapter 5.

**Appendix D – Outreach**
Appendix D contains a description of public and stakeholder outreach in the development of the SWAP.

**Appendix E – Prioritization Matrix**
This appendix is a matrix that allows for the prioritization of conservation actions

# Chapter 2: An Overview of the Challenges and Strategies for Conserving Biodiversity in Washington

# Table of Contents



**List of Figures**

# Chapter 2

# An Overview of Challenges and Strategies for Conserving Biodiversity in Washington

## 2.0 Introduction and Overview

This chapter provides the context for understanding both the distribution of fish and wildlife in Washington and the framework that exists to conserve and protect these species and the habitats on which they depend. Bearing in mind that a primary audience for the State Wildlife Action Plan (SWAP) is the Washington Department of Fish and Wildlife (WDFW), this is written from an agency perspective, and intended to lay the groundwork for the conservation actions that are outlined later in the document, in Chapters 4, 5, 6 and 7. These actions will collectively inform WDFW strategic plans and agendas throughout the life of the plan.

Washington is one of the most ecologically diverse states in the United States, due in part to its varied topography, exposure to Pacific Ocean currents and weather patterns, and location on the migratory path of many wildlife species, including birds, California gray whales and Pacific Northwest salmon. Our geographic diversity includes seacoast, shrub-steppe, native grasslands and prairies, river canyons, mountain ranges, and the huge inland estuary known as Puget Sound. Washington contains most of the major ecosystem types found in the western United States, including two that are found nowhere else in the world—the channeled scablands of eastern Washington and the Olympic rainforest.

Biodiversity is partially defined or characterized by species richness—the number of plants and animals that spend all or part of their lifecycle in a particular area. Washington is a permanent or temporary home to thousands of plant and animal species, including 140 mammals, 451 freshwater and saltwater fish species, and 341 species of birds that either breed here or stop here on their annual migrations. Washington also hosts 150 other vertebrate species, 3,100 vascular plant species, and more than 20,000 classified invertebrates. More than 3,000 of the invertebrate species are butterflies and moths. While Washington's SWAP only focuses on animal species and their associated habitats, it is important to frame this discussion in the larger context of the state's full biological diversity. Most of the state's native animal species fall within the legal definition of "wildlife" and are under the purview of the WDFW. Responsibility for native plant conservation, including designated rare plant species, rests with Washington Department of Natural Resources (WDNR) Natural Heritage Program.

Biodiversity is not constant, even in a natural ecosystem with minimal human influence. Changes are accelerated, however, by human population growth, human disturbance, and shifts in economic activity, and Washington's biodiversity is impacted every day by human disturbance to natural ecosystems. Loss of habitats may lead to loss of species diversity. For example, much of the state is forested and most forests have been harvested, with an estimate of only about 18 percent of old-growth forest habitat remaining. Estuarine (coastal) wetlands are extremely productive biologically, yet more than 90 percent of these wetlands in the Puget Sound region have been lost since European settlement. As Washington continues to grow and develop, fish and wildlife habitat is being altered and sometimes lost, resulting in a net loss of biodiversity.

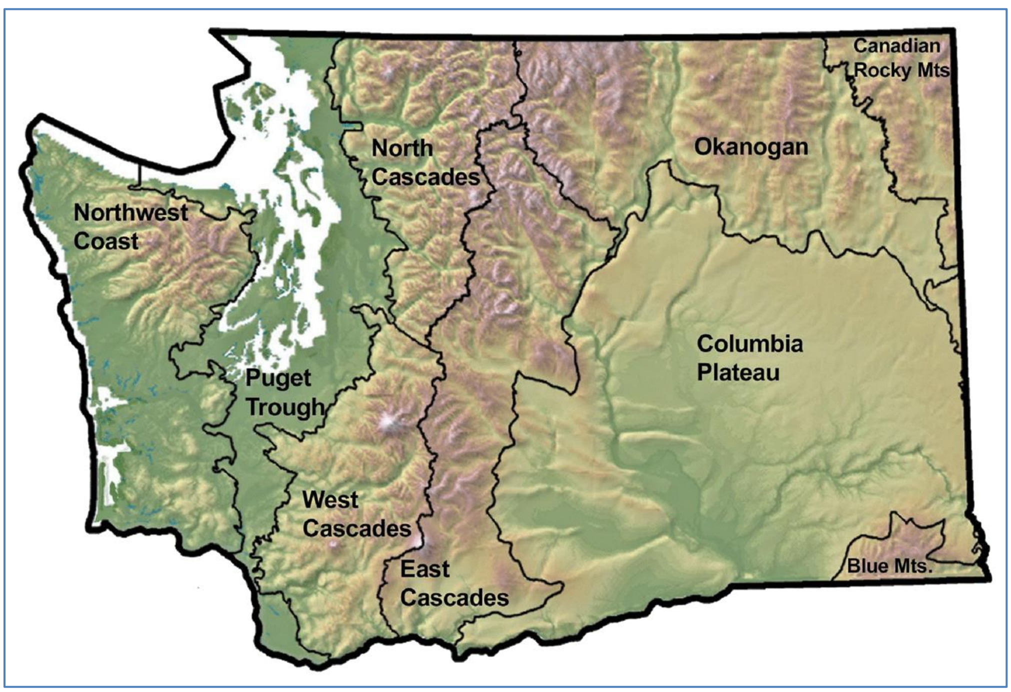
The remainder of this chapter presents, at a fairly high level, some of the most challenging problems facing our wildlife populations and the range of specific programs and institutional framework that has been developed to address them. To be effective at stemming the loss of biodiversity, including important fish and wildlife resources, the WDFW and its conservation partners must work together and improve efforts to identify and prioritize the most important places for conservation action. The SWAP recognizes this need and identifies opportunities for collaboration in efforts such as the priority landscapes initiatives, described in Chapter 4, climate change research and monitoring, described in Chapter 5, and several others outlined in Chapter 7, Implementation.

## 2.1 Washington's Ecoregions

Ecoregions are defined through broad but unique patterns in the landscape. Each ecoregion exhibits a suite of physical and environmental characteristics, including unique: combinations of soils, geology, climate, water availability and distribution that shapes the composition and distribution of plant communities and associated wildlife. These factors make ecoregions a useful tool for conservation planning. Ecoregions are used in Chapter 4 – Habitats of Greatest Conservation Need (HGCN) – to provide a landscape context to the discussion of conservation needs related to ecological systems and habitats used with regard to their occurrence within their respective ecoregion.

There are 63 ecoregions delineated in North America, and nine of these ecoregions occur partly, or completely, within Washington (Figure 1).

Figure 1: Washington's Ecoregions



## 2.2 Wildlife Species Distribution, Status and WDFW Management Priorities

The distribution and richness of Washington's species are dependent on the quality and quantity of habitats available to them. As Washington's habitat base has changed over the last hundred years, so has the distribution and status of the state's wildlife. Wild populations of Pacific salmon and steelhead have diminished in both numbers and diversity with the construction of dams, water development projects, and land use changes. Species such as the greater sage-grouse that are dependent on native shrub-steppe habitat have declined in numbers and distribution as shrub and grassland habitat has been converted to farms and orchards, or been developed for other economic uses. On the other hand, water development in the Columbia Basin has created new areas of wetland habitat for migrating and wintering waterfowl, and the clearing of forests for agriculture in northeast Washington has facilitated the expansion of white-tailed deer into many areas where they did not occur prior to statehood in 1889.

The WDFW and its predecessors, the Department of Fisheries and the Department of Game, have always classified fish and wildlife species for purposes of management and harvest regulation. Historically, management emphasis was almost exclusively on commercially harvested fish species (salmon, shellfish and other food fish) and game species. This began to change in 1972 when a citizen initiative established a Nongame Program funded from the sale of personalized license plates. The mission of the program was to identify and conserve species not identified as game species. In 1980, the Department of Game developed a state list of Endangered Species (which included all federally listed species). In 1990, the Fish and Wildlife Commission adopted WAC 232-12-297, which defines procedures for state listing and delisting of species as Endangered, Threatened or Sensitive. Species on the state list are called Species of Concern.

In 1989, the Department created a statewide list of Priority Habitats and Species (PHS), which has been used to provide important fish, wildlife and habitat information to local governments, state and federal agencies, private landowners and consultants, and tribal biologists for land use planning and wildlife conservation purposes. For more information, go to http://wdfw.wa.gov/conservation/phs/list/. PHS is currently the agency's primary means of transferring fish and wildlife information from resource experts to those who protect and manage habitat on both public and private land.

### 2.2.1 Species of Greatest Conservation Need (SGCN)

The SWAP requires a list of SGCN, updated at least every 10 years. The SGCN list differs from WDFW's Species of Concern list and Priority Habitats and Species list in that it is more comprehensive. It includes not only species known to be imperiled and in immediate need of conservation attention, but also other more common species that are in rapid decline or have other identified conservation concerns. One of the guiding principles of the State Wildlife Planning Process is to encourage conservation actions for species before they become imperiled and opportunities for recovery become more limited. For this reason, the SGCN list also differs from the PHS list of species in that it includes game species only when those populations are low due to declines in habitat or the species has other conservation concerns that can be addressed through the implementation of the SWAP. Alternatively, PHS includes a more comprehensive list of vulnerable game species, since a primary purpose of PHS is to conserve species for recreational and cultural use. Chapter 3 includes a list of all SGCN and more discussion on the criteria and process for determining the 2015 SGCN list. Appendix A includes a fact sheet for every SGCN, describing habitat, distribution and key stressors and conservation actions needed.

### 2.2.2 Other Managed Species

In addition to adopting strategies to manage species on the statewide SGCN list, the SWAP and SGCN list do not diminish or replace WDFW's responsibility and mission to assess, conserve and manage *all* wildlife and the habitats on which they depend for the benefit of Washington's public. WDFW will continue to conserve and manage other fish and wildlife species and associated habitats for recreational use and/or commercial harvest. The term "other managed species" includes game species not on the SGCN list, including non-natives such as ring-necked pheasant, chukar partridge, and largemouth bass, as well as commercially harvested marine fish, anadromous fish, and shellfish. Many conservation actions undertaken for SGCN, especially actions that protect or restore habitat, will also benefit many game and commercially harvested species. In 2014, the WDFW published the *2015-2021 Game Management Plan*, which articulates management and research objectives, priorities and policies for all terrestrial game species managed by the WDFW. Go to: [http://wdfw.wa.gov/conservation/game/ for additional details](http://wdfw.wa.gov/conservation/game/). Similar plans for sportfish, commercial fish and shellfish have also been adopted by the WDFW. More complete lists of WDFW management plans are available on the WDFW website ([wdfw.wa.gov](http://wdfw.wa.gov)).

### 2.2.3 SWAP Habitats of Greatest Conservation Need

The SWAP also requires the identification of habitats important for the conservation of SGCN. The WDFW has updated its 2015 list of important habitats using ecological systems, a classification unit used in the National Vegetation Classification. Each of the SGCN are associated with the specific ecological systems important for their continued persistence. In addition to the relative importance of the ecological systems system to SGCN, the WDNR's Natural Heritage Program provided an assessment of the conservation status for all of the ecological systems found in Washington. For the purposes of the SWAP, we refer to the habitats of greatest conservation need as those ecological systems most at risk (imperiled or critically imperiled) as well as those particularly critical for SGCN (defined by the greatest number of associated SGCN). Chapter 4 provides a full discussion regarding the relationship of ecological systems to habitat, and includes a description of each of the imperiled systems in Washington, the SGCN which depend on them, key stressors and conservation actions needed.

## 2.3 Major Statewide Conservation Problems and Issues

Most of the major statewide problems affecting Washington's wildlife and biodiversity are the direct or indirect result of human influence on the state's habitat base. Rapid, sustained population growth since the end of World War II has resulted in substantial losses of fish and wildlife habitat in urbanizing areas of the state, as well as a constant invasion of exotic plant and animal species across the landscape. These habitat losses and changes are most profound in the Puget Sound region, which is home to most of the state's human population and where development pressure and urban runoff affect a host of terrestrial and aquatic habitats. Dramatic effects are also apparent for the Columbia Plateau, where much of the native shrub-steppe and grassland habitat has been converted to agriculture. Washington's population is projected to continue to rise, and with this population growth will come more cars and roads, more demand for water, energy and developable land, and increased need for the treatment and disposal of solid waste, sewage and stormwater runoff—all of which will impact the state's wildlife and habitat resources. In the face of this projected growth, the WDFW and its conservation partners find themselves in the difficult position of applying limited funds and staff resources to identifying, conserving and managing the remaining native species and the habitats on which they depend.

In addition to the threats described above, we are now also faced with the unprecedented threat of a changing climate, which has the potential to significantly and irreversibly alter our forests, coasts, wetlands, grasslands, freshwater aquatic systems and the species that depend on these habitats. The following are the key conservation challenges facing Washington's fish, wildlife and habitat base:

- Habitat loss through conversion, fragmentation and degradation
- Invasive alien plant and animal species
- Water quantity—allocation and diversion of surface water
- Water quality issues
- Forest management issues
- Unsustainable agricultural and improper livestock grazing practices
- Diseases and pathogens
- Inadequate data on wildlife species, populations, and
- Climate change

### 2.3.1 Habitat loss through conversion, fragmentation and degradation

Habitat conversion, fragmentation, and degradation together pose the most serious state-wide threat to Washington's native fish and wildlife resources. Since statehood in 1889, these combined problems have cost the state more than half of its highest priority functioning habitats, including an estimated 70 percent of estuarine wetlands, 50 to 90 percent of riparian habitat, well over 80 percent of old growth forest, 70 percent of arid grasslands, and more than 50 percent of shrub-steppe. These five native habitat types alone are among the most diverse and productive for the state's native fish and wildlife. About 75 percent of Puget Sound's estuaries and their adjacent habitats, such as grasslands, mixed woodlands and floodplain forests, have been modified so significantly that they no longer provide their original functions.

Once native habitat is converted to other uses, the remaining habitat is often left as isolated fragments in a matrix of multiple land uses. Wildlife populations associated with these fragmented habitats are often blocked from their normal movement patterns and migration routes, and thus subjected to isolation from other breeding populations. Habitat loss and fragmentation also causes increased competition with other species, predation, and increased conflicts with other land uses. In a fragmented landscape, animals have to move from one patch of habitat to another and when this happens, migrating wildlife populations become broken into smaller, isolated units that are more susceptible to population decline, disease impacts, localized natural disasters, and possible extirpation.

Transportation systems such as major highways and roads are also a primary cause of habitat loss and fragmentation, as well as constituting direct barriers to wildlife movement and a source of direct mortality via collisions with vehicles using these roadways. When wildlife populations are low, roadkill mortality is significant, especially for slow-moving animals such as turtles and salamanders and wide-ranging carnivores that have to cross many roads. Washington will continue to experience significant human population growth into the foreseeable future. This growth and development will result in continued loss, conversion and fragmentation of fish and wildlife habitat. Steps are being taken by WDFW, other state and federal agencies, local governments and many private conservation organizations to identify and conserve the most important and productive habitats, as well as to identify habitat connectivity corridors across the state with efforts such as the Washington Habitat Connectivity Working Group (http://waconnected.org).

### 2.3.2 Invasive alien plant and animal species

Invasive species constitute a severe and growing threat to Washington's native wildlife, habitat and biodiversity—second only, many believe, to habitat fragmentation. Across the state, aggressive non-native plants and animals are displacing native species, profoundly altering natural systems and affecting the state's economy and human health. These alien plants and animals have been introduced through both intentional and unintentional mechanisms, including: "hitchhiking" on horses and other livestock, trucks and boats; transport on ocean currents and in ballast water and importation in aquaculture and horticulture products and the pet/aquarium trade. Although many non-native species are unable to form self-sustaining populations and soon disappear, some become established and thrive, often outcompeting native species and adversely changing ecosystems in the process. They evolved in other parts of the world and arrive in Washington without natural predators and diseases that would normally keep their population growth in check in their native environment. The number and abundance of introduced species is both a cause and an indicator of declining ecosystem health.

The effect of invasive species is especially severe in the shared inland marine waters of Puget Sound and Georgia Basin to the north (collectively, the Salish Sea). Examples include cordgrasses (*Spartina*), Japanese eelgrass, wireweed (*Sargassum muticum*), oyster drill, varnish or dark mahogany clam, European green crab, and the American bullfrog. Cordgrass and wireweed outcompete and eliminate native salt marsh vegetation and raise the level of the marsh substrate. Additionally, wireweed clogs intake pipes of industrial facilities and hinders shellfish harvest on oyster beds. Oyster drills prey upon young oysters. The green crab, first reported in Willapa Bay in 1998, is a voracious predator that feeds on many types of organisms, particularly bivalve mollusks (clams, oysters and mussels), polychaetes, small crustaceans and juvenile Dungeness crab, and outcompetes Dungeness crab for habitat and food supply. In freshwater habitats, the proliferation of non-native bullfrogs has had a severe impact on declining species such as western pond turtles, northern leopard frogs, and other native species.

Some of the most destructive invasive plants are found in the shrub-steppe, grassland and forested communities of eastern Washington, where they thrive through the effects of agriculture, grazing, mining and certain natural disturbances such as catastrophic wildfire and floods. These invaders not only out-compete native plants, but also present a severe and growing problem for farmers, ranchers and forest managers. Perhaps the most widespread and problematic of the dryland invasive species is cheatgrass, originally from Eurasia, which has replaced native grassland communities all over the Intermountain West. Cheatgrass has limited or no food value for wildlife and livestock, and it presents a significant fire hazard in both shrub-steppe deserts and ponderosa pine forests, where it can add to the fire fuel load, resulting in hotter wildfires and more damage to native vegetation. Other examples of invasive, nuisance plant species include yellow star thistle, Japanese knotweed, knapweed species, Dalmatian toadflax, and sulfur cinquefoil.

Many freshwater aquatic invasive plants found in Washington were originally brought here as ornamental plants for aquariums or water gardens. These ornamentals are usually hardy species and, when introduced to Washington's waters, often thrive and outcompete native plants. Eurasian water milfoil is one aquatic noxious weed that is a particular problem state wide. It reproduces by fragmentation and proliferates to form dense mats of vegetation in the littoral zone of lakes and reservoirs, where it crowds out native aquatic vegetation, reduces dissolved oxygen and can severely degrade the ecological integrity of a water body in just a few growing seasons.

The invasion of alien plant and animal species is recognized as a critical problem in Washington, not just for native fish, wildlife and biodiversity, but for the state's vital agricultural industry. The problem is currently being addressed at many different levels in Washington, within the constraints of budgets and staffing resources. Examples include Washington's Noxious Weed Control Board, which serves as the state's noxious weed coordination center for the activities of 48 county noxious weed control boards and districts, and the Washington Invasive Species Council, which was established by the legislature in 2006 and tasked with providing policy level direction, planning, and coordination for combating harmful invasive species throughout the state.

### 2.3.3 Water quantity—allocation and diversion of surface water

The survival, distribution and diversity of Washington's fish and wildlife is largely determined by the availability of water, including water to support aquatic and marine species, water to drink, water to grow wildlife food plants, and water to support the annual upstream and downstream migration of anadromous fish. Water is as important in the Olympic rainforests, which can receive more than 200 inches of moisture a year, as it is in the Juniper Dunes wilderness of eastern Washington, which averages only 8 to 14 inches of annual precipitation. Without adequate water to support fish and wildlife, other conservation issues become secondary.

The relative abundance of water has been a major factor in the growth and development of Washington's landscape and economy since the late 1800s. The seemingly unlimited supply of surface and groundwater encouraged the growth of cities and development of irrigated agriculture, not to mention the generation of hydroelectric power and production of aluminum, both of which require massive amounts of water. Until recent years, water was considered so plentiful in the Northwest that plans were evaluated to divert water from the Columbia River and ship it south to California and other states.

*Dams:* There are currently over 1,000 dams on Washington's rivers and tributary streams. Because they obstruct the natural flow of rivers, these dams can have many detrimental effects on the aquatic environment, including altering the natural flow cycles of rivers, interrupting the transport of nutrients and sediments normally deposited in deltas and estuaries, fragmenting resident aquatic wildlife populations, and hindering anadromous fish migration between the ocean and upstream spawning areas. Older dams without fish ladders, including Chief Joseph and Grand Coulee Dam on the Columbia River, completely block the upstream migration of fish. Even on newer dams, spinning turbines that generate electricity often disorient, injure or kill juvenile fish on their downstream migration to the sea.

*Water diversions:* Salmon and other aquatic wildlife depend on reliable water flows during critical periods in their lifecycles. Unless adequate minimum flows are established for fish and wildlife and enforced by Washington state agencies, water withdrawals may result in dewatering important mainstem habitats as well as pools and quiet backwater areas that provide essential habitat for the growth and development of juvenile fish, amphibians and aquatic invertebrates. Inadequate flows and water depth in these backwater areas deprive developing fish eggs of oxygen, make it easier for fish predators to find their prey, and generally interfere with the journey of migrating fish. Interrupting or delaying migration can cause adult fish to resort to spawning in unsuitable habitat.

There are many ongoing state and federal efforts to mitigate for the adverse impacts of past water diversions and dams, ranging from adding or improving fish ladders on hydroelectric dams, to screening fish out of irrigation culverts, to requiring adequate year-round instream flows for fish and wildlife.

These efforts have become more common and better-funded since the listing of numerous Northwest salmonid under the federal Endangered Species Act.

### 2.3.4 Water quality issues

Major water quality discussions in Washington usually revolve around preserving the quality of public drinking water supplies and the effects of non-point source contamination on ground and surface waters. However, the effect of surface water quality on the health of aquatic ecosystems and wildlife is also becoming increasingly important. The most common water quality problems affecting fish and wildlife in Washington's waters are: 1) fecal coliform bacteria contamination; 2) contaminated sediments, which are a particular problem in Puget Sound; 3) elevated water temperature, which can quickly alter or degrade an aquatic ecosystem; 4) increased sediment in streams, which can blanket important food sources and fish spawning areas; 5) excess nutrients and pesticides washed into lakes and streams from lawns, golf courses and agricultural fields, which can directly poison aquatic organisms or contaminate waterways and 6) issues related to stormwater runoff. Water quality issues related to potential contamination of the Columbia River from the Hanford Nuclear Reservation are also of concern, particularly if long-buried radioactive waste reaches the river or its tributaries.

Recently, a shift in ocean chemistry has been observed in the state's marine waters that is related to increased concentrations of atmospheric carbon dioxide ($CO_2$). Changing ocean chemistry has profound implications for marine ecosystems. As an example, between 2005 and 2009, disastrous production failures at commercial oyster hatcheries were caused by the arrival of low-pH seawater along the West Coast, which created conditions corrosive to shell-forming organisms like young oysters. Ocean acidification is a reduction in the pH of seawater for an extended period of time due primarily to the absorption of $CO_2$ from the atmosphere. When $CO_2$ is absorbed by seawater, chemical reactions occur that lead to increased concentrations of hydrogen ions, causing seawater to become more acidic and causing carbonate ions to be relatively less abundant. Other, local sources of acidification such as nitrogen oxides and sulfur oxide gases, nutrients and organic carbon from wastewater discharges and runoff from land-based activities, can also contribute to ocean acidification. More than 30 percent of Puget Sound's marine species are vulnerable to ocean acidification by virtue of their dependency on availability of carbonate ions to form their calcium carbonate shells, skeletons, and other calcified body parts.

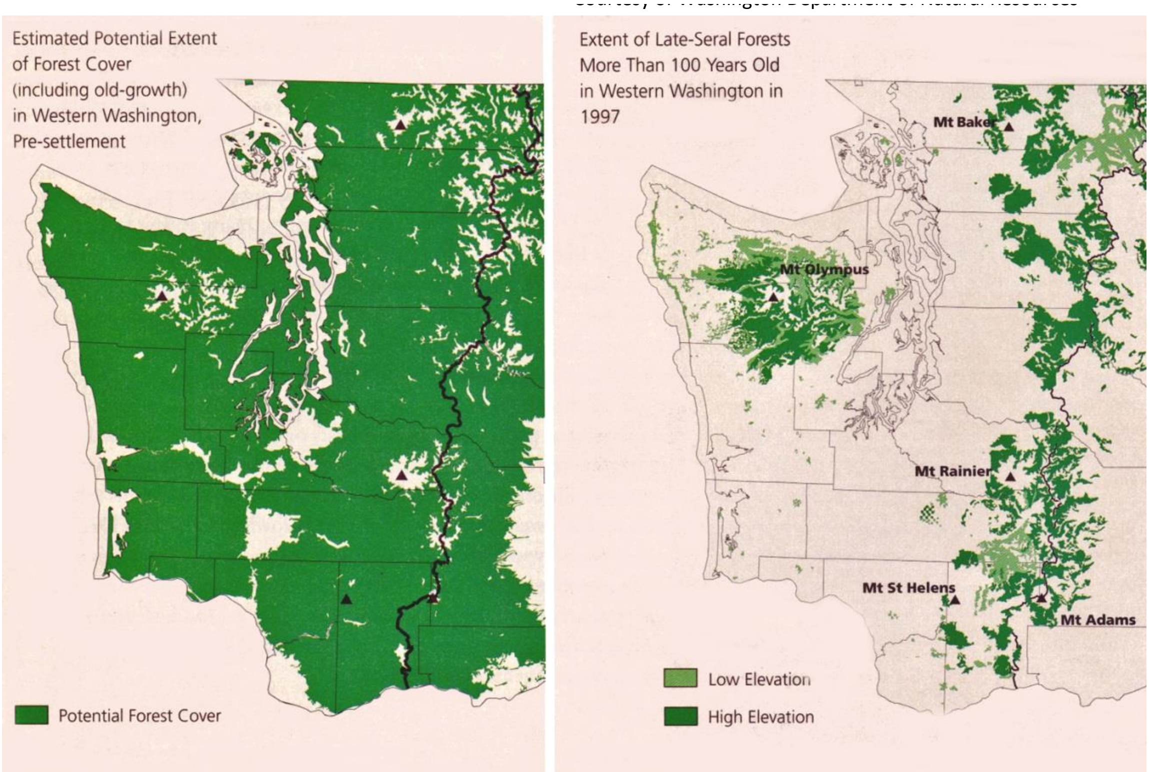
Although water quality is not a direct responsibility of WDFW, it is critical for the long-term health and survival of the state's fish and wildlife, including marine species in Puget Sound and the coastal ocean. The WDFW supports many other agencies to reduce water pollution from various sources listed above and maintain water quality standards that support healthy fish and wildlife populations. The federal Environmental Protection Agency and the Washington Departments of Ecology, Health, and Natural Resources all have important responsibilities for water quality, as does the Puget Sound Partnership.

### 2.3.5 Forest conservation and management practices

Over half the land area of Washington is covered in forests, ranging from the temperate rain forest of the Olympic Peninsula to the Douglas-fir dominated lowland forests of the Puget Trough, and from the stunted, slow growing trees of alpine forests to the dry, ponderosa pine dominated forests of eastern Washington. The management and commercial harvest of timber on both public and private lands has been and remains an important part of Washington's history, economy and culture.

In western Washington, forests have been fragmented by urbanization, transportation corridors, and other land development.  In remaining forested areas, commercial harvest and replanting has changed the natural forest structure, resulting in simplified forest habitats and a reduction in overall biological diversity.  Some commercial timberlands are also being sold to non-industrial owners and in many instances, the new owners choose to convert the land to non-forest uses.  The overall loss and fragmentation of forest land in western Washington has resulted in a parallel loss of fish and wildlife habitat and wildlife movement corridors as well as diminished water quality in streams and rivers (Figure 2).

Figure 2:  Forest land cover in Washington




Eastern Washington forests have also been harvested for timber and timber products for many years. Although timber harvest activities have affected the long-term structure and diversity of eastern Washington forests, these forests are nearly as extensive today as they were in 1900.  The pressures of urbanization and deforestation are not as great in eastern Washington as they are west of the Cascade Mountains.  One of the most severe long-term problems for wildlife and habitat in eastern Washington forests is the suppression of natural fires on both public and private forestland.  Frequent, low intensity ground fires were historically part of the forest ecosystem, including forest-associated wildlife, and the recent emphasis on fire suppression has eliminated an important natural means for removing fuels and thinning stands.  The lack of fires often results in denser tree cover, particularly at low elevations, and changes in both species composition and structure of natural timber stands, leading to overcrowding and increased susceptibility of these stands to damage by bark beetles and defoliating insects.

Historically, the construction of logging roads near streams or across wetlands was often destructive to fish and wildlife habitat.  Although modern forest practices under state and federal rules provide much more protection for wetlands and riparian zones, there are still potential adverse impacts from construction and operation of logging roads that do not meet modern forest practice standards. Improperly constructed or maintained logging roads may trigger or accelerate slope failure, erode stream channels, block fish migration and deposit sediment into streams and wetlands.

The WDFW is collaborating with WDNR and other agencies, organizations, and private forest landowners to promote, develop and implement forest practices that best protect the Washington's fish and wildlife resources.

### 2.3.6 Agriculture and livestock grazing impacts to habitat

Agriculture, like forestry, is an important part of Washington's landscape and economy. About one-third of the state's land area (15 million acres) is in agricultural production, including cropland, pastures and orchards. This current condition is a result of conversion of native grassland, shrub-steppe and wetlands to agricultural purposes since the turn of the 20th century has resulted in extensive losses and fragmentation of habitat and associated wildlife.

Historic agricultural practices didn't consider impacts to wildlife habitat, and consequently were apt to have detrimental effects. Modern agricultural practices have developed an awareness for the need for and techniques to maintain and enhance habitat quality. Agricultural development has tended to be concentrated in low elevation valleys all over the state, which has significantly reduced and fragmented valley bottom grasslands, shrublands and forested riparian habitats. Agricultural operations in valley bottoms and riparian zones have also increased sediment loads of rivers and tributary streams and past practices unintentionally introduced herbicides and pesticides into aquatic ecosystems. As a result of increased environmental regulation, publicly funded incentive programs and public values, modern agriculture has adapted to reduce impacts to fish and wildlife habitat.

Livestock grazing throughout Washington over the last century has had widespread impacts on the structure and composition of native vegetation and wildlife habitat. Although properly managed grazing can be neutral or even beneficial to wildlife, improper management of grazing (overgrazing) can destroy native vegetation, change the balance of plant species, compact soil, accelerate soil erosion, and reduce the abundance and diversity of native wildlife. The severity of these impacts depends on the number and type of livestock (e.g. cattle, sheep, and horses) and their grazing pattern. Improper grazing practices also promote the spread of invasive plants and eventually reduce the productivity of native grasslands for both wildlife and livestock.

WDFW works at many different levels, including with many individual farmers and ranchers, to influence grazing and other agricultural practices to protect and enhance fish and wildlife habitat and biodiversity on private land. In 1993, the Washington State Legislature enacted House Bill 1309, which directs WDFW and WDNR to develop consistent grazing standards that preserve, protect and perpetuate fish, wildlife and habitat on state public lands.

### 2.3.7 Diseases and pathogens

The rapid spread of new wildlife diseases in the United States and around the world since the beginning of the 21st century has created new challenges for both wildlife managers and public health officials. The social and economic impacts of wildlife diseases can be large, not only affecting wildlife populations and habitat but also human health, agriculture and food safety, and many nature-based industries.

A number of serious diseases currently affect Washington's wildlife populations and species at risk in every region of the state. These diseases include notoedric mange, which has become a serious risk to western gray squirrel populations; West Nile virus, a mosquito-borne virus that can cause encephalitis and/or meningitis in birds, horses and humans; avian botulism, which occurs principally in waterfowl and other birds living in an aquatic environment; and hair loss syndrome, which causes hair loss, emaciation and often death in Columbian white-tailed deer. Other diseases of current concern include hoof disease in elk, pneumonia in Bighorn Sheep, avian influenza, and white nose syndrome in bats

Hoof disease was first reported in elk populations in Washington around 2008; it has spread across the southwestern part of the state, affecting the St. Helens and Willapa Hills elk herds. Bighorn Sheep face a major threat from an exotic strain of pneumonia carried by domestic sheep and goats. The disease is often fatal in wild Bighorn Sheep, and can also affect the survival rate of lambs later born to animals that survive the disease. In 2010, roughly a third of two wild Bighorn Sheep populations totaling 260 animals had to be euthanized in the Yakima River region of Washington.

Avian influenza ("bird flu") is a viral illness found in birds. Wild birds can carry a number of bird flu viruses, but most strains do not seriously affect them. In 2014 a Gyrfalcon on northwest Washington died after eating a wild duck; it was tested and found to have a highly pathogenic strain of bird flu. In addition, a Northern Pintail Duck tested positive for carrying another strain of the virus, and this year a third form was detected in a wild duck in Whatcom County. Since then, several forms of the virus have spread quickly in the Pacific Flyway and have been found in backyard poultry flocks, commercial poultry, and wild waterfowl.

White-nose Syndrome (WNS) of bats is a disease caused by a fungus. It is estimated to have killed over six million bats in the eastern United States since 2006, and can kill up to 100 percent of bats in a colony during hibernation. Of the seven bat species so far afflicted by WNS, Little Brown Bats and Big Brown Bats occur in Washington, in addition to another 11 cave or mine-roosting species that are potentially at risk in this state. Although it has not been found in Washington to date, the fungus and disease are spreading across North America towards the West and into Canada.

WDFW works closely with neighboring states and Canadian provinces, as well as federal wildlife and fisheries agencies and the veterinary medicine and academic communities, to identify and respond to outbreaks of the wildlife diseases highlighted here.

### 2.3.8 Inadequate data on wildlife species, populations and

Although range, distribution, life history, populations and habitat requirements of some wildlife species under the WDFW's purview are fairly well understood in terms of life history, populations and habitat requirements, the ecology of many others is poorly known. The WDFW and its conservation partners, including the Washington Natural Heritage Program, recognize the need to design and implement additional applied research and surveys for many of the identified SGCN and Ecological Systems of Concern to better craft and prioritize conservation actions. In Chapter 4, additional research needs are outlined for some of our most imperiled ecological systems, including eastern Washington wetlands and Puget Sound prairies.

Development of the SGCN list and their associated habitats will help direct and focus the efforts of the WDFW and its conservation partners to collect more and better information in the future on wildlife species, populations and habitats. SGCN Fact Sheets (Appendix A) describe specific additional research needs and in Chapter 4 outlines additional research and data needs for some of our most imperiled ecological systems. See also Chapter 6 – Monitoring and Adaptive Management, and Chapter 7 – Implementation for more discussion on data collection and management.

### 2.3.9 Climate change

Impacts from a changing climate are already being observed on fish and wildlife across the region, including a northern shift in species' ranges, shifts in the timing of ecological events, and increased incidence of disease and invasive species. Among the many consequences for Washington's natural systems, several stand out as key vulnerabilities: forests, coastal systems and freshwater habitat. Forests will be impacted both directly and indirectly through synergisms between multiple disturbances, including pest and disease outbreaks and susceptibility to wildfires, the extent and severity of which are expected to increase with climate change. Many of the state's coastal wetlands, tidal flats and beaches are likely to decline in quality and extent due to an accelerating rate of sea level rise, particularly where upland migration of habitats is hindered by bluffs or anthropogenic structures such as dikes, or where natural sources of sediment are limited. And finally, climate change is already having an impact on the state's freshwater aquatic systems, including higher average water temperatures and altered hydrology. The region's salmonids stand out as especially vulnerable given that they are expected to face climate change impacts throughout their complex life cycle. The impacts of ocean acidification on marine systems also have significant implications for wildlife and is discussed above in section 2.3.4. A summary of impacts to species and habitats and an analysis of species specific sensitivities and projected exposure to climate change are presented in Chapter 5, with supporting information available in Appendix C.

## 2.4 Major Conservation Strategies

Many tools and strategies are available to the WDFW and its partners to address the conservation of fish and wildlife habitat and biodiversity in Washington, on both public and private lands. These range from direct conservation efforts such as law enforcement and habitat protection, to indirect but equally important programs such as environmental education, habitat assessment and research.

Many Washington residents and decision makers care deeply about their quality of life, including their fish and wildlife resources, and they have consistently been willing to pass laws and fund programs to help identify and protect important wildlife, habitat and biodiversity. It may or may not be necessary to pass new laws or create new programs, but it is important to effectively administer and enforce existing laws and to coordinate the various federal, state, tribal and private programs that are already in place—all of which require adequate funding, staffing and support from the public and decision makers at all levels.

Some of the most effective programs, strategies and tools used by the WDFW and its public and private conservation partners are briefly discussed below.

### 2.4.1 Species conservation strategies

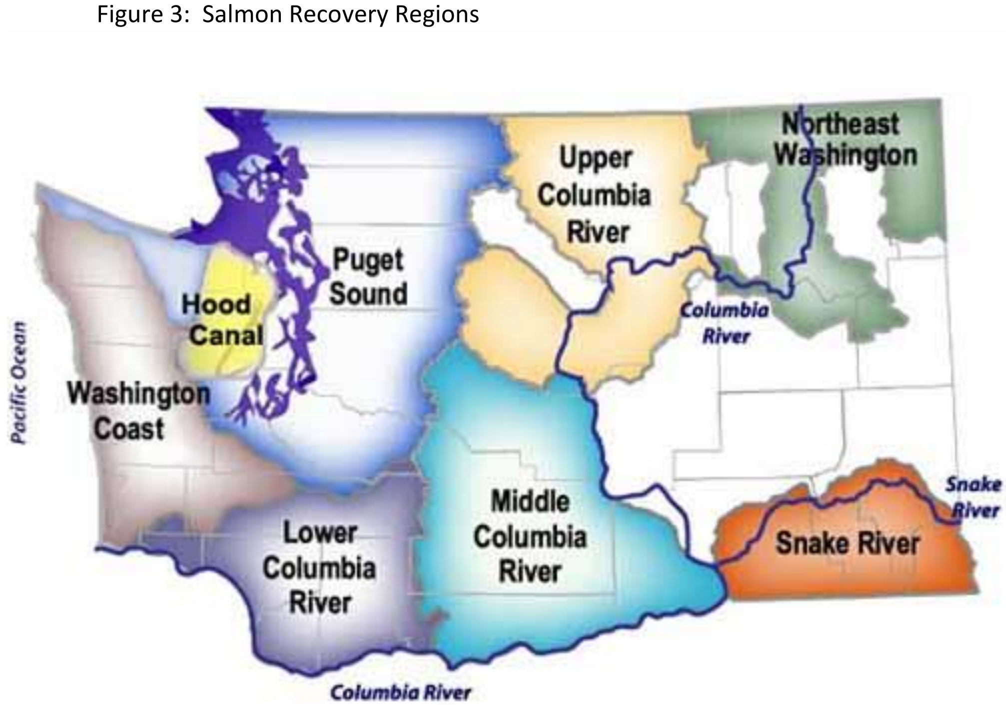
The WDFW works closely with other conservation agencies and organizations to identify wildlife species in need of special conservation measures. The USFWS and National Marine Fisheries Service (NMFS) classify and protect fish and wildlife species under the federal Endangered Species Act, and WDNR uses the NatureServe methodology to rank the global and state status of plant and animal species. For the purposes of implementing the SWAP, the WDFW will focus attention on species included on the SGCN list (Chapter 3), which includes many classified by Washington as endangered, threatened, or sensitive. It also includes a number of species that are not included in one of those classifications but which have been identified as needing additional research or funding attention. A range of conservation actions are recommended for identified SGCN, from the development of recovery plans for endangered, threatened or sensitive species to baseline population surveys for other species. Appendix A includes fact sheets describing life history, population status, distribution, threats and conservation actions recommended for all SGCN.

### 2.4.2 Coordinated salmon recovery

In 1999, after Pacific salmon listings were made under the Endangered Species Act, Washington developed the *Statewide Strategy to Recover Salmon: Extinction is Not an Option* to outline the vision, goals and objectives necessary to keep salmon from becoming extinct in Washington. The Strategy identified four main areas of recovery emphasis, referred to as the "four Hs"—habitat, harvest, hatcheries and hydropower—and stressed that recovery efforts need to be appropriately integrated and coordinated at the federal, state, regional and watershed levels. Since then, large-scale, coordinated salmon recovery efforts have been underway in Washington, involving many federal, state, tribal and local agencies, as well as organized conservation groups and the public. For additional information go to: http://www.rco.wa.gov/salmon_recovery/gsro.shtml.

Salmon recovery is a complex and expensive proposition in the Pacific Northwest. The WDFW and many of its conservation partners are committed to assuring that these various efforts are successful in recovering salmonid populations. Salmon recovery is being coordinated in seven regions of the state (Figure 3).

Figure 3: Salmon Recovery Regions




In 1999, the Legislature also created the Salmon Recovery Funding Board (SRFB), composed of five citizens appointed by the Governor and five state agency directors, which provides grant funds to protect or restore salmon habitat and assist related activities. It works closely with local watershed groups known as lead entities. The SRFB has helped finance over 500 salmon recovery projects since its creation.

### 2.4.3 Habitat conservation on public lands and waterways

Approximately 40 percent of Washington's land base is in public ownership, and conservation of wildlife and habitat may be easier to accomplish on these public lands and waterways than on private property, depending on the legal mission of these public lands. Most of Washington's public lands and water resources are either managed under a multiple-use concept that addresses the conservation of important habitat in the context of other uses or specifically for fish and wildlife habitat. All public land and water management agencies have some responsibility for protecting fish, wildlife and habitat on their lands. The Department of Defense and Department of Energy operate or fund active fish and wildlife programs on their lands, including Joint Base Lewis-McChord, the Yakima Training Center, and the Hanford Nuclear Reservation.

The WDFW manages a statewide network of over 1,000,000 acres of land and water that provide important habitat for wildlife while offering a range of fishing, hunting and other wildlife-related recreational opportunities. Most of these lands are designated as state Wildlife Areas and are found in almost every county in Washington. Washington Department of Natural Resources (WDNR) manages almost 3 million acres of public lands and trust lands (not counting aquatic lands), which include lands managed for timber, agriculture, recreation and conservation.

Protecting wildlife habitat and biodiversity on other public lands, including state and federal lands, depends on each agency's mission, management priorities, funding, knowledge of natural resources, and their willingness to identify and conserve areas important for fish, wildlife and biodiversity. The WDFW has many cooperative conservation agreements with other agencies and provides fish and wildlife information and habitat management recommendations to other public land management agencies on request. WDFW's wildlife areas are managed to benefit biodiversity and SGCN conservation.

### 2.4.4 Habitat conservation on tribal lands

About 16% of the land area of Washington is within tribal reservations. Conservation of fish, wildlife and habitat within tribal reservations is the responsibility of the governing tribal councils. The WDFW, as well as other state, federal and private conservation partners, work closely with the various tribal councils to identify and conserve important fish and wildlife resources on tribal lands. The largest Indian reservations in Washington are the Yakama, Colville, and Quinault reservations.

### 2.4.5 Habitat conservation on private lands

Because about 60% of Washington's land base is in private ownership, the WDFW and its conservation partners have developed many different approaches or tools for identifying and protecting important wildlife species, habitats and biodiversity on private lands. Conservation tools include direct and indirect regulation, habitat acquisition and voluntary landowner incentives. All conservation tools are important, but no single approach can adequately identify, protect, restore and properly manage the state's wildlife resources and biodiversity, especially on private lands.

WDFW regularly utilizes conservation tools that include regulations for hunting and fishing seasons, our Priority Habitats and Species lists (integrated into local land-use planning), management actions for imperiled species associated with Forest Practice Rules for private forestlands, and our hydraulic permit approval that is required for any work that is conducted that uses, obstructs, diverts, or changes the natural flow or bed of state waters.

One of the most cost effective ways to ensure the protection of important wildlife and habitat on private lands is through the application of financial and non-financial landowner incentive programs. These voluntary landowner incentives include direct local property tax reductions by counties; conservation easements by agencies and land trusts; Farm Bill tools such as the Conservation Reserve Program (CRP) and State Acres for Wildlife (SAFE) and programs such as WDFW's voluntary Upland Wildlife Restoration program, which provide direct incentives to willing agricultural landowners to protect and restore wetlands and other important habitat on their land. WDFW will continue to work with landowners, private conservation organizations, county extension agents, and conservation districts to provide technical assistance and encouragement to landowners to implement land and water management practices, including grazing practices that benefit fish and wildlife on private land.

### 2.4.6 Habitat acquisition

For the WDFW and conservation partners like WDNR, USFWS, Rocky Mountain Elk Foundation, The Nature Conservancy, the Trust for Public Land, and local land trusts, acquisition of land from willing landowners is an important non-regulatory tool for protecting areas with high habitat or biodiversity values. Although the cost of acquiring land can be significant compared to other alternatives, in some cases it is the best or only alternative for long-term protection and stewardship of critical habitats. The term "acquisition" is usually associated with the outright purchase of land, but may also include conservation easements, land donations, or land trades.

The WDFW has a long and successful history of identifying important habitat areas and protecting them through acquisition. The State's habitat acquisition program began in 1939, shortly after the Department of Game was established by the legislature. It tapered off in the 1970s after about 340,000 acres of habitat had been purchased, but continues today in a targeted and collaborative fashion. Currently, WDFW owns or manages over one million acres of land, all of which are open to public use 365 days a year.

In 2005, the WDFW completed a policy plan to guide its future acquisition and management of habitat and wildlife recreation lands. This plan, entitled *Lands 20/20: A Clear Vision for the Future* is available at http://wdfw.wa.gov/publications/00726/. WDFW assesses species and landscape conservation needs using species recovery and management plans, habitat conservation plans, biodiversity conservation frameworks, habitat connectivity analyses, and other data. The Lands 20/20 process includes robust vetting and public outreach before a project is approved to pursue funding. The following principles are employed in this process:

- Optimize, pursue, and use partnerships
- Evaluate whether acquisition is the best conservation alternative
- Pursue lands that provide long-term opportunities
- Pursue lands that will provide long-term ecological value
- Place a higher value on acquisitions that create blocks of ownership
- Pursue easements or other non-fee title options on smaller tracts
- Prioritize lands that are ecologically or socially important

A number of state and federal funding programs have been established over the last twenty years to address habitat acquisition, and these programs are administered in Washington by a mix of federal, state and local agencies, partnerships and conservation organizations including the Pacific Coast and Intermountain West joint ventures and an expanding system of regional and local land trusts.  These programs include:

- Washington Wildlife and Recreation Program (state)
- Salmon Recovery Funding Board (state)
- Trust Land Transfer Program (state)
- Aquatic Lands Enhancement Account (state)
- Land and Water Conservation Fund (federal)
- Cooperative Endangered Species Conservation Fund (federal)
- North American Wetlands Conservation Act (federal)
- National Fish and Wildlife Foundation (federal-private partnership)
- National Coastal Wetland Conservation Grant Program (federal)
- Regional Conservation Partners Program (federal)

### 2.4.7 Research, monitoring and surveys of fish, wildlife and habitat

Scientific research has long provided the foundation for fish and wildlife management in Washington. WDFW and its conservation partners conduct ongoing research and field investigations into the ecological requirements, population status, migrations, distributions, and habitat relationships of many fish and wildlife species.  The WDFW also conducts genetic research on terrestrial wildlife and fishes, performs DNA forensic analysis to support WDFW enforcement investigations, and provides technical support and expertise in wildlife veterinary medicine, including training on humane and safe handling and immobilization of wildlife species.  The WDFW develops, analyzes and maintains wildlife and fish survey databases.  To ensure that conservation priorities always reflect the current conservation needs of wildlife species and habitats, research and surveys will continue to be a high priority for the WDFW. Species, habitats and biodiversity survey and monitoring are addressed in Chapter 6, Monitoring and Adaptive Management.

### 2.5.8 Direct enforcement of state laws to protect fish, wildlife and habitat

The WDFW's direct authority for the protection of wildlife habitat is limited, although the agency does enforce state laws to protect fish habitat (Hydraulic Project Approval), and fish passage and diversion standards.  Through the Washington Fish and Wildlife Commission, the WDFW establishes regulations for the legal harvest of game species and commercially harvested fish and wildlife, and WDFW officers enforce those harvest regulations statewide in cooperation with other state, federal and tribal enforcement personnel.  Harvest regulations are generally conservative and designed to allow sustainable harvest that has no adverse impact on fish and wildlife populations.  However, the illegal overharvest of fish and wildlife or the destruction of critical protected habitats can have a profound impact on populations that are rare, depressed or threatened with extinction.  WDFW's Enforcement Program is primarily responsible for enforcing **Title 77**, the Fish and Wildlife Code.  WDFW Enforcement Officers are fully commissioned, meaning they have authority to enforce all criminal laws and have jurisdiction over federal fish and wildlife violations.  They ensure compliance with licensing and habitat requirements and enforce prohibitions against the illegal taking or poaching of fish and wildlife.

### 2.4.9 Indirect enforcement of local, state and federal laws to protect fish, wildlife and habitat

The WDFW works closely with other agencies including local and tribal police agencies, WDNR, USFWS, and NMFS to enforce laws and regulations that are both within and outside the WDFW's jurisdiction. For example, migratory birds and marine mammals are protected and regulated under both state and federal law and jointly enforced by the WDFW, USFWS and NMFS. The WDFW also works closely with other agencies in publicizing, implementing and sometimes enforcing laws, regulations and permit conditions that prevent the destruction or degradation of important habitat, including the federal Endangered Species Act, Northwest Power Planning Act, Clean Water Act, the Washington Forest Practices Act, Shoreline Management Act and the locally administered Washington Growth Management Act. WDFW also works with the Washington Departments of Transportation and Ecology in developing and implementing mitigation measures for projects with potential adverse impacts on fish and wildlife.

Because much of Washington's authority to protect fish and wildlife habitat is shared with cities and counties, the WDFW puts a high priority on providing comprehensive biological information to local planners and decision makers to improve their ability to administer the Growth Management Act and other locally administered land use laws. The PHS program has provided site-based information to local governments since 1989.

### 2.4.10 Wildlife information and conservation education

Effective conservation of habitat and biodiversity is best accomplished if the public and policymakers understand fish and wildlife needs, the importance of biodiversity to our overall quality of life, and how citizens can be involved and contribute to conservation efforts. To support this understanding, it is critical that the public have opportunities to observe and enjoy fish and wildlife in their natural surroundings. As Washington's population grows, so does public demand for wildlife information and wildlife-related recreation opportunities on both public and private lands, including hunting, sportfishing, wildlife viewing and naturalists' pursuits.

The WDFW's Public Affairs Office and various teams in the Fish and Wildlife Programs communicate with the news media, the public and various government agencies and conservation groups about wildlife conservation and recreation. Interpreted wildlife viewing opportunities are offered online through the WildWatch cameras and seasonally at WDFW wildlife areas (e.g. Oak Creek elk viewing). WDFW access sites and wildlife areas provide resources online and on site to promote outdoor experiences afield by promoting access and site-specific information about wildlife viewing on our kiosks and online (http://wdfw.wa.gov/lands/wildlife_areas/). WDFW offers some watchable wildlife resources in print, but a great deal of information is provided online (**http://wdfw.wa.gov/viewing/** and **http://wdfw.wa.gov/living/**) including the *Living With Wildlife* series; marine wildlife, marine sanctuary, and SCUBA viewing guides; road trip and roadside viewing access areas' directions and interpretive materials; and information about the Great Washington State Birding Trail (developed collaboratively with our Audubon Society partners, **http://wa.audubon.org/great-washington-state-birding-trail**), among many other guides and resources.

For a more field-directed and interpreted experience, WDFW provides opportunities for volunteers to engage directly in survey, monitoring, management and conservation activities through our citizen science efforts, stewardship projects on wildlife Areas and Access Sites, and other coordinated special events. Importantly, many of these activities can be tailored and promoted to address information gaps in SGCN range, distribution and ecology. Participants volunteer with purpose, contributing directly to the work WDFW does in exchange for training, friendship-building, and an opportunity to view and understand wildlife in their native habitats.

### 2.4.11 Wildlife recreation programs

The demand for traditional hunting and fishing activities remains steady in Washington. The 2011 National Survey of Fishing, Hunting and Wildlife-Associated Recreation indicated that the state of Washington is eighth in the nation in spending by recreational fishers and hunters, generating an estimated $1.6 billion in annual revenues to the state. The fastest growing sector of wildlife recreation demand, however, is watching wildlife: an estimated 47 percent of Washington's residents participated in some form of wildlife watching in 2001. The WDFW has embraced the national Watchable Wildlife concepts and is working with the Washington Division of Tourism, Department of Transportation, Washington State Parks and Recreation Commission, Audubon Washington, and other partners to promote programs that connect with and serve traditional (hunting, fishing, resource collection) and non-traditional constituencies [e.g., birding, botanizing, butterfly and dragonfly watching, "herping" (reptile and amphibian enthusiasts)]. Wildlife viewing opportunities (passive, passive interpreted, or actively interpreted) have long been a part of WDFW's values and recreation delivery on our lands and some of our access easement programs.

More recently, WDFW and conservation partners have been growing citizen science opportunities which also provide a recreational aspect. Out in the field, projects and tools which are part of the WDFW Wildlife Areas Ecological Integrity Monitoring, eBird Northwest, and Incidental Wildlife Observation reporting (**http://wdfw.wa.gov/viewing/observations/**), tap into the enthusiasm and expertise of naturalists, avid learners, and other interested people to participate directly in the Department's survey, monitoring, and stewardship response data needs. A springtime walk through the shrub-steppe can provide opportunities to enjoy the day, connect with a wildlands experience, and provide information that can help WDFW manage our lands in an informed way. These recreational opportunities engage the public in a way to better understand fish and wildlife needs while recreating outside.

As the state's population grows, so does the demand for wildlife-related recreation opportunities and public access to wildlife on both public and private lands. The WDFW will continue to work with public and private conservation organizations and landowners to try to meet this growing public demand for wildlife recreation.

### 2.4.12 Forest practices management

Over half the land area of Washington is forested, and most of the state's forested landscapes continue to be managed for timber and timber products. Because of the influence of commercial forestry on the state's forest lands and wildlife habitat, it is imperative that the WDFW and its conservation partners continue to put an emphasis on influencing forest practices on these public and private timberlands. In the last 30 years, Washington's forest practices regulations have been dramatically improved and are now considered by some to be the best in the nation. It is critical that WDFW work as partners with forest landowners and other stakeholders to optimize conservation of fish and wildlife, as well as to assure that healthy forest lands remain on the landscape.

Federal forest lands within the range of the northern spotted owl are regulated by the Northwest Forest Plan (NWFP), adopted by the federal government in 1994 to provide for maintenance and restoration of functional, healthy and interconnected late-successional forest ecosystems, alongside sustainable and predictable supplies of timber and other forest products. State and private forest lands in Washington are regulated by the state Forest Practices Act. Since the federal listing of the northern spotted owl as a Threatened species in 1990 and the passage of the Northwest Forest Plan in 1994, there have been a number of proactive efforts and agreements among public agencies, Indian tribes, conservation groups and forest landowners. These agreements work to protect listed species and their habitat, and to avoid further listings of forest species under the Endangered Species Act, while protecting the economic viability of the timber industry in Washington.

One of the most recent and successful of these public-private efforts is the Washington Forests and Fish Agreement initiated in 1997 by state and federal agencies, local governments, Indian tribes, conservation groups and private forest landowners. The primary goals of this agreement were to: provide compliance with the Endangered Species Act for aquatic and riparian-dependent species; restore and maintain riparian habitat to support a harvestable supply of fish; meet the requirements of the Clean Water Act for water quality; and keep the timber industry economically viable in the State of Washington. In 2006, Washington State completed the Forest Practices HCP, based on this Forest and Fish agreement. This HCP is the largest programmatic HCP in the nation, and the associated forest practices rules and adaptive management program are believed to be some of the most progressive in the nation. The forest practices rules apply to over 9 million acres of state and private forest lands and protect habitat on over 60,000 miles of streams. The HCP and associated rules that resulted from this agreement were developed in concert by all parties and are a good example of how a high degree of habitat protection can be achieved through collaboration.

In addition to the Forests and Fish Agreement, the WDFW and many of its conservation partners are heavily involved in other efforts to promote conservation of forest ecosystems and fish and wildlife. State forest practices rules include protections for specific state and federally listed wildlife species and their habitats, and voluntary protection strategies are developed for other listed species. WDFW screens forest practices applications for potential conflicts with wildlife species of concern; and when potential conflicts are identified, WDFW works with landowners to develop management plans which will both protect the species and their habitats, while also meeting the goals of the landowners. Other landscape management plans have and are being developed to address wildlife species of concern. WDFW is also engaged with the NWFP planning and revision processes on the various national forests to ensure that forest health, and wildlife and aquatic resource objectives are met.

The development of HCPs with private forest landowners, and most recently, public land management agencies, is a good alternative to additional federal regulation to protect ESA-listed wildlife species and habitats. In 1997, WDNR and federal fish and wildlife agencies signed a multi-species Habitat Conservation Plan that covers 1.6 million acres of state-owned trust forestlands. The WDFW is also currently at work on a similar federally-funded HCP that would apply to the management of lands owned and managed by the WDFW.

### 2.4.13 Landscape Conservation Efforts

Ultimately, conservation of Washington’s biodiversity relies on collaboration across ownership boundaries. Federal, state, and local land-use planning needs to be coordinated and mutually supportive to meet not only the ecological goals, but other social, cultural and economic goals associated with natural resource use. Much conservation success in Washington also relies on management practices on private lands. WDFW and our partners are working to create and deliver incentives to support the ability of private landowners to uphold fish and wildlife values through their land management. Current conservation efforts require landscape-level efforts and collaboration across broad groups. WDFW and our partners have been engaged in a multitude of such efforts, several of which are highlighted in this section. The tenets of multiple societal values, defining shared goals, and working together to preserve the future of our cherished Washington natural heritage will continue to be essential as we move forward in our efforts to conserve our state's fish and wildlife.

*1. Douglas County State Acres for Wildlife Enhancement (SAFE) Program*

The Douglas County's Sage and Sharp-tailed Grouse SAFE program has benefitted declining species by putting tens of thousands of acres of less productive farm lands back into shrub-steppe habitat. The Washington Department of Fish and Wildlife along with its partners have been very successful at encouraging farmers and ranchers in Douglas County to enroll in this voluntary incentive program, where Landowners enter into a 10 to 15 year agreement to plant eligible lands with native flora. The mix of seed enrollees are required to plant provides both food and cover to shrub-steppe wildlife once plants have established. Douglas County is of particular significance to shrub-steppe wildlife given it holds the last remaining population of Pygmy Rabbits in Washington. The county also is habitat to the largest populations of Greater Sage and Columbian Sharp-tailed Grouse in the state.

Since the inception of the Douglas County SAFE program, its success has surpassed expectations both in the numbers of landowners interested in enrolling, as well as the amount of land that now successfully supports a suite of shrub-steppe species. Strong enrollment was also attributed to the solid relationships and trust that our biologists have formed with Douglas County property owners. Strong teamwork with other stakeholders, including the Foster Creek Conservation District and Natural Resources Conservation Service, was also vital to how much the program has achieved so far.

*2. The South Puget Sound Prairie Partnership*

The South Puget Sound Prairie Partnership is an effort by federal, state, local jurisdictions, land trusts and other NGO's to either provide private landowner incentives or acquire lands to restore, and conserve grassland and adjacent oak woodland in primarily Pierce and Thurston counties, Washington. The partners use funds from a variety of sources to achieve conservation efforts. These include the Army Compatible Use Buffer Program, the Sentinel Landscape Program, funds from Washington Recreation and Conservation Office projects, Fish and Wildlife Service Recovery funds, and NRCS easement funds. The DOD programs (Army Compatible Use Buffer Program and Sentinel Landscape Program) have provided over 16 million dollars since 2006 for acquisition and enhancement of grasslands outside of DOD lands. Partners have contributed at least 7 million in funds during this period for acquisition, restoration, and easements. Joint Base Lewis McChord has provided significant funds (in the millions) during this timeframe for active management of prairies on DOD lands.

Partnership for South Puget Sound Prairies began in the 1990's with The Nature Conservancy, WDFW, WDNR, and U.S. Fish and Wildlife Service initiating planning and conservation efforts at several publicly-owned grasslands. The partnership grew during the 2000's with the addition of Joint Base Lewis-McChord (then Fort Lewis), land trusts, and expanded work by the NRCS. One of the significant achievements has been the development of genetically appropriate native seed resources for habitat restoration and species translocation and reintroduction projects for two federally listed endangered species, the Mazama Pocket Gopher and Taylor's checkerspot. Research has been conducted on habitat needs of Washington's SGCN, as well as the federally listed pocket gophers, Taylor's checkerspot, and streaked horned lark.

Major challenges for the program have been battling invasive species like Scot's broom and invasive grasses, developing and implementing a prescribed fire program, and nursery development. The Center for Natural Land Management recently took over projects formerly implemented by The Nature Conservancy, and is the primary contractor for the DOD ACUB program. They have played a leadership role in many efforts, including prescribed fire and the development of plant resources for restoration.

*3. Skagit Watershed Council*

The WDFW, Skagit Watershed Council, non-governmental conservation organizations, as well as other partners have been active in protecting and restoring key segments of this important watershed. The Skagit Watershed Council's strategic approach is committed to restoring and protecting landscape processes to produce long-term, sustainable recovery of habitat conditions to benefit multiple species. Their landscape scale approach is demonstrated in an analysis they carried out for a 43 river mile reach of the Skagit River. The purpose was to take a landscape scale approach to targeting priority areas so they could focus their activities to restore and protect key segments of the watershed. They also target much of their work to the delta and floodplain habitat in the lower Skagit River, given its significance for Chinook Salmon as well as a multitude of other species like shorebirds.

Non-profits such as Skagit Land Trust and TNC have also formed strong ties with the community. The Nature Conservancy in particular has taken a role in finding ways to keep working lands working, while balancing the needs of fish and wildlife. One way they have done this is by building relationships with the farmers that manage much of the land along the Skagit River. For instance, TNC has partnered with agricultural producers in their Farming for Wildlife program. This program aims to replace lost freshwater wetlands in the Skagit Delta by paying farmers to incorporate wetland habitat into their crop-rotations. A strong partnership between WDFW, TNC and others in the community has also led protection of thousands of acres in the Skagit Watershed. The Skagit Land Trust has built a broad list of partners that have helped them secure the conservation and protection of nearly 7,000 acres in the watershed. Some of the Trust's greatest successes have come in the form of projects where they have protected habitat areas across private ownership boundaries.

*4. Blue Mountain Elk Initiative*

The Blue Mountain Elk Initiative (BMEI) is the cooperative effort of many dedicated partners to improve habitat for elk and other wildlife across the Blue Mountains of Oregon and Washington. The BMEI partners, which include WDFW staff engagement, are consistently leveraging funds to improve wildlife habitat across the 30,000 square miles that make up the Blue Mountains Ecoregion. With this money they have funded numerous projects to improve elk habitat.

This year marks the initiative's 25th anniversary, during which BMEI partners can boast that they have leveraged nearly $10 million. BMEI has directed much of this money to projects that have resulted in over 300,000 acres of habitat enhancements spanning political and ownership boundaries. Such work has ranged from removing weeds in mid- to higher elevation grasslands to benefit all native species to prescribed fire for restoring forest health. In recent years, BMEI has supported weed control on thousands of acres of WDFW lands. The initiative has also funded important research to guide elk habitat management.

One of the biggest challenges for the BMEI has been finding consistent sources of funds to keep up the group's momentum for funding elk conservation projects, as well as reaching out to new partners to work with. Another challenge is locating money to conduct post project monitoring for each and every

BMEI funded project.  To increase the chances that BMEI funded projects will be successful, their strategy is to fund projects that not only benefit elk, but that also address other needs of land managers implementing these important projects.  This strategy has increased the odds that managers overseeing BMEI funded projects achieve a successful outcome.

*5. Restoring Fish Passage*

Fish passage has been a priority for WDFW for decades. Since 1991, WDFW's fish passage unit has been dedicated to finding and removing fish barriers in streams and rivers across Washington. The unit's biologists, engineers, and field technicians provide all the services needed for passage restoration projects. WDFW staff is on the ground walking streams to assess potential barriers and upstream habitat gain. Over 14,000 barriers have been identified and included in WDFW's statewide database. Our biologists prioritize barriers for removal and collaborate with environmental engineers to design fish passage solutions.

WDFW also works with outside organizations, such as the Washington State Department of Transportation, to find and remove barriers on their lands. WDFW identifies and prioritizes WSDOT-owned barrier culverts and collaborates on design and construction of barrier removal projects. WDFW also evaluates and monitors the post construction effectiveness of all WSDOT fish passage projects.
As a leader in fish passage, WDFW developed the Fish Passage Barrier and Surface Water Diversion Screening Assessment and Prioritization Manual to teach other restoration groups on proper procedures for collecting and managing barrier information. These science-based protocols are nationally recognized and the standard for collecting data on a fish barrier.

In 2014, the Washington State Legislature created the Fish Passage Barrier Removal Board to identify and expedite and a coordinated statewide approach to fish barriers removal.  Chaired by WDFW, the board is represented by other state agencies, tribes, city and county governments, as well as the Governor's Salmon Recovery Office.  The goal of this board is to coordinate the removal of barriers within a watershed to help ensure fish passage throughout the entire stream. WDFW is developing a grant program to fund projects that remove several barriers along a stream and projects that open more habitat upstream of recent barrier removal sites. This statewide initiative builds on the momentum of existing restoration programs and partnerships, but funding is needed to implement coordinated work that maximizes investments.

*6. Yakima Basin Integrated Plan*

For decades stakeholders have disputed over control of the Yakima Basin's over-allocated water supply. These disputes involved irrigators; federal, state, local, and tribal governments; as well as conservationists and community leaders.  After five drought years in a 15 year period the problem only became worse.  So after decades of inaction, water users throughout the region put aside their differences to craft a consensus-based plan for meeting everyone's needs.  Spearheaded by the U.S. Bureau of Reclamation and the Washington Department of Ecology, this effort became the Yakima Basin Integrated Plan (YBIP), whose goal it is to restore the ecological integrity of the Basin while shoring up existing agricultural water rights.

To restore ecological integrity, YBIP partners have set out to acquire nearly 100,000 acres of forest and shrub-steppe, protect 200 miles of river, and increased fish passage on six existing dams.  Since the plans inception in 2009, partners have quickly come a long way to meeting these objectives.  The most notable accomplishment is the 50,000 acre Teanaway Community Forest acquisition in 2013, the single largest land transaction in Washington in 45 years. This transaction was made possible because this diverse set of stakeholders worked together for a common set of goals. Washington Department of Fish and Wildlife and DNR jointly manage this property as a working, recreational forest managed as a healthy watershed with input from the local community. Another success was the completion of the Manastash Creek Project in 2014. Water conserved from removing a diversion in Manastash Creek has increased instream flow and opened up 25 miles of habitat for steelhead, coho, bull trout, and spring Chinook.

Key to these extraordinary achievements is the strong relationships that have been built amongst the diverse range of private, local, state, and federal entities. This includes the mutual trust that has been built with the Yakama Nation, irrigators, local governments, and conservation organization through years of working together. This relationship along with others helped WDFW and our partners work out an agreement that ultimately became the YBIP. Upon its completion, the YBIP is estimated to cost nearly $3.8 billion. Many consider the YBIP a model because for every dollar spent, nearly double the investment will be gained from tangible benefits to stakeholders, including increased water for farming and more productive fisheries.

*7. Mountain to Sound Greenway*

A coalition of diverse stakeholders makes up the Mountain to Sound Greenway partnership, including environmentalists and timber companies; developers and farmers; federal and state agencies; cities and counties; nonprofits and businesses. This partnership focuses on the conservation, restoration, and protection of lands that make up this greenway that parallels Interstate-90 from the shores of Puget Sound, over the Cascades, to the arid landscapes of Central Washington. The Greenway was first envisioned in 1990 by a group of citizens when the region experiencing a significant economic and development boom. They saw that unchecked urban sprawl had the potential to fragment much of this corridor and they wanted to keep this landscape intact and connected.

WDFW supports the shared vision of the partnership in a many ways. This includes WDFW's purchase of thousands of acres of lands to form contiguous blocks of public lands where otherwise there lands would be in a checker board of public-private ownership. The Trust also had a role in acquiring the 50,000 acre Teanaway Community Forest, which lies at the eastern flank of the greenway. They also have brought on board many supporters in Washington D.C. to push for a proposal to designate the greenway as a National Heritage Area. Overall, the trust has been involved in purchases or exchanges of 170,000 acres of new public lands.

*8. Merrill Lake Conservation*

WDFW and the Rocky Mountain Elk Foundation are pursuing almost 1,500 forested acres adjacent to Merrill Lake. For a number of reasons WDFW considers this site, which lies just southwest of Mount Saint Helens, a priority for protection. Merrill Lake is an ecologically unique and diverse place that is home to old-growth forest, miles of riparian corridor, seeps and springs, wetlands, and lava tubes. As for fish and wildlife, biologists have documented high numbers of SGCN, primarily amphibians. Western Toad, Larch Mountain Salamander, Van Dyke's Salamander, and Cascade Torrent Salamander occur on site. Other SGCN include Steelhead, Northern Spotted Owl, and Bald Eagle. As for Merrill Lake's place in the big picture, it lies at a strategic landscape position and would provide important connectivity. Just north and east is Mount Saint Helens National Monument, while Washington Department of Natural Resource holds large land blocks just south of Merrill Lake. Although these blocks are separated by a small area of private lands, a Merrill Lake acquisition would nearly link the two large blocks of public land together.

From almost the start, the Merrill Lake project has garnered support from everyone involved, including partnering conservation organizations in the region.  Strong support has also come from the community, including the Cowlitz County Commission and local sportsman groups.  The latter have a personal connection to this land because for years the landowner has opened it to recreation.  This project success has a lot to do with these relationships and with the trust we have built with the landowner and with this community.  The Merrill Lake project has seen challenges in acquiring the needed funds to purchase the property, though all are confident that it will happen thanks to everyone patiently staying engaged.  This is testament to the fact that all involved have felt they have something to gain by protecting Merrill Lake.

*9. Washington Wildlife Habitat Connectivity Working Group*
The Washington Wildlife Habitat Connectivity Working Group is a science-based partnership that is composed of participants representing land and natural resource management agencies, organizations, tribes, and universities. The working group is co-led by Washington Department of Fish and Wildlife and the Washington Department of Transportation.  Organizations and/or individuals engage in the development of analyses within the Washington Connected Landscapes Project.

The Full Working Group encompasses all participants and includes talents in science, communications, and implementation.  This group has produced several research papers regarding habitat connectivity needs and modeling results statewide as well as in the Columbia Plateau and Transboundary regions of Washington.  Current efforts include looking at connectivity needs in the Southwest coastal region.  The work of the WWHCWG has been utilized in several landscape conservation efforts.  The vision for the Working Group is for connectivity to be consistently included in decisions and conservation actions related to: land use, restoration, private landowner incentive programs, species recovery, and wildlife area plans.  WDFW is working to integrate the results into multiple on-going implementation efforts and to integrate more on-the-ground land managers into the development of future products.

*10. Northcentral Washington Prescribed Fire Council*
Established in 2005 by WDFW fire experts and partners, the Northcentral Washington Prescribed Fire Council's (NCWPFC) mission is to protect, conserve, and expand the safe use of prescribed fire.  More specifically, the group works to promote an understanding of benefits of fire, distribute guidance for prescribed fire safety, endorse fire management and safety policies, and provide a platform for communication.  Support for the council has come from state, federal, and county government; conservation districts; industry trade organizations and professional societies; landowner groups; university extension; as well as conservation organizations.

Overcoming the public's negative perception of fire has been a significant challenge for the NCWPFC.  Prescribed fire is still not a widely accepted tool, although council members say the health of many ecosystems in Washington depend on its widespread use.  The Council is actively working to dispel negative attitudes and teach about the ecosystem health benefits of fire.  They have done this by holding media events and by producing and distributing flyers and fact sheets on various topics concerning fire management.  The NCWFPC also has periodically pushed for legislation.  One such effort was their push for a law to indemnify fire managers, on condition they adhered to strict safety protocol prior to an accident. The ultimate vision of many Council members is to see the day when fire becomes a go-to tool to manage for healthy fire-depended ecosystems in Washington.

*11. Arid Lands Initiative*
Formed in 2009, Washington's Arid Lands Initiative (ALI) is a collaboration of public, private, and tribal interests working to conserve and restore viable and connected terrestrial and freshwater systems in Washington's shrub-steppe and Palouse prairie landscapes that support plants, fish, wildlife, and the communities who depend on these resources. WDFW has been a core partner of the ALI since its inception.

Experts and stakeholders working through ALI have developed guidance to assess ecosystem health and the species that characterize eastern Washington's arid lands. This included identifying focal systems and species requiring management to achieve successful conservation. The species and systems ALI identified include many that WDFW classify as Ecological Systems of Concern and Species of Greatest Conservation Need. They also identified key locations across the arid landscape requiring immediate actions, and are currently working to map the necessary actions to specific places across the landscape. In this way, the ALI partners have laid out a road map for investing resources and for engaging partners to help efficiently manage and conserve key locations.

Partners are putting the ALI's shared priorities into practice by using Initiative tools to guide their own conservation work. Federal and state partners in particular have begun using these products in a range of ways. The USFWS and WDFW are using priority area maps developed by ALI to identify where to invest Candidate Conservation Agreement with Assurances resources to safeguard sage grouse. WDFW is using these same tools to guide many of their eastern Washington private landowner conservation efforts and land acquisitions. Products developed by ALI are also guiding decisions to mitigate the impacts that the Vantage to Pomona transmission line will have on valuable shrub-steppe and sage grouse habitat.

ALI is gradually identifying more projects to move from planning to implementation. In light of a changing climate, habitat fragmentation, and the complex ownership patterns that currently characterize these arid landscapes, a forum for partners to coordinate conservation action continues to be essential for the long-term preservation of fish and wildlife across the Columbia Plateau.

*12. Simcoe Mountains Acquisition*
WDFW is partnering with the Eastern and Central Klickitat Conservation Districts to conserve fish and wildlife habitat, as well as promote non-motorized recreation and working lands on a large tract of privately owned timber lands in Klickitat County. The Simcoe site sits in the Simcoe Mountains of central Klickitat County, just south of the Yakama Reservation. WDFW recognizes the value that the Simcoe's hold for their high ecological integrity. Of particular interest for fish and wildlife conservation are two relatively large blocks of land that feature intact Oregon white oak woodlands, riparian corridors, and shrub-steppe. The combined land area of the two tracts is nearly 20,000 acres, much of which is important habitat for many SGCN, including Steelhead, the State Threatened Western Gray Squirrel, as well as Western Toad, Golden Eagle, Black-tailed Jackrabbit, and White-headed Woodpecker. These lands would constitute a near contiguous corridor of protected lands running the length of the east slope Cascades from the boarder with British Columbia to the Columbia River.

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# CHAPTER 3

# SPECIES OF GREATEST CONSERVATION NEED

## Table of Contents

# CHAPTER 3
# SPECIES OF GREATEST CONSERVATION NEED

## 3.1 Overview

In this chapter we review the methodology used to develop the Species of Greatest Conservation Need (SGCN) and discuss changes in this list since 2005, including species no longer included. Section 3.2 includes an overview of all the current SGCN by taxonomic group: mammals, birds, reptiles and amphibians, fish, and invertebrates are all discussed separately. For each taxonomic group, there is a narrative summary of conservation trends and a table summarizing conservation status. Section 3.3 identifies the most prevalent stressors across taxa. Finally, Section 3.4 includes an explanation of terms used throughout the chapter.

Appendix A contains detailed information in the form of fact sheets for each species that describe distribution, habitat needs, stressors and priority actions needed. Additional information and discussion on the habitats important to SGCN and the actions needed to conserve them can be found in Chapter 4.

### Revising the SGCN: criteria and process

WDFW staff focused significant effort on a re-evaluation of the 2005 SGCN list. Criteria used to develop the 2005 SGCN list were revised to simplify the methodology and provide clearer communication both internally and externally about the rationale for species inclusion on the SGCN list. NatureServe[1] rankings were emphasized in developing our revised list, as recommended in the Best Practices for State Wildlife Action Plans Guidance document. The most recent research was consulted to make evaluations for all proposed SGCN, and increased agency input resulted in inclusion of more fish and invertebrate species. As a result, the 2015 list is substantially different from the 2005 list.

#### *Methodology*

Selection of species for inclusion on the SGCN list began with a master list of 700 plus species with each species included in the first draft SGCN list for further consideration if it met at least one of the following criteria:

- Rank of “high” on threat/vulnerability by WDFW biologists in the 2005 SGCN process
- Listed as a state sensitive, threatened or endangered species or a federal threatened or endangered species
- Rank of S1 or S2 in NatureServe (see Section 3.4 - References section of this chapter for a description of these ranks)

If a species met at least one of these criteria it was included in a first draft SGCN list. An SGCN technical team then reviewed all the draft SGCN and applied a secondary set of criteria to either remove or add species. Secondary criteria included: 1) updated conservation status, 2) whether or not the population in Washington is considered peripheral to the species and, 3) if occurrence in the state was a result of a recent range expansion. The draft SGCN list was then reviewed by regional and field biologists across the state which resulted in additional modifications to the list. Experts and advisors outside the agency were also consulted for their input and guidance in developing the list (see Appendix D for a full description of outreach activities).

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[1] (see Section 3.4 for an explanation of NatureServe rankings)

*Multiple Species Lists*
Prior to development of the 2005 Comprehensive Wildlife Conservation Strategy (CWCS), the agency had two lists of species at risk: 1) the Species of Concern list, maintained by the Wildlife Program, that included all State or Federal Endangered, Threatened, Sensitive or Candidate species; and 2) the Priority Habitats and Species List (PHS) list, maintained by the Habitat Program, to guide local governments and others in land use planning activities as part of the PHS Program. The requirement of the State Wildlife Action Planning Process to develop a SGCN introduces a third species "list". The 2015 SGCN list was developed for a different purpose and audience compared to the other two lists. The SWAP Update process provided a timely opportunity for the agency to work internally across programs to clarify the distinct purposes of these three lists, focusing in particular on the relationship between PHS and the SGCN.

In general, the PHS Program is the primary vehicle for WDFW to provide important fish, wildlife and habitat information to local governments, agencies, tribes, and private landowners for land use planning purposes. Local government officials and landowners seeking guidance for land use planning decisions should continue to consult the PHS program and the services it provides. The Species of Greatest Conservation Need, an integral part of the State's Wildlife Action Plan Update, is designed as a more comprehensive list and includes not only species already listed as threatened, endangered or sensitive, but also species that are in decline and in need of conservation attention to avoid becoming listed. The SGCN list serves in part as an "early warning system", drawing attention to species for which a primary conservation need might be additional monitoring and research. We expect that the data collected for SGCN and the habitats on which they depend may inform future updates of the PHS Program, as well as other conservation planning processes throughout the agency, including updates of the Species of Concern Lists.

*Other Notable Changes in the SGCN list from 2005*
The number of SGCN on the 2015 SGCN list is substantially bigger than in 2005 – increasing from 183 in 2005 to 265 in 2015 (Table 3-1) due to changes in the inclusion criteria. Including NatureServe rankings as one of our criteria resulted in more species qualifying as SGCN. Other factors included the availability of updated information and research for many of the species, particularly several invertebrates that are now better understood in terms of distribution and threats.

**Table 3-1: Number of SGCN 2015 and 2005**

| | 2015 | 2005 |
|---|---|---|
| Mammals | 44 | 31 |
| Birds | 52 | 58 |
| Reptiles | 12 | 8 |
| Amphibians | 14 | 11 |
| Fish | 51 | 33 |
| Invertebrates | 95 | 42 |
| **TOTAL** | **268** | **186** |

## Species dropped from the SGCN list since 2005

Thirty-four species included on the 2005 SGCN list were removed from the 2015 SGCN list. The specific reasons each species was dropped are shown in Table 3-2. In a few cases, these reflect the improved conservation status of the species (for example, Steller Sea Lion and Pacific Harbor Porpoise) and are examples of conservation successes that should be celebrated. In other cases, the changes were due to a taxonomic reclassification (for example, Pallid Townsend's Big-eared Bat and Bog Idol Leaf Beetle), or determinations that the taxa is likely extirpated in Washington (Pacific Gopher Snake and Western Yellow Bellied Racer). Another group of species was removed from the list as a result of refining our SGCN Criteria

– specifically clarifying that if a species' range in Washington is very limited and considered peripheral to its overall range, it should not be considered an SGCN (unless it is listed under federal or state endangered species laws). Finally, in other cases, species were removed from the list due to a lack of knowledge regarding their distribution or status (for example, Common Murre and Cassin's Auklet). For these species, if new data surface that indicate a species should be on the SGCN list, the WDFW will take the necessary steps to add them during the next revision or address conservation needs as emerging issues if SWG funds are needed

**Table 3-1. SGCN from 2005 not included on 2015 list**

| 2005 SGCN not included on 2015 list | |
|---|---|
| **MAMMALS** | |
| Elk (Nooksack herd) | This is one of ten managed herds in the state of Washington and is no longer of conservation concern. |
| Pallid Townsend's Big-eared Bat | Based on recent taxonomic changes, this subspecies of Townsend's Big-eared bat is no longer recognized as occurring in Washington. |
| Pronghorn Antelope | This species is native to the Columbia Basin in Washington, but was rare in the 1800s prior to agricultural conversion, possibly because of marginal habitat. No records exist from the 1900s. Habitat in Washington is now fragmented and may remain marginal. |
| Stellar Sea Lion | This species was state delisted from threatened in May 2015 due to its strong population growth in Washington since the late 1980s, and along the North American west coast from about 1980 to the present. Washington has a small breeding population that has continued to grow since 1992. |
| Pacific Harbor Porpoise | The Pacific Harbor Porpoise has increased in abundance in the Washington portion of the Salish Sea during the past 15 to 20 years. It is now considered common in this area and may be at historical high population levels. |
| **BIRDS** | |
| Acorn Woodpecker | Although rare in Washington, it is peripheral and has expanded its range into the state in the last two decades. |
| Ancient Murrelet | The Ancient Murrelet's breeding range is peripheral in Washington. There is only one nest record from 1924. |
| Arctic Tern | The Arctic Tern is peripheral in Washington. It breeds in the Arctic, and the local breeding population--represented by one colony at a single location (human-built)--is 1,000 miles south of the breeding range. |
| Black Oystercatcher | Much of the population is secure, and generally does not appear to be greatly vulnerable to human disturbance. Sea level rise could affect the species in the future, but this is not currently an issue. This species is currently on Washington's Climate Watch List. Oil spills remain a threat. |
| Black-backed Woodpecker | This species is found primarily on federal land. Forest fires and insect outbreaks, which are favorable for habitat conditions, are expected to continue. Thus, it appears to be not at risk in the foreseeable future. Breeding Bird Survey (BBS) data are not informative for Washington or the Western BBS Region. |
| Cassin's Auklet | Twelve years of at-sea monitoring data have yet to be analyzed. When that task has been completed, this species may be added later as an SGCN if the information warrants. |
| Common Murre | Twelve years of at-sea monitoring data have yet to be analyzed. When that task has been completed, this species may be added later as an SGCN if the information warrants. |
| Great Blue Heron | Washington populations are common and appear to be stable according to BBS surveys. |
| Greater Scaup | This species is a fairly common migrant and winter visitor in Washington, with a stable population. |
| Lesser Scaup | The overall population of this species in Washington has increased. BBS surveys show that populations are stable. |

| 2005 SGCN not included on 2015 list | |
|---|---|
| Northern Goshawk | Scientific literature indicates that there is no population concern about this species at a range-wide scale. There are no specific data from Washington to support keeping the Northern Goshawk as an SGCN. |
| Northern Pintail | The Northern Pintail occurs at a limited number of sites in Washington, but it is abundant at those sites. |
| Pileated Woodpecker | Concerns relate only to industrial forest lands. The Pileated Woodpecker is reasonably common elsewhere and in some urban/suburban areas it appears to be faring well. |
| Prairie Falcon | Data from the BBS suggest stable or increasing populations in Washington, neighboring states, and the Great Basin as a whole. These trends are noted for the long-term analysis period of 1966 to 2013 as well as the more recent short-term period of 2003 to 2013. |
| Redhead | The overall population of Redheads in North America has increased. In Washington, BBS surveys for the last five years show that populations are stable. |
| Trumpeter Swan | Numbers and range for this species have been increasing for 30 years. Currently the population is at nearly 20,000 birds. |
| Tule Greater White-fronted Goose | This species spends only a few weeks in Washington each year during stopovers in September on its way to wintering areas in the southwestern U.S. Hunter harvest in Washington is limited and there is adequate habitat to accommodate them. |
| Vaux's Swift | Vaux's swift is abundant in some areas of Washington. |
| Willet | This species is peripheral and does not breed in Washington. The Washington population appears to consist of between 8 and 15 individuals that overwinter near Tokeland. |
| **REPTILES** | |
| Pacific Gopher Snake (Western WA) | This subspecies is extirpated in Washington. The only known evidence of occurrence is based on specimens from the 1800s. |
| Western Yellow-bellied Racer (Western WA only) | This subspecies is believed to be extirpated in western Washington. The last observations were reported in the 1970s. However, systematic geographic-level surveys need to be conducted before extirpation can be confirmed. |
| **FISH** | |
| Black Rockfish (Puget Sound) | Black Rockfish are currently plentiful and may be on an abundance upswing. A harvest management plan is in place help achieve conservation goals. |
| **INVERTEBRATES** | |
| Bog Idol Leaf Beetle | Taxonomic uncertainties make it difficult to justify keeping this species on the list, though it does appear on the list of species for the USFWS Cedar River HCP, updated in March 2015. |
| Boreal Whiteface | This species is peripheral in Washington. Knowledge of only a single site suggests that it is not present at very many additional sites. It has not been found in recent years, even at the historical site. Few surveys have been done. |
| Native Mussel | This mussel species is common and locally abundant in Washington's marine waters. It has a large Northeast Pacific Ocean range and has a NatureServe National Conservation Status Rank of "Secure". Aquaculture of non-native mussels (e.g., *M. galloprovincialis* and *M. edulis*) raises concerns about hybridization and competition risks, but few data are available about these potential threats in Washington. |
| Oregon Floater (bivalve) | Taxonomic questions exist regarding the Oregon Floater and Western Floater, and anatomical and genetic studies must be conducted to resolve them before either can be considered for addition to the SGCN list. |
| Shepard's Parnassian | This species is a rare and threatened habitat specialist. However, taxonomic questions exist, and surveys need to be conducted to resolve them. |
| Subarctic Darner | The Subarctic Darner occurs at four locations in Washington but is common in appropriate habitat throughout its range across North America. The species faces few immediate threats, though global warming could become a problem sometime in the future. |
| Western Floater (bivalve) | Taxonomic questions exist regarding the Western Floater and Oregon Floater, and anatomical and genetic studies must be conducted to resolve them before either can be considered for addition to the SGCN list. |

### Climate Change

Climate change poses potentially significant impacts for many of the SGCN on our list and we included it as a stressor where appropriate for both SGCN and their habitats. We assessed the relative vulnerability to climate change of all SGCN by evaluating the inherent sensitivity to climatic change, as well as the likelihood that such changes will occur. These two factors comprised a relative climate vulnerability rank for each species - low, moderate, high, or unknown. We also included the degree of confidence we had in assigning such ranks based on the extent and quality of available references. These rankings and the rationale and references for them are available in Appendix C.

For species which ranked low to moderate in vulnerability, we simply included the ranking in the SGCN fact sheets (see Appendix A). Species which ranked moderate-high or high, *and* for which we had a high degree of confidence in our assessment were placed on a Climate Watch list, indicating a high climate risk. Note that several species ranked as likely moderate-high or high in terms of overall vulnerability, but because our confidence was less than high based on initial literature availability, they were not included on the Climate Watch list. As additional reference information becomes available these rankings will be updated.

Future tasks for the Climate Watch species will include evaluating which of the existing stressors are likely exacerbated by climate change, and might consequently be considered as a higher priority to address. Please see Chapter 5 for a full discussion of Climate change in the context of the SWAP, including a summary of the projected impacts on fish, wildlife and their habitats, a detailed explanation of the methodology for ranking climate vulnerability, and a discussion of potential approaches for addressing climate risks and increasing the resilience of species and habitats.

## 3.2 The SGCN Species

The following sections of this chapter provide a high level summary of the SGCN species, by taxa, in the following order: mammals, birds, amphibians and reptiles, fish, and invertebrates. For each taxonomic group we provide a brief narrative summarizing the conservation trends of the species, a table listing the conservation status, and a table summarizing key threats and actions for each species. Please refer to Appendix A for a complete set of species fact sheets, with detail on distribution, status, habitats, threats and conservation actions needed.

### 3.2.1 MAMMALS

#### Mammals Overview

Forty-four species of mammals are included on the SGCN list for Washington. These represent a variety of taxa including rabbits (4 species), shrews (3), bats (5), rodents (10), terrestrial carnivores (9), marine mammals (10), and ungulates (3). These species use various habitats across the state, have small to large geographic distributions in Washington, and are of concern for different reasons, as summarized below. Most of the species are year-round residents, but at least 10 are either fully or partially migratory, including most of the whales (7 species), and 2 bat species (Hoary Bat, Silver-haired Bat).

#### Distribution

SGCN mammals have varying distributions across the state and occupy many habitats. Of the 44 species, 20 are found only or largely in western Washington (e.g., Mazama Pocket Gopher, Columbian White-tailed Deer), 16 in eastern Washington (e.g., Spotted Bat, Lynx), and 8 in both western and eastern Washington (e.g., Western Gray Squirrel, Western Spotted Skunk). Marine mammals comprise half of the species occurring only or largely on the state's west side. Three species are found statewide: Hoary Bat, Silver-haired Bat, and Townsend's Big-eared Bat. In contrast, all other species have much smaller ranges that cover less than a third of the state. Several taxa currently have extremely limited ranges that are less than five percent of the land area of Washington (e.g., Pygmy Rabbit, Brush Prairie Pocket Gopher, Gray-tailed Vole, Columbian White-tailed Deer, Woodland Caribou). Two species (Destruction Island Shrew, Shaw Island Townsend's Vole) are restricted entirely to islands, with the shrew having a total range of just 30 acres.

Three-quarters of the taxa are commonly associated with three general habitat types: 16 species in conifer and/or deciduous forest ecosystems (e.g., Keen's Myotis, Western Gray Squirrel, Fisher, Woodland Caribou); 10 species in marine ecosystems (all marine mammals); and 8 species in shrub-steppe ecosystems (e.g., Washington Ground Squirrel, American Badger). Other habitat types include grasslands, alpine, wetlands, and riparian corridors.

**Population Sizes and Trends**

Most of Washington's SGCN mammals are uncommon or rare, or are represented by small populations. Populations of seven taxa are considered to be in critical condition (Grizzly Bear, Coastal American Marten, Wolverine, Blue Whale, North Pacific Right Whale, Sei Whale, Woodland Caribou) and probably have state populations of fewer than 25 individuals at any one time. Twenty-two species have "low" populations compared to their historical abundance (e.g., White-tailed Jackrabbit, Northern Bog Lemming, Gray Wolf, Killer Whale, Bighorn Sheep). Four species (Hoary Bat, Silver-haired Bat, Shaw Island Townsend's Vole, Gray Whale) are characterized by having moderately-sized populations that face specific conservation challenges. Information is lacking on the relative population sizes of 11 species, which are categorized as having "unknown" population sizes (e.g., American Pika, Preble's Shrew, Western Gray Squirrel, Cascade Red Fox, Western Spotted Skunk). Population trends of SGCN mammals are either unknown (23 species), declining (8), stable (8), or increasing (5). With population trends unknown for nearly half of the species, improved information of this topic represents a clear need in future research and monitoring efforts.

**Conservation Concern**

Threats to SGCN mammals are varied and most taxa are of concern due to habitat-related factors, the lingering impacts of historical unsustainable harvest (e.g., most marine mammals, Coastal American Marten, Fisher), small population size, or a combination of these factors. For a few species, the cause(s) of concern are poorly understood (e.g., Spotted Bat, Kincaid Meadow Vole, Western Spotted Skunk). Other factors include human disturbance, disease, prey declines, unnatural levels of predation, mortality at wind energy facilities, vessel interactions, entanglement in marine debris, highway mortality, direct human-caused mortality, oil spills, and the threat of future climate change. For nearly all species, there exists a need to gather more information to clarify threats.

**Climate Change**

Species evaluated with moderate-high or high vulnerability (but varying levels of confidence) included: American Pika, Cascade Red Fox, Keen's Myotis, Lynx, southern resident Killer Whale, Northern Bog Lemming, Olympic Marmot, Pacific Marten, Pygmy Rabbit, Townsend's Big-eared Bat, Wolverine, and Woodland Caribou. In general, species occupying higher elevation habitats such as alpine and subalpine forests, meadows, and parklands have higher vulnerability, in particular, to warming temperatures and reduced snowpack.

**Conservation Success**

Many of the 13 SGCN mammals with increasing or stable population trends represent conservation success stories, but they remain SGCN species because their recovery has not yet progressed far enough or delisting has not occurred so their legal status under Washington law remains unchanged. Conservation programs have allowed a number of mammal species in the state to recover (i.e., Gray Whale), to show recent improving trends in population size (e.g., Pygmy Rabbit, Gray Wolf, Fin Whale, Humpback Whale, Sea Otter), or to stabilize their population size (e.g., Townsend's Big-eared Bat, Blue Whale, Sperm Whale, Columbian White-tailed Deer).

**Alphabetical List of SGCN Mammals**

1. American Badger
2. American Marten (Coastal population)
3. American Pika
4. Bighorn Sheep
5. Black-tailed Jackrabbit
6. Blue Whale
7. Brush Prairie Pocket Gopher
8. Cascade Red Fox
9. Columbian White-tailed Deer
10. Destruction Island Shrew
11. Fin Whale
12. Fisher
13. Gray Whale
14. Gray Wolf
15. Gray-tailed Vole
16. Grizzly Bear
17. Hoary Bat
18. Humpback Whale
19. Keen's Myotis
20. Killer Whale
21. Kincaid's Meadow Vole
22. Lynx
23. Mazama Pocket Gopher
24. Merriam's Shrew
25. Minke Whale
26. North Pacific Right Whale
27. Northern Bog Lemming
28. Olympic Marmot
29. Preble's Shrew
30. Pygmy Rabbit
31. Sea Otter
32. Sei Whale
33. Shaw Island Townsend's Vole
34. Silver Haired Bat
35. Sperm Whale
36. Spotted Bat
37. Townsend's Big-eared Bat
38. Townsend's Ground Squirrel
39. Washington Ground Squirrel
40. Western Gray Squirrel
41. Western Spotted Skunk
42. White-tailed Jackrabbit
43. Wolverine
44. Woodland Caribou

**Table 2-3 SGCN Mammals: SUMMARY OF CONSERVATION STATUS**

**Please see Appendix A for a complete discussion of key threats and conservation actions needed for these species.**

Please see Section 3.4 at the end of this chapter for an explanation of the terms used in the headings.

| MAMMAL SPECIES | Federal Status | State Status | PHS | Population size/trend | Climate Vulnerability | Summary of Conservation Concern |
|---|---|---|---|---|---|---|
| **RABBITS** | | | | | | |
| American Pika | None | None | No | Unknown/ unknown | High | A montane talus habitat specialist that may face threats from climate change. |
| Black-tailed Jackrabbit | None | Candidate | Yes | Low/declining | Moderate | Once abundant and broadly distributed in eastern Washington, the species is now rare and sparsely distributed due to habitat loss from fragmentation and possibly disease. |
| Pygmy Rabbit | Endangered | Endangered | Yes | Low/increasing | Moderate-High | The Columbia Basin Pygmy Rabbit, a distinct population segment of this species, is a sagebrush obligate associated with shrub-steppe in eastern Washington. Large-scale loss and fragmentation of shrub-steppe habitat were likely the primary factors contributing to decline, but once the population dropped below a certain threshold, other factors such as environmental events (extreme weather and fire), predation, disease, and inbreeding likely became threats. A major recovery effort is currently underway for this species. |
| White-tailed Jackrabbit | None | Candidate | Yes | Low/declining | Moderate | Once abundant and broadly distributed across the bunchgrass communities of eastern Washington, the species is now rare and sparsely distributed due to the loss, degradation, and fragmentation of habitat and possibly disease and competition with Black-tailed Jackrabbits. |
| **SHREWS** | | | | | | |
| Destruction Island Shrew | Species of Concern | None | No | Unknown/ unknown | Low-Moderate | This subspecies is endemic to Destruction Island. Its status and biology have not been assessed, but it may be threatened by herbivory from introduced European Rabbits. |
| Merriam's Shrew | None | Candidate | Yes | Unknown/ unknown | Low-Moderate | This relatively little known species appears rare but widespread in much of the Columbia Basin and several adjoining localities of eastern Washington. Additional sampling is needed to clarify its status. It may be threatened by habitat loss and fragmentation, and by the invasion of cheatgrass. |
| Preble's Shrew | Species of Concern | Candidate | Yes | Unknown/ unknown | Low-Moderate | Preble's Shrew is a poorly known species that appears to be extremely rare in Washington; additional sampling is needed to understand distribution, habitat needs, and factors that affect populations. |
| **BATS** | | | | | | |
| Hoary Bat | None | None | No | Moderate/ unknown | Low-Moderate | This is a widely distributed migratory bat that is vulnerable to mortality from wind turbines during migration. It also faces threats from habitat alteration throughout its range. |

| MAMMAL SPECIES | Federal Status | State Status | PHS | Population size/trend | Climate Vulnerability | Summary of Conservation Concern |
|---|---|---|---|---|---|---|
| Keen's Myotis | None | Candidate | Yes | Low/unknown | Moderate-High | In Washington, this bat is poorly known and probably rare. Loss of large decadent trees and snags is likely an important threat. |
| Silver-haired Bat | None | None | No | Moderate/ unknown | Low-Moderate | Although relatively common in much of Washington, silver-haired bats experience extensive mortality at wind turbines. Loss of large roost trees and snags locally and along migration routes is another important concern. |
| Spotted Bat | None | Monitor | No | Low/unknown | Low | Individual populations are apparently disjunct and may be vulnerable to human disturbance. Population trends, life history, and habitat requirements are unknown. |
| Townsend's Big-eared Bat | None | Candidate | Yes | Low/stable | Moderate-High | This species occurs in small to moderately-sized aggregations at sites throughout the state, where it may be vulnerable to human disturbance during the breeding and wintering periods. |
| **RODENTS** | | | | | | |
| Brush Prairie Pocket Gopher | None | None | No | Unknown/ unknown | Low-Moderate | Current status and distribution of the Brush Prairie Pocket Gopher in Washington is unknown. It is known only from southwestern Clark County, a developing urban/suburban area. |
| Gray-tailed Vole | None | Candidate | Yes | Unknown/ unknown | N/A | Gray-tailed Voles are probably still common in pastures and grassy roadsides in Clark County, but current status and distribution is uncertain; southwestern Clark County is a developing urban/suburban area. |
| Kincaid Meadow Vole | None | Monitor | No | Low/unknown | Low-Moderate | The Kincaid Meadow Vole is a unique subspecies only found in eastern Washington. Its distribution is poorly defined and there is little current information on the status of populations. |
| Mazama Pocket Gopher | Threatened | Threatened | Yes | Low/declining | Low-Moderate | Some subspecies are threatened by habitat loss from human development. Species existence is compatible with some levels of development, but high density development likely leads to extirpation. |
| Northern Bog Lemming | Petitioned | Monitor | No | Low/unknown | Moderate-High | The Northern Bog Lemming is known from about 12 locations in Washington, where it reaches the southwestern limit of its range. Its glacial relict habitats are isolated and patchy in nature, making the risk of extinction very high. |
| Olympic Marmot | None | Candidate | Yes | Low/possibly stable | Moderate-High | An endemic to mountainous meadows of the Olympic Peninsula, Olympic Marmot populations have possibly stabilized since 2007 after declining from 2002 to 2006. Threats include increased coyote predation, and habitat fragmentation due to rising tree line (caused by declining snow pack and climate change), resulting in greater population isolation and increasing the risk of inbreeding and extinction. |
| Shaw Island Townsend's Vole | None | Monitor | No | Moderate/ unknown | N/A | This subspecies occurs on at least 16 islands in the San Juan Archipelago. Overall population status is unclear, but populations appear secure on several larger islands. Apparent threats include habitat loss and mortality from agricultural practices. |
| Townsend's Ground Squirrel | None | Candidate | Yes | Unknown/ unknown | Moderate | Population status of this Washington-endemic ground squirrel requires clarification. Significant declines have occurred in many areas, yet this species is common at a number of human-modified locations. |

| MAMMAL SPECIES | Federal Status | State Status | PHS | Population size/trend | Climate Vulnerability | Summary of Conservation Concern |
|---|---|---|---|---|---|---|
| Washington Ground Squirrel | Candidate | Candidate | Yes | Low/declining | Moderate | This species is associated with shrub-steppe and steppe in eastern Washington and is threatened by a number of factors, especially habitat loss, degradation, and fragmentation. |
| Western Gray Squirrel | None | Threatened | Yes | Low/unknown | Low-Moderate | The three remaining populations of this species in Washington are isolated and face a number of threats, including habitat loss and degradation, wildfires, highway mortality, and disease. |
| **TERRESTRIAL CARNIVORES** | | | | | | |
| American Badger | None | Monitor | No | Unknown/ unknown | Low-Moderate | The status of badgers in Washington is poorly understood because of a lack of survey effort and the small amount of occurrence data available to indicate its current distribution. |
| American Marten | None | None | Yes | Critical or possibly extirpated/ unknown | Moderate-High | Based on the almost complete lack of recent verifiable detections, the population of coastal martens in Washington is very small. Trapping, loss, and fragmentation of late-successional forests at low elevations, and small population size are likely factors in the decline of the species in Washington. |
| Cascade Red Fox | None | Candidate | Yes | Unknown/ unknown | High | Little information is available on the distribution and status of this fox in Washington, although recent surveys suggest that populations are likely to be small and may be isolated. Climate change could reduce the availability of habitat for this species. |
| Fisher | Proposed Threatened | Endangered | Yes | Unknown/ unknown | Moderate-High | Historical over-trapping, incidental mortality, and habitat loss and fragmentation caused the extirpation of Fishers in Washington by the mid-1900s. A reintroduction project to recover the species on the Olympic Peninsula was completed in 2010. A Cascades Fisher reintroduction is scheduled to begin in 2015. |
| Gray Wolf | Endangered (Western two-thirds of WA only) | Endangered (State-wide) | Yes | Low/increasing | Low-Moderate | Gray wolves were once common throughout most of Washington, but human persecution led to their extirpation from the state by the 1930s. Wolves have started to recover in recent years, with pack numbers increasing from one in 2008 to 16 in 2014. Human-related mortality is the greatest threat to the population. |
| Grizzly Bear | Threatened | Endangered | Yes | Critical/ unknown | Moderate | This omnivore is extirpated from most of the state; however, two populations of uncertain viability have been identified and each plays an important role in the range-wide conservation and recovery of the species. Grizzly populations in Washington are very small and isolated due to habitat fragmentation caused by human settlement and highways, which makes the species more vulnerable to inbreeding, wildfire, illegal harvest, and other threats. |
| Lynx | Threatened | Threatened | Yes | Low/declining | High | Washington's Lynx population is small (likely less than 100 animals) and restricted to a small portion of its historical range. Small population size, habitat loss from large wildfires, and climate change are threats to Lynx in Washington. |

| MAMMAL SPECIES | Federal Status | State Status | PHS | Population size/trend | Climate Vulnerability | Summary of Conservation Concern |
|---|---|---|---|---|---|---|
| Western Spotted Skunk | None | None | No | Unknown/ declining in Puget Trough | Low | There is inadequate information on the current status and distribution of this species in much of its range in western and southeastern Washington. The increased occurrence of opossums and loss and fragmentation of forest habitats due to urban and agricultural development may explain the apparent substantial decline of verified occurrences in the Puget Trough since the 1970s. |
| Wolverine | None | Candidate | Yes | Critical/stable | Moderate-High | Washington's Wolverine population is small, largely restricted to the North Cascades, and is an extension of a larger population in southern British Columbia. Climate change may be a significant threat to the species in Washington if denning and food cache sites are impacted. |
| **MARINE MAMMALS** | | | | | | |
| Blue Whale | Endangered | Endangered | Yes | Critical/stable | Low-Moderate | The stock along the U.S. west coast, which includes Washington, is estimated at 1,647 whales and has a stable trend. Ship strikes and fisheries entanglements may negatively affect recovery. |
| Fin Whale | Endangered | Endangered | No | Low/increasing or stable | Low-Moderate | The stock along the U.S. west coast, which includes Washington, is estimated at about 3,000 whales and is either increasing or stable. Ship strikes and fisheries entanglements may hinder recovery. |
| Gray Whale | None | Sensitive | Yes | Medium/stable | Low-Moderate | The eastern North Pacific stock of this whale has recovered from over-harvest and has been stable for several decades. Status of a small group within this stock, the Pacific Coast Feeding Group, whose range includes Washington, requires further assessment. |
| Humpback Whale | Endangered | Endangered | Yes | Low/increasing | Low-Moderate | Abundance of this species along the U.S. west coast, including Washington, has steadily grown in recent decades. Entanglements in fishing gear and ship strikes are relatively minor sources of mortality and injury. |
| Killer Whale | Endangered (southern residents only) | Endangered | Yes | Low/declining (southern residents); Moderate/unknown (transients, offshores) | Southern residents: Moderate-High; Transient/offshore: Low-Moderate | Of the three main populations occurring in Washington, southern resident Killer Whales have shown an overall decline since 1995, whereas transient and offshore populations are currently not of conservation concern. The reduced availability of depleted Chinook salmon populations has limited the population's productivity. High levels of chemical contaminants, noise and disturbance from vessels and other human activities, as well as large oil spills all have the potential to negatively impact the health and status of the population. |
| Minke Whale | None | | No | Low/unknown | Low-Moderate | The stock along the U.S. west coast, including Washington, is estimated at about 500 whales, with trend unknown. Ship strikes and fisheries entanglements may hinder population growth. |
| North Pacific Right Whale | Endangered | Endangered | No | Critical/ unknown | Moderate | The stock along western North America, including Washington, is critically endangered, with trend unknown. Threats to the stock are poorly known. |
| Sea Otter | Species of Concern | Endangered | Yes | Low/increasing | Low-Moderate | Washington's population of Sea Otters has shown steady growth to almost 1,600 animals since its reintroduction in 1969 to 1970. Oil spills are the greatest potential threat to the population. |

| MAMMAL SPECIES | Federal Status | State Status | PHS | Population size/trend | Climate Vulnerability | Summary of Conservation Concern |
|---|---|---|---|---|---|---|
| Sei Whale | Endangered | Endangered | No | Critical/ unknown | Low-Moderate | The stock along the U.S. west coast, which includes Washington, is quite small at about 125 whales, with trend unknown. Threats to the stock are poorly understood. |
| Sperm Whale | Endangered | Endangered | Yes | Low/stable | Low-Moderate | The stock along the U.S. west coast that includes Washington, numbers no more than several thousand whales, with trend probably stable. Fisheries entanglements are a relatively minor source of mortality and injury. |
| **UNGULATES** | | | | | | |
| Bighorn Sheep | None | None | Yes | Low/Some herds declining, others stable or increasing | Moderate | Although a game species and sustainably hunted, Bighorn Sheep remain a conservation reliant species. Bighorns currently occupy approximately 15 to 20 percent of their historical habitat in Washington, and connectivity among individual herds is difficult to establish. Bighorns are susceptible to pneumonia caused by bacteria routinely carried by domestic sheep and goats. |
| Columbian White-tailed Deer | Endangered | Endangered | Yes | Low/stable | Moderate-High | This subspecies exists in small, isolated populations, rendering it vulnerable to such factors as disease and stochastic events. Continued habitat degradation will impede recovery by further fragmentation of existing habitat and loss of areas for future range expansion. In addition, this species has the potential to be greatly affected by climate change due to sea level rise that will reduce island and lowland coastal habitats. |
| Woodland Caribou | Endangered | Endangered | Yes | Critical/ declining | High | The South Selkirk Woodland Caribou population has been adversely affected by predation and habitat change. The core range for this population, which overlaps into Washington, is in British Columbia. The population is at a perilously low level with recent annual calf mortality recorded at 40 to 70 percent mainly due to predation, severe weather, and malnutrition. |

### 3.2.2 BIRDS

**Overview**

The Species of Greatest Conservation Need list for Washington includes 51 avian taxa. This diverse group of species includes waterfowl, upland game birds, marine birds and waterbirds, diurnal raptors (i.e., falcons, hawks and eagles), cranes, shorebirds, pigeons, cuckoos, owls, woodpeckers and perching birds. These species occupy a variety of habitats across the state, include year-round residents and migrants, have limited to widespread distributions in Washington, and are of concern for various reasons, as summarized below.

Because of the strong tendency for migration (or other seasonal movements) in this taxa group, it is not surprising that about one-half of Washington's SGCN birds are migrants. Eight species reside in the state during winter after breeding elsewhere (i.e., six waterfowl species, two shorebird species), two species occur only as migrants (i.e., Short-tailed Albatross, Red Knot), one species (Brown Pelican) breeds to the south and migrates to the Washington coast for the post-breeding season, and a dozen species overwinter to the south and migrate north to breed in Washington (e.g. American White Pelican, Ferruginous Hawk, Flammulated Owl, Sage Thrasher). Some species have both resident and migrant individuals in the population (e.g. Burrowing Owl, Ferruginous Hawk, Snowy Plover).

**Distribution**

SGCN birds have varying distributions across the state and use a variety of cover types. Of the 51 taxa, 22 are found only or largely in western Washington (e.g. Surf Scoter, Marbled Murrelet), 21 in eastern Washington (e.g. Greater Sage Grouse, Pygmy Nuthatch) and 8 are found in both western and eastern Washington (e.g. Peregrine Falcon, Bald Eagle, Golden Eagle). Some species have fairly large distributions; an example is the Northern Spotted Owl which is found on both slopes of the Cascade Range and the Olympic Peninsula, but which is now essentially extirpated from southwestern Washington and the Puget Trough. Other well distributed species include Peregrine Falcon, Bald Eagle, and Western Screech-Owl. Conversely, a number of taxa have extremely limited ranges that are now less than 5 percent of the land area of Washington: Marbled Godwit, Red Knot, Rock Sandpiper, Sandhill Crane, Slender-billed White-breasted Nuthatch, Snowy Plover, Tufted Puffin, Upland Sandpiper, and Oregon Vesper Sparrow.

Nearly two-thirds of the taxa are commonly associated with three general cover types: 15 species in marine ecosystems, including marine waters (seabirds, waterbirds) and estuaries and beaches (shorebirds); 9 species on conifer forest ecosystems (e.g. Spruce Grouse, Band-tailed Pigeon), and 9 species in shrub-steppe ecosystems (e.g. Columbian Sharp-tailed Grouse, Burrowing Owl, Sage Thrasher). Other types include grasslands, freshwater, alpine, wetlands, and riparian.

Some avian taxa on the SGCN list are uncommon or rare subspecies or are represented by very small populations. Examples of uncommon or rare subspecies (overall, or the portion of the population that occurs in Washington) include Marbled Godwit, Oregon Vesper Sparrow, Sandhill Crane, Slender-billed White-breasted Nuthatch, and Streaked Horned Lark. Some of these and other taxa populations are very small and may number fewer than 100 individuals in Washington: Great Gray Owl, Oregon Vesper Sparrow, Rock Sandpiper, Sandhill Crane (breeding population), Short-tailed Albatross, Snowy Plover, Upland Sandpiper, and Yellow-billed Cuckoo. The latter two species have been virtually extirpated and neither has been documented breeding in the state for several decades or more and might be "functionally extinct."

**Conservation Concern**

Reasons for concern about the taxa are varied and most taxa are either of concern due to a factor related to habitat or for an unknown reason. Consequently, for a number of species there exists a need to gather basic information that may illuminate the cause for concern. Some reasons for concern include small population size that makes the taxon vulnerable to environmental impacts. Finally, other factors of concern are varied and include human disturbance, effects of oil spills, water management, fire suppression effects and even volcanic activity. See Table 3.2-4 for more information on species status and conservation concerns.

**Population Trends**

Population trends of 41 of the 51 avian taxa are either declining (19) or unknown (22). Four species are thought to have stable populations and six are increasing. Some of the increasing populations are species that are recovering strongly and will likely be delisted in the future. Other increasing populations are very small and the perceived increase may in fact reflect influence of other subspecies present in the state (e.g. Marbled Godwit). Some landbirds impacted by conversion of shrub steppe exhibited declining trends from 1966 to 2013, although recent trends (2003 to 2013) for some were stable. For these species stability is obviously at a new, lower level of abundance given the reduced carrying capacity of the remaining habitat, and future management will be directed at increasing populations to make them more robust to environmental change.

**Climate Change Considerations**

Many species evaluated as having low or low-moderate overall vulnerability are considered generalist species or are highly adaptable (e.g., occur within a range of habitats, including human-altered landscapes); e.g., Bald Eagle, American White and Brown Pelicans, Dusky Canada Goose, Loggerhead Shrike and Peregrine Falcon. Species evaluated with moderate-high or high vulnerability (but varying levels of confidence) included: Barrow's Goldeneye, Harlequin Duck, Sage Grouse, Northern Spotted Owl, Sage Thrasher, Sagebrush Sparrow, Red Knot, Spruce Grouse, Surf Scoter, Western Snowy Plover, and White-tailed Ptarmigan. Birds utilizing higher elevation habitats (e.g., white-tailed ptarmigan and spruce grouse) and sagebrush-obligate species appear more vulnerable. Coastal species such as Red Knot, Surf Scoter, and Western Snowy Plover exhibit higher vulnerability due to sea level rise impacts on nesting and/or foraging habitat, as well as climate-driven changes in timing mismatches.

**Conservation Success**

Lastly, it is appropriate to mention the species that are doing well. These taxa are still identified as SGCN because listing status was a criterion used to identify species for the list. The following species will have status reviews conducted and if they are formally delisted as expected, they will be removed from the SGCN list: Bald Eagle, Brown Pelican, and Peregrine Falcon. Other species may be doing well but risks remain ornot enough is known about them to justify removing them from the list of SGCN taxa at this time. For example, winter abundance of Marbled Godwit has increased in Washington but subspecies identity of Washington birds is uncertain (one subspecies totals only 2000 globally) and requires clarification. Similarly, the risk to Short-tailed Albatross, which has begun to recover and again use coastal waters of Washington, is that the primary nesting area is a small active volcano off the coast of Japan. It remains an SGCN due primarily to its federal status under the ESA.

**Alphabetical List of SGCN Birds**

1. American White Pelican
2. Bald Eagle
3. Band-tailed Pigeon
4. Barrow’s Goldeneye
5. Black Scoter
6. Brown Pelican
7. Burrowing Owl
8. Cinnamon Teal
9. Clark’s Grebe
10. Columbian Sharp-tailed Grouse
11. Common Loon
12. Dusky Canada Goose
13. Ferruginous Hawk
14. Flammulated Owl
15. Golden Eagle
16. Great Gray Owl
17. Greater Sage-grouse
18. Harlequin Duck
19. Lewis’ Woodpecker
20. Loggerhead Shrike
21. Long-tailed Duck
22. Marbled Godwit
23. Marbled Murrelet
24. Mountain Quail
25. Northern Spotted Owl
26. Oregon Vesper Sparrow
27. Peregrine Falcon
28. Purple Martin
29. Pygmy Nuthatch
30. Red Knot
31. Red-necked Grebe
32. Rock Sandpiper
33. Sage Thrasher
34. Sagebrush Sparrow
35. Sandhill Crane (Greater)
36. Short-eared Owl
37. Short-tailed Albatross
38. Slender-billed White-breasted Nuthatch
39. Spruce Grouse
40. Streaked Horned Lark
41. Surf Scoter
42. Tufted Puffin
43. Upland Sandpiper
44. Western Bluebird (W. Wash)
45. Western Grebe
46. Western High Arctic Brant
47. Western Screech Owl
48. Western Snowy Plover
49. White-headed Woodpecker
50. White-tailed Ptarmigan
51. White-winged Scoter
52. Yellow-billed Cuckoo

**Table 3-4 SGCN Birds: SUMMARY OF CONSERVATION STATUS**

Please see Appendix A for a complete discussion of key threats and conservation actions needed for these species.

Please see Section 3.4 at the end of this chapter for an explanation of the terms used in the headings.

| BIRD SPECIES | Federal Status | State Status | PHS | Population size/trend | Climate Vulnerability | Summary of Conservation Concern |
|---|---|---|---|---|---|---|
| **WATERFOWL** | | | | | | |
| Barrow's Goldeneye | None | None | Yes | Low/ declining | High | This sea duck species breeds in Washington, has low population numbers and has been declining in Puget Sound. Sources of impacts have not been clearly identified. |
| Black Scoter | None | None | Yes | Moderate /declining | Moderate-High | This species has undergone significant population declines in Puget Sound. Sources of impacts have not been clearly identified. |
| Cinnamon Teal | None | None | No | Low/Stable | Moderate | Cinnamon Teal is a once fairly common breeding species in Washington that has declined significantly in the past 40 years. |
| Dusky Canada Goose | None | None | No | Low/Stable | Low-Moderate | Habitat changes on the dusky Canada goose breeding grounds on the Copper River Delta, Alaska have led to high predation pressure; combined with losses of wintering habitat in western Washington, these factors are responsible for a long-term population decline for this subspecies. |
| Harlequin Duck | Concern | None | Yes | Low/declining | Moderate-High | Declines in wintering numbers of Harlequin Ducks have occurred on Puget Sound. Sources of impacts have not been clearly identified. |
| Long-tailed Duck | None | None | No | Moderate/ declining | Moderate | This species has undergone significant population declines in Puget Sound. Sources of impacts have not been clearly identified. |
| Surf Scoter | None | None | Yes | Moderate/ declining | Moderate-High | This species has undergone significant population declines in Puget Sound. Sources of impacts have not been clearly identified. |
| White-winged Scoter | None | None | Yes | Low/declining | Moderate-High | This species has undergone significant population declines in Puget Sound. Sources of impacts have not been clearly identified. |
| Western High Arctic Brant | None | None | Yes | Low/stable | Moderate-High | Western High Arctic Brant include a small population which has experienced a long-term decline in numbers. Factors affecting population status and distribution are currently unknown. |
| **UPLAND GAME BIRDS** | | | | | | |
| Greater Sage-grouse | Candidate | Threatened | Yes | Low/stable | High | Greater Sage-grouse require large landscapes of sagebrush steppe, much of which has been degraded, fragmented, or lost. The primary threat is the combined impact of habitat loss, fragmentation, and degradation. |
| Columbian Sharp-tailed Grouse | Concern | Threatened | Yes | Low/declining | Moderate-High | The statewide population of Columbian Sharp-tailed Grouse is distributed in seven subpopulations that are not sustainable. Maintaining the species in Washington will require restoring habitat and increasing populations. |

| BIRD SPECIES | Federal Status | State Status | PHS | Population size/trend | Climate Vulnerability | Summary of Conservation Concern |
|---|---|---|---|---|---|---|
| Mountain Quail | None | None | Yes | Low/Unknown | Moderate | Populations have declined to very low levels within the native range in Washington. The decline is thought to be due to loss or degradation of dense shrub communities, and hydroelectric and other development in riparian zones. |
| Spruce Grouse | None | None | No | Declining | High | Although a gamebird, the indirect effects of climate change including disease of trees and wildfire, the direct effects of clear-cut timber harvest, and the uncertainty about taxonomy mean that their conservation status is uncertain. |
| White-tailed Ptarmigan | Petitioned | None | No | Low | High | The greatest threat to the long-term survival of ptarmigan populations appears to be climate change, which may lead to a gradual loss of alpine habitats as the treeline moves upward. |
| **MARINE AND WATERBIRDS** | | | | | | |
| American White Pelican | None | Endangered | Yes | Low/increasing | Moderate | The abundance of American White Pelicans in Washington is relatively low and the population is somewhat vulnerable in that nesting is restricted to only one location in Washington. |
| Brown Pelican | Concern | Endangered | Yes | 7-10,000/ increasing | Moderate-High | This species has recovered from its previous populations decline and has been delisted by the U.S. Fish and Wildlife Service. This species will undergo a status review and its SGCN status will be assessed pending the outcome of that review. |
| Clark's Grebe | None | Candidate | Yes | Low/declining | Moderate | The small breeding population of this species in Washington, which occurs at a small number of Columbia Basin lakes and reservoirs, is strongly impacted by various threats relating to water drawdowns and recreational boating activity. |
| Common Loon | None | Candidate | Yes | Low/stable | Moderate | This species has a small breeding population in Washington. Its overall range has contracted northward. Due to life history and a small population in Washington it is highly vulnerable to impacts if not monitored and managed where appropriate. |
| Marbled Murrelet | Threatened | Threatened | Yes | Low/declining | Moderate-High | Because of its breeding association with old forests, Marbled Murrelet populations have been severely affected by loss of mature and old forest habitat. Food resources in the marine environment may also influence population status. |
| Red-necked Grebe | None | Monitor | Yes | Unknown/ unknown | Moderate-High | Status of this species is unclear. Wintering populations in Washington exhibit ecological traits identified as risk factors for marine birds that occur in the Salish Sea that are declining. |
| Short-tailed Albatross | Endangered | Candidate | No | Rare/increasing | Low-Moderate | The Short-tailed Albatross is vulnerable to extreme reduction and breeding capacity due to about 90% of nesting pairs located in one colony (Torishima Island, Japan). Unintentional bycatch in offshore fisheries is a mortality threat. |

| BIRD SPECIES | Federal Status | State Status | PHS | Population size/trend | Climate Vulnerability | Summary of Conservation Concern |
|---|---|---|---|---|---|---|
| Tufted Puffin | Concern | Endangered | Yes | Low/declining | Moderate-High | In Washington, this species has experienced an order-of-magnitude population decline in recent decades and has disappeared from more than half of its historical breeding sites. Sources of impacts have not been clearly confirmed. |
| Western Grebe | None | Candidate | Yes | Low/declining | Moderate | The breeding and wintering populations of this species in Washington, which occur in freshwater and marine habitats, respectively, are strongly impacted by different groups of threats, such as fluctuating water levels at breeding sites, disruption of nesting activities, and reductions of prey at overwintering areas in the Salish Sea. |
| **FALCONS, HAWKS, EAGLES** | | | | | | |
| Bald eagle | Concern | Sensitive | Yes | Medium/ increasing | Moderate | This species has experienced recovery as a result of removal of DDT from most of its range. This species will undergo a status review and its SGCN status will be assessed pending the outcome of that review. |
| Ferruginous Hawk | Concern | Threatened | Yes | Low/declining | Low-Moderate | This species is impacted by the loss and fragmentation of shrub-steppe and grasslands from agriculture and residential development and associated declines in distribution and abundance of its primary prey, jackrabbits and ground squirrels. In addition, direct sources of mortality include shooting, electrocution, and collision with wind turbines. |
| Golden Eagle | None | Candidate | Yes | Low/unknown | Moderate-High | This species is of concern due to declines in the distribution and abundance of its primary prey species, jackrabbits and ground squirrels; across its range additional mortality factors include continued exposure to lead in the environment and collisions at wind energy facilities. |
| Peregrine Falcon | Concern | Sensitive | Yes | Low/increasing | Low | This species has experienced a remarkable recovery and the population continues to increase across Washington. This species will undergo a status review and its SGCN status will be assessed pending the outcome of that review. |
| **CRANES** | | | | | | |
| Sandhill Crane (greater) | None | Endangered | Yes | Critical/increasing | Moderate-High | The Washington population of Greater Sandhill Cranes numbers about 80 adult and sub-adult birds, with about 30 breeding pairs. Sandhill Cranes are long-lived, but have a low reproductive rate, and nests are vulnerable to predators, disturbance, and fluctuating water levels. |
| **SHOREBIRDS** | | | | | | |
| Marbled Godwit | None | None | Yes | Low/increasing | Moderate-High | Due to the extremely small size of the *beringiae* subspecies population and the localized area of foraging and roosting in coastal Washington, this species is vulnerable to oil spills or other actions that would degrade or impact its habitat. |
| Red Knot | None | None | Yes | Low/declining | Moderate | Limited information suggests the population has declined; its localized use of food resources in tidal areas along the flyway suggests it will be sensitive to climate change effects. |
| Rock | None | None | Yes | Low/unknown | Low-Moderate | Studies predicting vulnerabilities of Rock Sandpipers to climate change |

| BIRD SPECIES | Federal Status | State Status | PHS | Population size/trend | Climate Vulnerability | Summary of Conservation Concern |
|---|---|---|---|---|---|---|
| Sandpiper | | | | | | indicate no change in risk associated with wintering and migration habitats; all breeding habitat exists outside Washington State, and does have expected increased risk associated with climate change. |
| Upland Sandpiper | None | Endangered | Yes | Critical/unknown | Moderate-High | Habitat loss most likely contributed to population decline of this species in Washington. Incomplete information on distribution prevents meaningful protection should there be other extant small populations of breeding birds in the state. Lack of records suggests it no longer breeds in Washington. |
| Western Snowy Plover | Threatened | Endangered | Yes | Low/increasing | High | Washington's Snowy Plover population is very small and vulnerable to a variety of impacts such as predation, adverse weather, shoreline modification, dune stabilization, and recreational activities. Due to ongoing conservation efforts, regional and state populations are approaching targets established to indicate recovery. |
| **PIGEONS** | | | | | | |
| Band-tailed Pigeon | None | None | Yes | Low/declining | Low-Moderate | The Band-tailed Pigeon population, which is reliant on upland forests and limited mineral sources in western Washington, has declined due to a combination of factors. |
| **CUCKOOS** | | | | | | |
| Yellow-billed Cuckoo | Candidate | Candidate | Yes | Extirpated/ breeding Critical/migrant | Moderate-High | This species hasn't bred in Washington since about 1940 and has been a very rare migrant and summer resident since then. Recovery efforts are probably best directed at remnant nesting habitats still occupied in the southwest U.S. |
| **OWLS** | | | | | | |
| Burrowing Owl | Concern | Candidate | Yes | Low/declining | Low-Moderate | This species is associated with shrub-steppe and grassland habitats and has experienced a contraction of its range and decline in numbers due to loss of habitat and persecution of mammalian species that provide earthen burrows that owls use. |
| Flammulated Owl | None | Candidate | Yes | Low/unknown | Moderate | Flammulated Owls are probably impacted by habitat loss (and degradation) and fire suppression in dry forest landscapes. |
| Great Gray Owl | None | Monitor | No | Low/unknown | Moderate-High | Little is known about this species, and although impacts and range contraction may have occurred over the last century, current threats and impacts are not understood. |
| Northern Spotted Owl | Threatened | Endangered | Yes | Low/declining | High | Impacts from habitat loss are now exacerbated by effects of competition with Barred Owls for prey and habitat. As the population declines and becomes even smaller, other threat factors may become more relevant. |
| Short-eared Owl | None | None | Yes | Low/unknown | Low-Moderate | This species is thought to be experiencing a range-wide, long-term decline in North America. The primary threat is the combined impact of habitat loss, fragmentation, and degradation. |

| BIRD SPECIES | Federal Status | State Status | PHS | Population size/trend | Climate Vulnerability | Summary of Conservation Concern |
|---|---|---|---|---|---|---|
| Western Screech Owl | None | None | No | Unknown | Low-Moderate | This species appears to have been impacted by the presence of Barred Owls in western Washington. More information is needed to assess whether its population has declined or if suspected changes reflect only behavioral response to Barred Owls. |
| **WOODPECKERS** | | | | | | |
| Lewis' Woodpecker | None | Candidate | Yes | Low/declining | Low-Moderate | This species may be impacted by habitat loss and effects of fire suppression practices. Salvage harvest of trees in recently-burned forest may preclude or limit breeding in such areas for this fire-dependent species. Historically, breeding records included many areas in western Washington, but there have been no records for decades. |
| White-headed Woodpecker | None | Candidate | Yes | Low/declining | Low-Moderate | White-headed Woodpeckers are probably impacted by habitat loss (and degradation) and fire suppression in dry forest landscapes. |
| **PERCHING BIRDS** | | | | | | |
| Loggerhead Shrike | Concern | Candidate | Yes | Low/stable | Low-Moderate | This species is strongly associated with shrub-steppe in Washington and has likely experienced a population decline in accordance with loss and conversion of shrub-steppe habitat. |
| Oregon Vesper Sparrow | Concern | Candidate | Yes | Low/declining | Moderate | Due to loss and degradation of habitat this subspecies is now in danger of extirpation in Washington. |
| Purple Martin | None | Candidate | Yes | Low/stable | Low-Moderate | The population of Purple Martins in Washington is very small and is essentially dependent on humans to provide nest structures. Consequently, persistence of the population likely requires ongoing human intervention (e.g. erecting and maintaining nest structures). |
| Pygmy Nuthatch | None | Monitor | Yes | Low/unknown | Moderate-High | The Pygmy Nuthatch is a species of concern because of its dependence on old ponderosa pine forests to provide suitable nesting cavities in dead and decadent trees and a year round food source of pine seed. Historic logging and fire suppression have altered the structure and species composition of ponderosa pine forests. |
| Sage Thrasher | None | Candidate | Yes | Low/declining | High | This sagebrush obligate is vulnerable to population declines and range contractions due to loss or degradation of shrub steppe habitat. |
| Sagebrush Sparrow | None | Candidate | Yes | Low/declining | High | The Sagebrush Sparrow is a species of concern because large expanses of big sagebrush, its preferred habitat, have been lost or degraded. |
| Slender-billed White-breasted Nuthatch | Concern | Candidate | Yes | Critical/declining | Low-Moderate | This species is of concern due to its dependence on large, mature oak trees to provide nest cavities and food (mast) and due to the fragmentation of oak tree stands from agriculture and residential development. |
| Streaked Horned Lark | Candidate | Endangered | Yes | Critical/unknown | Moderate-High | The Streaked Horned Lark is a subspecies only found in southwest Washington and western Oregon, with a total population estimated at less than 2,000. Primary concerns are the loss and degradation of habitat and |

| BIRD SPECIES | Federal Status | State Status | PHS | Population size/trend | Climate Vulnerability | Summary of Conservation Concern |
|---|---|---|---|---|---|---|
| | | | | | | human-related disturbance and mortality (e.g. mowing of grass) at breeding sites. |
| Western Bluebird – Western Washington | None | Monitor | No | Low/declining | Moderate-High | Declines in recent decades were caused primarily by habitat loss. Recent reintroductions onto San Juan Island may need additional translocations and removal of competitor's nests from nestboxes to be successful. |

### 3.2.3 AMPHIBIANS AND REPTILES

**Overview**
Approximately half the amphibian and reptile species native to Washington qualify as Species of Greatest Conservation Need. This includes eight salamanders, four frogs, two toads, four turtles, three lizards and five snakes. These species were included as SGCN for one or more of the following reasons: 1) Only a small number of populations occur in the state; 2) The species has a small state/global range; 3) The species is closely associated with a habitat type in Washington that is declining; 4) Declines have been noted in a certain ecoregion of the state and/or 5) Almost nothing is known about the species status within the state and what little is known suggests the species might be at risk.

**Distribution**
SGCN amphibians and reptiles occur throughout the state with the exception of the North Cascades, Okanogan Highlands and the Northeast corner. Northern Leopard Frogs, Washington's most imperiled frog, occurred historically in some of these regions but it is now presumed extirpated except in the Columbia Basin near Moses Lake. Leopard Frogs, along with Oregon Spotted Frogs, Western Pond Turtles and Striped Whipsnakes are SGCN because so few populations occur that the persistence of the species within the state is at risk. Oregon Spotted Frogs occur in six watersheds in the Puget Sound Lowlands and southeastern Cascades, Western Pond turtles occur at two sites in Puget Sound and four sites in the Columbia River Gorge, and Striped Whipsnakes are confirmed extant from only one area of the Columbia Basin.

Nine of the SCGN amphibians and reptiles are included primarily because they are globally rare and/or have small ranges in Washington with specialized habitat requirements. The majority of these species are restricted to streams and seepages in moist coniferous forests and all but two occur in western Washington. Two of the species are Washington endemics: The Olympic Torrent Salamander is found only in the Olympia Peninsula and the Van Dyke's Salamander is found in the Olympic Peninsula, Willapa Hills and Southwest Cascades. Cope's Giant Salamander has a similar distribution to Van Dyke's Salamander and is nearly a Washington endemic with only a small portion of its range in Oregon. The Washington ranges of the Columbia Torrent Salamander and Dunn's Salamander are limited to the Willapa Hills and the Cascade Torrent Salamander and Larch Mountain Salamander occur only in the Southern Cascades and Columbia River Gorge. The Larch Mountain Salamander is closely associated with talus and other rocky habitats and the Rocky Mountain Tailed Frog occurs only in the Blue Mountains. The California Mountain Kingsnake occurs along a 20 mile stretch of the Columbia River Gorge and is isolated from the rest of the species' range by approximately 200 miles.

Six SGCN species are closely associated with shrub-steppe habitat in Washington's Columbia Basin. Today, less than 50 percent of Washington's shrub-steppe remains and much of it is degraded and fragmented. Of the habitat that remains, much of the vegetation has been altered by historic unsustainable grazing, invasion by exotic plants, and changes in fire frequency and intensity. In some areas of the basin, water withdrawal for agriculture is resulting in loss of surface water. Consequently, the amphibian and reptile species closely associated with shrub-steppe habitat may be at risk for declines. These species include Tiger Salamander, Woodhouse's Toad, Pygmy Horned Lizard, Sagebrush Lizard, Side-blotched Lizard, and Desert Nightsnake. With the exception of the nightsnake, these species can be common where they occur but all may experience local declines if the trend toward habitat loss and degradation continues. Tiger Salamanders, Pygmy Horned Lizards, and Desert Nightsnakes are found throughout the Columbia Basin. Woodhouse's Toads are found only along the Snake River and portions of the Columbia River. Side-blotched Lizards are limited primarily to the central Columbia Basin. Sagebrush Lizards are associated with inland sand dunes in Washington and more than 70 percent of this habitat has been lost since the 1970s. These losses will likely continue due to increasing needs for agricultural land and stabilization of the sands by invasive grasses.

While the Western Toad and Columbia Spotted Frog have large ranges in Washington and remain common in many places, they are SCGN because of regional declines. The Western Toad was once common in the lowland Puget Sound but now is relatively rare and has declined in the lower Columbia River Gorge. The concern for the Columbia Spotted Frog is in the Columbia Basin where the species appears to have been extirpated from the central basin and is declining from other areas within shrub-steppe habitat.

Current information available in the WDFW database regarding Ring-necked Snakes and Sharp-tailed Snakes suggest these species have limited distributions in Washington and are patchy on the landscape. However, finding Ring-necked Snakes and Sharp-tailed Snakes is challenging due to their small size and secretive habits including activity that takes place within and under surface litter, woody debris, and below ground. Consequently, it is possible that they are more common than current information indicates. More surveys targeted specifically for these species are needed to better understand their status.

Sea turtles are occasional visitors to Washington's outer coastal waters and all have Federal Endangered or Threatened status. Leatherback Sea Turtles are adapted to colder waters and may occur in Washington waters more than is currently recognized.

**Population Sizes and Trends**

For SCGN amphibians and reptiles, the population sizes are almost never known with the exception of the rarest species such as the Oregon Spotted Frog and Western Pond Turtle that are intensely monitored. Even for these species, estimating population size can be challenging. Many amphibian and reptiles species can be difficult to find even when common because they spend so much time inactive below the surface. For some species, such as the Torrent Salamanders, they can be common to abundant where they occur, but they have limited distributions and highly specific habitat requirements that make them vulnerable to habitat disturbance or alteration. Therefore, for most species the trend is unknown. Where trend is indicated, it is based on factors such as documented loss of habitat or populations. With population trends unknown for almost all the amphibian and reptile species, this information represents a clear need for future inventory, monitoring and research efforts. See Table 3.2.-5 and 3.2.-6 for more information about species status and conservation concerns.

**Conservation Concern**

The main threat to SGCN amphibians and reptiles is the loss, fragmentation, and degradation of habitat. The small size of these animals prevents them from dispersing long distances to find new suitable habitat. Many species have a strong association to certain habitat features such as breeding ponds and overwinter sites (*e.g.,* snake dens) that they return to annually. The fidelity to these sites and, perhaps, the scarcity of these unique habitat features, prevents them from leaving areas even if their habitat is degraded. When they do attempt to disperse, they encounter many barriers such as roads.

Some species, such as Western Pond Turtles, require occasional habitat disturbance to provide open sunny areas for basking and nesting. Many of the natural disturbance processes that set back plant succession, such as fires, have been altered in modern times and are either less frequent or more intense than in the past. Invasive plant species are another major issue for many of the SCGN amphibians and reptiles because these plants can completely alter the vegetation structure and plant species composition. Reed canarygrass and cheatgrass are particularly problematic. Lastly, many SCGN species are threatened by non-native predatory animals such as American Bullfrogs and predatory fish. Most of Washington's native amphibians do not have strong defense mechanisms against these species or the diseases they carry. In the case of Washington's endangered Western Pond Turtles, hatchlings are small enough that bullfrogs eat them. Where there are high densities of bullfrogs and small numbers of Western Pond Turtles, bullfrog predation can reduce natural recruitment of young Western Pond Turtles to almost zero.

**Alphabetical List of Reptiles**

1. California Mountain Kingsnake
2. Desert Nightsnake
3. Green Sea Turtle
4. Leatherback Sea Turtle
5. Loggerhead Sea Turtle
6. Night Snake
7. Sagebrush Lizard
8. Sharptail Snake
9. Short horned Lizard
10. Side-blotched Lizard
11. Striped Whipsnake
12. Western Pond Turtle

**Alphabetical List of Amphibians**

1. Cascade Torrent Salamander
2. Columbia Spotted Frog
3. Columbia Torrent Salamander
4. Cope's Giant Salamander
5. Dunn's Salamander
6. Larch Mountain Salamander
7. Northern Leopard Frog
8. Olympic Torrent Salamander
9. Oregon Spotted Frog
10. Rocky Mountain Tailed Frog
11. Tiger Salamander
12. Van Dyke's Salamander
13. Western Toad
14. Woodhouse's Toad

**Table 3-5: SGCN Amphibians: Summary of Conservation Status**

Please see Appendix A for a complete discussion of key threats and conservation actions needed for these species.

Please see Section 3.4 at the end of this chapter for an explanation of the terms used in the headings.

| AMPHIBIAN SPECIES | Federal Status | State Status | PHS | Population size/trend | Climate Vulnerability | Summary of Conservation Concern |
|---|---|---|---|---|---|---|
| **SALAMANDERS** | | | | | | |
| Tiger Salamander | None | Monitor | No | Medium/ unknown | Moderate-High | The Washington status is based on the small number of populations, a range that is restricted to a region that has been heavily altered, and a lack of information about this species. Of greatest concern is the drastic decline in stream flows and water body volume in much of Lincoln County and adjacent portions of Grant and Adams Counties caused by water withdrawal for agriculture. Larger remaining water bodies may not be suitable habitat because they may contain introduced predatory fish that eat larval salamanders. |
| Cope's Giant Salamander | None | Monitor | No | Unknown/ probably stable | High | The main concerns for this species have to do with protection of stream integrity. Activities that alter the integrity of small and medium-sized forested streams are of concern, especially those actions that increase water temperature and sedimentation. Sedimentation is particularly problematic in low-gradient streams, as increased silt deposition may fill crucial microhabitats such as the spaces between rocks and logs that are used as sheltering, hiding and nesting sites. |
| Cascade Torrent Salamander | None | Candidate | Yes | Medium/ unknown | High | This species is sensitive to temperature variation and increased sedimentation that may be caused by disturbances such as logging and road construction. Some populations are isolated by surrounding areas of unsuitable habitat and are vulnerable to extirpation through stochastic events exacerbated by habitat loss. Temperature sensitivity and limited dispersal ability makes this species potentially sensitive to climate change. |
| Columbia Torrent Salamander | Species of Concern | Monitor | No | Medium/ unknown | High | The Washington status is based on the small global range, narrow environmental specificity and the potential concern that the species' headwater habitat may not be fully protected. In Washington, some occurrences are in protected areas (e.g., Natural Area Preserves) and some riparian habitat protections occur through forest practices rules and Habitat Conservation Plans. The temperature sensitivity limited dispersal ability makes this species potentially sensitive to climate change. |

| AMPHIBIAN SPECIES | Federal Status | State Status | PHS | Population size/trend | Climate Vulnerability | Summary of Conservation Concern |
|---|---|---|---|---|---|---|
| Olympic Torrent Salamander | Species of Concern | Monitor | No | Medium/ unknown | High | The status is based on the small global range (Washington endemic) and narrow environmental specificity. Most known occurrences (77 percent) are within Olympic National Park with an additional 15 percent of locations on the Olympic National Forest. National Forest occurrences are within Late-Successional Reserves and Adaptive Management Areas that provide some level of riparian habitat protection. Occurrence in landscapes with more intact, mature habitat with legacy structures (e.g., coarse woody debris) will likely buffer some impacts of climate change for this temperature-sensitive, species with limited dispersal ability. |
| Dunn's Salamander | None | Candidate | Yes | Low/stable | Moderate-High | The Washington status is based on the small state range, narrow environmental specificity and concern that riparian habitats the species relies upon may not be fully protected. The need for retention of large woody debris is also of concern. |
| Larch Mountain Salamander | Species of Concern | Sensitive | Yes | Low/unknown | High | The status is based on the small global range, narrow environmental specificity and concern that there is not adequate protection for this species' specialized habitat of rocky accumulations and talus. Any ground-disturbing activity or land use that changes the moisture regimes and permeability of inhabited rocky substrates, such as over-story tree removal and gravel removal, may threaten populations. In addition, the sedentary habits and specific habitat requirements likely hinder dispersal and colonization to new areas as well as limiting gene flow between populations. |
| Van Dyke's Salamander | Species of Concern | Candidate | Yes | Low/unknown | High | Van Dyke's Salamander is one of relatively few vertebrate species endemic to Washington. It is at risk due to its limited distribution and apparently small, isolated populations. |
| **TOADS** | | | | | | |
| Western Toad | Species of Concern | Candidate | Yes | In lowland Puget Sound: unknown | Moderate | In Washington, Western Toad declines have been documented in the Puget Trough and the lower Columbia River below Bonneville Dam. Of about 107 historical sites in those areas, only about 19 are thought to still remain. Elsewhere in the state, toads are locally common in many areas. |
| Woodhouse's Toad | None | Monitor | No | Unknown/ unknown | Moderate-High | The Washington State status is based on the small number of populations, a limited distribution restricted to shrub-steppe habitat in a region heavily altered for agriculture and urban development (e.g., Tri-Cities area), and a lack of information about the species. |
| **FROGS** | | | | | | |
| Rocky Mountain Tailed Frog | Species of Concern | Candidate | Yes | Low/ unknown | Moderate-High | This species is vulnerable to management practices that alter the riparian or aquatic zones of streams, especially those practices that change the moisture regime, increase sediment load, reduce woody debris input and change stream bank integrity. Protection of headwater streams is particularly important. |
| Columbia | None | Candidate | Yes | In Columbia | Moderate-High | Populations of this species in the Columbia Basin are declining, likely due |

| AMPHIBIAN SPECIES | Federal Status | State Status | PHS | Population size/trend | Climate Vulnerability | Summary of Conservation Concern |
|---|---|---|---|---|---|---|
| Spotted Frog | | | | Basin: Low/ unknown | | primarily to habitat loss and alteration, although other factors such as fish stocking may also cause declines. This species is aquatic, so drying of ponds and creeks related to agricultural water withdrawals is a threat in the region. |
| Oregon Spotted Frog | Candidate | Endangered | Yes | Low/declining | Moderate-High | The Washington State status is based on the rarity of the species. Human-caused stressors include wetland loss and alteration, loss of disturbance processes that set back succession, introduction of non-native/invasive flora and fauna and alteration of creek and river channels. Only six watersheds are currently known to be occupied in Washington. Within a watershed, most breeding populations are small and many are isolated from other breeding populations. They require breeding sites in shallow water with short vegetation and full sun exposure. This habitat type is rapidly lost to invasive grasses without management such as grazing, haying, mowing or restoration to native flora. |
| Northern Leopard Frog | Species of Concern | Endangered | Yes | Low/ declining | Moderate-High | Only one known population remains in Washington; there is limited information about population status and trends; efforts are underway to determine the feasibility of translocations to portions of the former range. |

## Table 3–6. SGCN Reptiles: SUMMARY OF CONSERVATION STATUS

| REPTILE SPECIES | Federal Status | State Status | PHS | Population size/trend | Climate Vulnerability | Summary of Conservation Concern |
|---|---|---|---|---|---|---|
| **TURTLES** | | | | | | |
| Green Sea Turtle | Threatened | Threatened | No | Low/unknown | Moderate | A rare visitor off the outer Washington coast, this declining species is threatened by a number of factors occurring primarily outside of the state. However, issues related to consumption of plastic pollution could be addressed in Washington. |
| Leatherback Sea Turtle | Endangered | Endangered | No | Low/unknown | Moderate | This declining species, which may occur more regularly off the outer Washington coast than previously known, is threatened by numerous factors happening primarily outside of the state. However, issues related to oil spills and fishing gear entanglement as well as consumption of plastic pollution could be addressed in Washington. |
| Loggerhead Sea Turtle | Endangered | Threatened | No | Low/unknown | Moderate | A very rare visitor off the outer Washington coast, this declining species is threatened by factors occurring primarily outside of the state. However, issues related to consumption of plastic pollution could be addressed in Washington. |
| Western Pond Turtle | In review | Endangered | Yes | Low/increasing | Moderate | In the 1990s, only two populations remained in the Columbia River Gorge with estimates of less than 200 individuals. Because of recovery efforts, currently there are six populations with approximately 800 turtles. Many |

| REPTILE SPECIES | Federal Status | State Status | PHS | Population size/trend | Climate Vulnerability | Summary of Conservation Concern |
|---|---|---|---|---|---|---|
| | | | | | | issues remain for the recovery of this species. Habitat must be managed to prevent invasive weeds from overgrowing the nesting areas. Predation by non-native American Bullfrogs on hatchlings, as well as mammalian predation on nests, prevents natural recruitment of hatchlings at many sites. Disease has emerged as a major concern in recent years due to the discovery that a substantial number of turtles have ulcerative shell disease. The cause of the disease is under investigation but is not yet known. |
| **LIZARDS** | | | | | | |
| Pygmy Horned Lizard | None | Monitor | No | Medium/ unknown | Moderate-High | The conservation concern for this species is because its distribution is primarily restricted to the highly altered and fragmented shrub-steppe in Eastern Washington. |
| Sagebrush Lizard | Species of Concern | Candidate | Yes | Low/declining | High | The Washington status is based on the species' obligate association with sand dunes in the Columbia Basin where greater than 70 percent of this habitat type has been lost since the 1970s. |
| Side-blotched Lizard | None | None | No | Medium/ unknown | Moderate-High | The Washington State status is based on the small number of populations and a distribution that is restricted to the heavily altered shrub-steppe of Eastern Washington. |
| **SNAKES** | | | | | | |
| California Mountain Kingsnake | None | Candidate | Yes | Low/unknown | Low-Moderate | In Washington, occurs at the northern extreme of its range and the population is isolated from the rest of its range by approximately 200 miles. The species' range in Washington is small with few individuals documented. They occur in the Columbia River Gorge in an area of the state that is highly desirable and is likely to see increased development and vehicular traffic over the next decade. |
| Desert Nightsnake | None | Monitor | No | Medium/ unknown | Moderate-High | The Washington State status is based on a distribution that is primarily restricted to the shrub-steppe vegetation that has been heavily altered in Washington. |
| Ring-necked Snake | None | Monitor | No | Unknown/ unknown | Low-Moderate | The Washington State status is based on the small number of observations, patchy distribution and lack of information. Some of the distribution is in the Columbia Basin, a heavily altered region of the state. |
| Sharp-tailed Snake | Species of Concern | Candidate | Yes | Low/unknown | Moderate | The Washington status and concern is based on the small number of populations, patchy distribution and lack of information. |
| Striped Whipsnake | None | Candidate | Yes | Low/declining | Moderate | The Washington status is based on the small number of populations. Currently only two populations are verified extant. Threats include conversion of habitat to agriculture, degradation of native shrub-steppe habitat from irrigation water and invasive weeds, basalt mining, single home construction and increasing vehicular traffic on roads and highways that bisect the occupied areas. |

### 3.2.4 FISH

**Overview**
There are 51 fish species or species units included on Washington's SGCN list. A species unit is an "evolutionarily significant unit" (ESU) or a "distinct population segment" (DPS) designated by NOAA-National Marine Fisheries Service and the U.S. Fish and Wildlife Service, respectively, as entities of a taxonomic species for ESA-listing purposes, or is a geographically designated population grouping (e.g., bull trout-coastal recovery unit). The 18 exclusively marine species represent about 7.5 percent of Puget Sound-area marine fishes or about 4.5 percent of marine fishes in all of Washington's marine waters. Of about 50 native freshwater and anadromous (freshwater and marine phases) fishes in Washington, the number of taxonomic species (22) on SGCN list represent 44 percent of these. Rockfish (genus *Sebastes*) and Pacific salmon and steelhead (genus *Oncorhynchus*) form about half of the SGCN list, but species diversity ranges from the Olympic Mudminnow (a Washington freshwater endemic) to the Bluntnose Sixgill Shark. Distribution of these fishes ranges from Pacific coastal waters to mountain streams of the interior Columbia Basin. Threats in common across a broad diversity of SGCN fishes include habitat loss and degradation from land and water uses, lack of abundance trend data, unintentional over-harvesting, and passage barriers due to dams, road crossings, diking, and other artificial structures. Many of these threats will be exacerbated by long-term climate change.

**Distribution**
Of the 18 SGCN species that live exclusively in marine environments, 7 occur only within the confined marine waters of the Salish Sea (Puget Sound, Strait of Juan de Fuca, and Strait of Georgia). The other marine fishes and the anadromous fishes occur in these waters and in the Pacific Ocean. Most of the anadromous salmonids have a large Pacific Ocean range during marine phases of their life histories. In freshwater, anadromous fishes generally have well-defined spawning distributions, but rearing distributions may range more widely. Migration corridors between marine and freshwater habitats are essential elements of anadromous fishes' natural distributions, and include vital estuarine habitats. Due to their varied life histories, anadromous fishes are present year-round in freshwater habitats. Of the 13 exclusively freshwater SGCN species (including the non-anadromous salmonid species), 8 occur only east of Cascades Mountains crest in Columbia Basin streams and lakes. Only two of the exclusively freshwater fishes (Olympic Mudminnow and Salish Sucker) do not occur in the Columbia Basin. Several freshwater species have relatively small or limited distributions in Washington.

**Abundance Status - Size and Trends**
Quantitative abundance and trend data for many SGCN fish species are lacking. Current population or unit size was unknown for 49 percent of the species, and abundance trend was unknown for 59 percent of the species. In many cases, information used to judge abundance status is qualitative, based on fishery-dependent data, or based on few, short-term surveys. Data insufficiency is considered a conservation threat for many SGCN fishes. Of the seven marine fish with abundance status ratings, five were rated at critical and two were rated at low abundances, and trends were rated as stable. All of the ESA-listed anadromous salmonids have long-term abundance data to assess status. For abundance ratings, 11 were low and 3 were medium; for trend ratings, 2 were declining, 7 were stable, 4 were increasing and 1 was unknown. Only one of the freshwater species (Westslope Cutthroat Trout) was rated, and it had medium abundance and stable trend. Acquiring quantitative data for SGCN species is an action that will clearly benefit the design and evaluation of conservation actions.

**Conservation Concerns**

To effectively conserve SGCN fish we must attend to multiple sources of habitat degradation and loss. For many of the marine species, we need to curtail the loss of and restore degraded nearshore breeding and rearing habitats, such as spawning beaches for herring, sand lance, and surf smelt, and eelgrass and algal habitats. In Puget Sound, residential and industrial shoreline uses and development that reduce and degrade marine habitats and water quality require management by multiple jurisdictions. In freshwater environments, we need to continue mitigation and elimination of impacts from dams, culverts, road crossings, and other instream modifications. Dams pose threats to all anadromous and some freshwater species by reducing, fragmenting, and modifying river habitats and by altering natural flow regimes and water quality. Dams may still impede juvenile and adult passage even where artificial passage has been constructed. Agricultural, urban, residential and commercial (e.g., forestry) land-uses have removed, modified, or degraded estuarine, floodplain, riverine, riparian, and wetland habitats essential to anadromous and freshwater fishes. Restoration of these habitats must continue in order to improve abundance, productivity and persistence of numerous SGCN. Threats from habitat loss and degradation are intensified for species with small or restricted ranges such as Olympic Mudminnow, Margined Sculpin, Salish Sucker, and Burbot. See Table 3.2-7 for more information on species status and conservation concerns.

For anadromous salmonid SGCN, hatchery production and hatchery-origin fish pose several kinds of threats to natural populations. Management of these risks is on-going and must continue in order to meet ESA-related recovery goals. For many SGCN fish species, mortality due to fishery-related impacts (unintentional or incidental catch, illegal harvest) is a threat that continues to need direct management and public education. The freshwater salmonid species continue to face threats from interbreeding with hatchery bred and released non-native salmonids. Invasive non-native freshwater fishes pose competition and predation threats to various SGCN species, especially those with limited native ranges (e.g., Pygmy Whitefish). Lack of data, such as on abundance, distribution, breeding habitats and/or viability status, is considered a threat for many SGCN species and will require significant investment to rectify.

**Conservation Success**

The status of Hood Canal Summer Chum Salmon ESU has improved considerably since ESA-listing in 1999. Threat reduction actions, such as eliminating excessive harvest, and supplementing natural production by short-term hatchery propagation, both of which began prior to ESA-listing, have led to large increases in abundance for the ESU’s two independent populations. Re-introductions of chum to rivers that historically had sub-populations have occurred and continue to be monitored. Improvements to spawning and rearing habitats also have been made. Overall viability conditions are at a relatively high level.

**Alphabetical list of Fish SGCN**

1. Bluntnose Sixgill Shark
2. Bocaccio (Puget Sound/Georgia Basin DPS)
3. Broadnose Sevengill shark
4. Brown rockfish
5. Bull Trout - Coastal Recovery Unit
6. Bull Trout - Mid-Columbia Recovery Unit
7. Burbot
8. Canary Rockfish (Puget Sound/Georgia Basin DPS)
9. China Rockfish
10. Columbia River Chum Salmon ESU
11. Copper Rockfish
12. Eulachon (southern DPS)
13. Green Sturgeon (southern DPS)
14. Greenstriped Rockfish
15. Hood Canal Summer Chum Salmon ESU
16. Inland Redband Trout (landlocked populations)
17. Lake Chub
18. Leopard Dace
19. Lower Columbia Chinook Salmon ESU
20. Lower Columbia Coho ESU
21. Lower Columbia Steelhead DPS
22. Margined Sculpin
23. Middle Columbia Steelhead DPS
24. Mountain Sucker
25. Olympic Mudminnow
26. Ozette Sockeye ESU
27. Pacific Cod (Salish Sea population)
28. Pacific Hake (Georgia Basin DPS)
29. Pacific Herring (Georgia Basin DPS)
30. Pacific Lamprey
31. Pacific Sand Lance
32. Puget Sound Chinook Salmon ESU
33. Puget Sound Steelhead DPS
34. Pygmy Whitefish
35. Quillback Rockfish
36. Redstripe Rockfish
37. River Lamprey
38. Salish Sucker
39. Snake River Spring/Summer Chinook Salmon ESU
40. Snake River Basin Steelhead DPS
41. Snake River Fall Chinook Salmon ESU
42. Surf Smelt

43. Tiger Rockfish
44. Tui Chub
45. Umatilla dace
46. Upper Columbia River Spring Chinook Salmon ESU
47. Upper Columbia Steelhead DPS
48. Walleye Pollock (South Puget Sound)
49. Westslope Cutthroat Trout
50. White Sturgeon (Columbia River)
51. Yelloweye Rockfish (Puget Sound/Georgia Basin DPS)

**Table 3-7 SGCN Fish: SUMMARY OF CONSERVATION STATUS**

Please see Appendix A for a complete discussion of key threats and conservation actions needed for these species.

Please see Section 3.4 at the end of this chapter for an explanation of the terms used in the headings.

| FISH SPECIES | Federal Status | State Status | PHS | Population size/trend | Climate Vulnerability | Summary of Conservation Concern |
|---|---|---|---|---|---|---|
| **MARINE FISH** | | | | | | |
| Bluntnose Sixgill Shark | None | None | No | Unknown/ unknown | Moderate | This is a large and long-lived species that uses Puget Sound as a nursery/pupping ground. Relatively little is known about their life history, population structure, or abundance trend. |
| Broadnose Sevengill Shark | None | None | No | Unknown/ unknown | Moderate | Abundance estimates are data deficient for the population known to occur in Washington waters. Willapa Bay may be critical habitat for breeding and seasonal feeding grounds. |
| Bocaccio – Puget Sound/Georgia Basin DPS | Endangered | Candidate | Yes | Critical/ unknown | Moderate-High | Bocaccio once supported a commercial set-net fishery in south Puget Sound but catches declined precipitously in the 1990s. Bocaccio are now rarely encountered, and abundance is considered at a critical level. |
| Brown Rockfish | Species of Concern | Candidate | Yes | Unknown/ unknown | Moderate-High | A complete population assessment for this species is limited due to their wide distribution in Puget Sound and nearshore coastal habitats. They have been encountered rarely during WDFW Remotely Operated Vehicle (ROV)-based surveys (approximately 25 individuals between 2004 and 2014). |
| Canary Rockfish – Puget Sound /Georgia Basin DPS | Threatened | Candidate | Yes | Low/ unknown | Moderate-High | The species has been declared overfished along the entire West Coast of North America and this DPS's Threatened status is due to severely reduced populations in Puget Sound and Georgia Basin. |
| China Rockfish | None | Candidate | Yes | Unknown/ unknown | Moderate-High | China Rockfish population status is unknown, early life history is especially poorly understood, and relatively few are landed in the coastal recreational fishery. |
| Copper Rockfish | None | Candidate | Yes | Critical/stable | Moderate-High | A complete assessment for this species is limited due to their wide distribution in Puget Sound and nearshore coastal habitats. In a 2008 San Juan Islands survey, they were most abundant rockfish species encountered, other than Puget Sound rockfish. Overall, populations have declined recently. |
| Greenstriped Rockfish | None | Candidate | Yes | Unknown/unknown | Moderate-High | Abundance and distribution of this species are poorly known. A status assessment of Greenstriped Rockfish in Puget Sound concluded that federal ESA listing was not warranted. |
| Quillback Rockfish | None | Candidate | Yes | Critical/stable | Moderate-High | This species is currently considered depleted in both North and South Puget Sound, though increased fishery regulations and reductions in harvest have produced an increasing abundance trend in some areas. |

| FISH SPECIES | Federal Status | State Status | PHS | Population size/trend | Climate Vulnerability | Summary of Conservation Concern |
|---|---|---|---|---|---|---|
| Redstripe Rockfish | None | Candidate | Yes | Unknown/ unknown | Moderate-High | Abundance and distribution of this species is poorly known. A 2010 status assessment of Redstripe Rockfish in Puget Sound concluded that federal ESA listing was not warranted. |
| Tiger Rockfish | None | Candidate | Yes | Unknown/ unknown | Moderate-High | Tiger Rockfish population size and structure in Washington waters are unknown, early life history is poorly understood, individuals of all life history stages are rare in WDFW ROV surveys, and none have been captured in WDFW trawl surveys. |
| Yelloweye Rockfish – Puget Sound/Georgia Basin DPS | Threatened | Candidate | Yes | Criticalunknown | Moderate-High | The species is declared overfished along the entire West Coast and has ESA Threatened status due to severely declining populations in Puget Sound and Georgia Basin. |
| Pacific Cod – Salish Sea Population | Species of Concern | Candidate | Yes | Unknown/ unknown | Moderate-High | Abundance and distribution patterns of Pacific Cod in Washington waters are incompletely known. Historic over-harvest has led to dramatic declines in encounter rate and the curtailment of both commercial and recreational fisheries. |
| Pacific Hake – Georgia Basin DPS | Species of Concern | Candidate | Yes | Unknown/ stable | Low-Moderate | Pacific Hake populations in Puget Sound have not been assessed in over a decade, but prior to this time a marked decline was observed, resulting in cessation of commercial fisheries. |
| Pacific Herring – Georgia Basin DPS | Not Warranted | Monitor | Yes | Critical/stable | Moderate | A 2006 status assessment determined that ESA listing was not warranted. However, the Cherry Point stock is at critically low abundance, the Squaxin Pass stock is stable, and abundance of all other stocks has fluctuated substantially since the 1970s but exhibits a slight downward trend. |
| Pacific Sand Lance | None | None | Yes | Unknown/ unknown | Moderate-High | Pacific Sand Lance abundance and distribution in Washington are almost completely unknown. The species is ubiquitous in beach seining surveys but difficult to capture with most traditional sampling methods. |
| Surf Smelt | None | None | Yes | Unknown/ unknown | Moderate-High | Surf smelt abundance and distribution in Washington are almost completely unknown. The species is ubiquitous in beach seining surveys but has not been sampled comprehensively due to lack of funding and personnel. |
| Walleye Pollock – South Puget Sound | None | Candidate | Yes | Low unknown | Moderate | Walleye Pollock abundance and distribution in South Puget Sound are incompletely known. Declines in encounter rate have led to increased fishery regulation and decreased harvest in recent years, especially in southern Puget Sound. |
| **ANADROMOUS FISH – NON-SALMONIDS** | | | | | | |
| Eulachon – Southern DPS | Threatened | Candidate | Yes | Highly variable/ highly variable | Moderate-High | A complete population assessment for this species is unavailable but precipitous declines in spawner abundance in the Fraser and Columbia Rivers led to the Southern DPS being ESA-listed in 2010. |

| FISH SPECIES | Federal Status | State Status | PHS | Population size/trend | Climate Vulnerability | Summary of Conservation Concern |
|---|---|---|---|---|---|---|
| Pacific Lamprey | Species of Concern | Monitor | Yes | Unknown/ unknown | Moderate-High | The declining status of Pacific Lamprey led to a west coast-wide joint tribal/federal/state "Pacific Lamprey Conservation Initiative". Limiting factors include passage obstruction and mortality at mainstem dams and tributary water diversion dams and intakes, and low abundance in upper Columbia. |
| River Lamprey | Species of Concern | Candidate | Yes | Unknown/ unknown | Moderate-High | Abundance and distribution information is inadequate for status assessment. Breeding and rearing freshwater habitats are likely at risk throughout much of distribution from land-use degradation; dams and other passage barriers (e.g., culverts) impede or prevent migration. |
| Green Sturgeon – Southern DPS | Threatened | None | Yes | Medium/ declining | Moderate | Southern DPS Green Sturgeon has one spawning population with multiple habitat-related threats, and juvenile production may be declining. Harvest-related risks and estuarine degradation are threats in Washington. |
| White Sturgeon – Columbia River | None | None | Yes | Low to abundant/ declining to stable | Moderate | Although stable and numerous in lower Columbia River, they are increasingly rare upstream. Dams impede and prevent passage and have negatively impacted spawning habitat. |
| **SALMONIDS** | | | | | | |
| Lower Columbia River Chinook Salmon ESU | Threatened | Candidate | Yes | Low/stable | Moderate-High | Overall, this ESU is at substantial risk because of very low natural-origin spawner abundance, high hatchery fraction, habitat degradation, and harvest impacts. |
| Puget Sound Chinook Salmon ESU | Threatened | Candidate | Yes | Low/stable | Moderate-High | All populations in ESU are well below recovery plan target ranges for spawner levels. Risk factors are still present, including high fractions of hatchery fish and widespread habitat loss and degradation. |
| Upper Columbia River Spring Chinook ESU | Endangered | Candidate | Yes | Low/stable | Moderate-High | Although there have been increases in natural-origin spawner abundance, average productivity levels remain extremely low. Risks due to relatively high percent of hatchery-origin fish on spawning grounds, habitat degradation, and dam impacts are major concerns. |
| Snake River Fall Chinook Salmon ESU | Threatened | Candidate | Yes | Medium/ increasing | Moderate-High | This ESU includes one extant population. Abundance has improved substantially since ESA-listing, however hatchery-origin spawner proportions are high and dams continue to compromise habitat. |
| Snake River Spring/Summer Chinook Salmon ESU | Threatened | Candidate | Yes | Low/ increasing | Moderate-High | The entire ESU is rated at high extinction risk. Besides low abundance, risks due to percent of hatchery-origin fish on spawning grounds, habitat degradation, and dam impacts are major concerns. |
| Columbia River Chum Salmon ESU | Threatened | Candidate | Yes | Low/declining | Moderate | After near extirpation, abundance of this ESU remains very low, and extinction risk was rated very high. |

| FISH SPECIES | Federal Status | State Status | PHS | Population size/trend | Climate Vulnerability | Summary of Conservation Concern |
|---|---|---|---|---|---|---|
| Hood Canal Summer Chum Salmon ESU | Threatened | Candidate | Yes | Medium/ increasing | Moderate-High | Abundance has improved significantly since time of ESA-listing, but viability conditions have not been met completely. Evaluation of efficacy of habitat improvements and reintroductions is needed. |
| Lower Columbia Coho ESU | Threatened | None | Yes | Low/ unknown | Moderate-High | Washington coho populations in this ESU are dominated by hatchery-origin spawners, are not demonstrably self-sustaining, and considered at very high extinction risk. |
| Ozette Sockeye ESU | Threatened | Candidate | Yes | Low/stable | Moderate | Ozette Sockeye are at very low abundance compared to historic condition, and quantity and quality of adequate lake beach spawning habitat may be declining. |
| Lower Columbia Steelhead DPS | Threatened | Candidate | Yes | Low/stable | Moderate-High | Most populations are rated at high or very high extinction risk, and dams block several large areas of historic range. Habitat degradation and hatchery-related impacts are other limiting factors. |
| Middle Columbia Steelhead DPS | Threatened | Candidate | Yes | Intermediate/ stable | Moderate | Many populations are rated at high extinction risk. Dams impede passage and reduce or modify access to large areas of historic range, and other habitat degradation limits distribution and productivity. |
| Puget Sound Steelhead DPS | Threatened | None | Yes | Low/declining | Moderate-High | In 2011, most populations showed declining growth rates and extinction risks were relatively high overall, especially for central/south Puget Sound populations. Habitat degradation and poor early marine survival may be impeding productivity. |
| Snake River Basin Steelhead DPS | Threatened | Candidate | Yes | Low/stable | Moderate-High | Extant populations are at moderate to high extinction risk. Dams impede passage, reduce access to large areas of historic range, and limit productivity. Proportions of hatchery-origin spawners are a concern. |
| Upper Columbia Steelhead DPS | Threatened | Candidate | Yes | Low/ increasing | Moderate-High | Extant populations are rated at high extinction risk. Dams impede passage and reduce access to large areas of historic range, and limit productivity. Proportions of hatchery-origin spawners are a concern. |
| Bull Trout – Coastal Recovery Unit | Threatened | Candidate | Yes | Unknown/ unknown | Moderate-High | Many of the Washington core area populations have unknown status. Bull trout face threats from habitat degradation and fragmentation, poor water quality, and introduced non-native fish species. |
| Bull Trout – Mid-Columbia Recovery Unit | Threatened | Candidate | Yes | Unknown/ unknown | Moderate | Many of the Washington core area populations have unknown status. Bull trout face threats from habitat degradation and fragmentation, poor water quality, and introduced non-native fishes. |
| Inland Redband Trout | None | None | Yes | Unknown/ unknown | Moderate-High | Species is widespread, but some populations are at risk from non-native hatchery trout competition and interbreeding. Water quality issues threaten most locations, and barriers fragment populations. |

| FISH SPECIES | Federal Status | State Status | PHS | Population size/trend | Climate Vulnerability | Summary of Conservation Concern |
|---|---|---|---|---|---|---|
| Westslope Cutthroat Trout | Species of Concern | None | Yes | Medium/ stable | Low-Moderate | Westslope Cutthroat Trout is stable and abundant in its range, but faces threats to its habitat and threats from genetic introgression. |
| **FRESHWATER FISH** | | | | | | |
| Burbot | None | None | No | Unknown/ unknown | Moderate | Burbot are restricted to only 11 deep, cold-water lakes in Washington. Little is known about abundance, age structure, or productivity of any of the populations. |
| Lake Chub | None | Candidate | Yes | Unknown/ unknown | Moderate | The status of this species is unknown and its major threat is habitat alteration. |
| Tui Chub | None | None | No | Unknown/ unknown | Low-Moderate | This species is confined to a small part of the Columbia Basin and its biggest threat is predation by non-native predators. |
| Leopard Dace | None | Candidate | Yes | Unknown/ unknown | Moderate-High | The status of this species is unknown and it faces threats to its habitat. |
| Umatilla Dace | None | Candidate | Yes | Unknown/ unknown | Moderate | This species' status is unknown and it faces threats from human development and habitat alterations. |
| Olympic Mudminnow | None | Sensitive | Yes | Unknown/ unknown | Moderate | Populations of this endemic species are confined to a very small lowland portion of western Washington and its biggest threat is loss of habitat. |
| Margined Sculpin | Species of Concern | Sensitive | Yes | Medium/ unknown | Moderate | This species is confined to three rivers in southeastern Washington and faces threats to its habitat. |
| Mountain Sucker | None | Candidate | Yes | Unknown/ unknown | Low-Moderate | The status of this species is unknown and it faces threats to its habitat. |
| Salish Sucker | None | Monitor | No | Unknown/ unknown | Moderate-High | This species is only found in western Washington and faces threats from loss of habitat and degradation to water quality. |
| Pygmy Whitefish | Species of Concern | Sensitive | Yes | Unknown/ unknown | Low-Moderate | Pygmy Whitefish status in Washington is unknown and it faces threats to habitat and water quality. |

### 3.2.5 INVERTEBRATES

**Overview**

The Species of Greatest Conservation Need (SGCN) list for Washington includes 95 invertebrate taxa; a diverse group that includes butterflies, moths, beetles, bumblebees, stoneflies, dragonflies, caddisflies, terrestrial and freshwater snails and mussels, an earthworm, and a millipede. The increased number of SGCN invertebrates since 2005, reflects the increased information available for some invertebrate groups, such as terrestrial snails and slugs, and new threats and population declines in others, such as bumblebees. Worldwide, invertebrate species represent about 99 percent of animal diversity. Invertebrates play critical roles in nutrient cycling, soil formation, pollination, seed dispersal, water filtration, and as food for birds, fish, amphibians and reptiles, and bats and other mammals. Some species, such as bees and freshwater mussels and bivalves, are good indicators of environmental quality, the 'canary in the coal mine' that we ignore at our peril. Given their tremendous diversity, ecological importance, restricted species distributions, and vulnerability to pollution and habitat loss, the conservation of invertebrates has been historically underemphasized, and relatively few have received any conservation attention or regulatory protection. Although terrestrial vertebrate extinctions are well documented, invertebrate extinctions often go unnoticed by the general public, by most biologists, and by many conservation agencies.

Some species groups have been severely affected by human activities. For example, North America has a greater diversity of freshwater bivalves than any other region in the world, and an extraordinary number of species are imperiled or extinct as a result of dams, strip-mining, and pollution. In the United States alone, 37 species of freshwater mussels are presumed extinct. Though Washington has few freshwater bivalve species, it hosts a high diversity of slugs and terrestrial snails, as well as insects associated with mountain streams. In addition to the taxa recognized in this list, there are groups, such as native earthworms, that likely contain additional taxa at risk that may need be added to the SGCN list in the future, but information is generally insufficient to evaluate at this time.

**Distribution**

Many of the SGCN invertebrates have very limited distributions. Some species have very special ecological requirements, such as stonefly species only found in alpine springs and seeps, and some snails are associated with lowland forest with old Big-leaf Maples and hardwood debris. Other species may have become differentiated from related taxa in place and never spread very far, while many others were formerly widespread, but only survive in discrete sites where the environment has been less affected by climate and habitat changes since the last glaciation, or land cover changes associated with human activities. For example, species with limited distributions include several snails only known from eastern Chelan County, others only from the Snake River Canyon, and others only from the Columbia Gorge – relative 'hotspots' of endemic snails; some butterflies have declined with their associated prairie habitat, and some freshwater bivalves were eliminated from much of the Columbia and Snake Rivers by dams.

**Populations and Trends**

Almost without exception, there are few data on historical populations of SGCN invertebrates. Population trends are assumed based on loss or degradation of their habitat, and the absence of the species at historical sites. Many of these species have been selected either because their habitat has been reduced dramatically (e.g. west-side prairie, undammed rivers), or because their populations are only found at a few sites that are very vulnerable to land use activities. Some formerly very abundant species are still relatively widespread, but have declined dramatically. For example, freshwater mussels are still abundant in scattered locations, but some of the populations have been unable to reproduce for over 20 years, and will go extinct without substantial improvement in water quality.

**Threats and Conservation Actions Needed**

The major threats to SGCN invertebrates include habitat loss and degradation through siltation and pollution of surface waters, development, unsustainable agricultural and logging practices, wildfires, mining of talus, unsustainable grazing of riparian sites, pesticides, introduced species (diseases, exotic snails, invasive plants), and drying of seeps, springs, and streams with water withdrawals or climate change. Basic information needs are much more often a priority conservation action for invertebrates than for better known vertebrates. Many of these species need additional inventory surveys to more clearly delineate their distribution, or for the rarer taxa, to identify key sites in need of protection. Some of these taxa, though recognized as a unique form, have not yet been formally described and named, and some groups need to be studied to clarify relationships and the number of species present in Washington. Dramatic technological advances in recent years in genetic analysis provide the tools to investigate these questions. The life history of some species, for example some stoneflies, is largely unknown. Some of these investigations are more likely to be done by taxa experts at universities than by WDFW. Addressing these taxonomic, distribution, and life history information needs, will help in the development of management recommendations needed for conservation of these invertebrates. See Table 3.2-8 for more information on species status and conservation concerns.

While the conservation of so many invertebrate species may seem like a daunting task, the good news is that the conservation of many of these species can be addressed by identifying and protecting the small number of sites where they are found. Protection may require landowner incentive programs, conservation easements, acquisition of water rights, or a management plan for sites on public lands.

1. Caddisflies (six taxa included)
7. Mayflies (four taxa included)
11. Noctuid Moths (three taxa included)
14. Ashy Pebblesnail
15. Barren Juga
16. Beller's Ground Beetle
17. Bluegray Taildropper
18. Brown Juga
19. California Floater
20. Cascades Needlefly
21. Chelan Mountainsnail
22. Chinquapin Hairstreak
23. Columbia Clubtail
24. Columbia Oregonian
25. Columbia River Tiger Beetle
26. Crowned Tightcoil
27. Dalles Hesperian
28. Dalles Juga
29. Dalles Sideband
30. Dry Land Forestsnail
31. Giant Palouse Earthworm
32. Great Arctic
33. Hatch's Click Beetle
34. Hoary Elfin
35. Hoder's Mountainsnail
36. Hoko Vertigo
37. Idaho Vertigo
38. Island Marble
39. Johnson's Hairstreak
40. Juniper Hairstreak
41. Leschi's Millipede
42. Limestone Point Mountainsnail
43. Mad River Mountainsnail
44. Makah Copper
45. Mann's Nollusk-eating Ground Beetle
46. Mardon Skipper
47. Masked Duskysnail
48. Meadow Fritillary
49. Mission Creek Oregonian
50. Monarch
51. Morrison's Bumblebee
52. Nimapuna tigersnail
53. Northern (pinto) abalone
54. Northern Forestfly
55. Olympia oyster
56. Olympia Pebblesnail
57. One-band Juga
58. Oregon Branded Skipper
59. Oregon Megomphid
60. Oregon Silverspot
61. Pacific Clubtail
62. Pacific Needlefly
63. Pacific Vertigo
64. Poplar Oregonian
65. Propertius' Duskywing
66. Puget Blue
67. Puget Oegonian
68. Puget Sound Fritillary
69. Rainier Roachfly
70. Ranne's Mountainsnail
71. Salmon River Pebblesnail
72. Sand-verbena Moth
73. Sasquatch Snowfly
74. Shortface Lanx
75. Silver-bordered Fritillary
76. Siuslaw Sand Tiger Beetle
77. Sonora Skipper
78. Spotted Taildropper
79. Straits Acmon Blue
80. Subarctic Bluet
81. Suckley Cuckoo Bumblebee
82. Talol Springfly
83. Taylor's Checkerspot
84. Three-band Juga
85. Valley Silverspot
86. Washington Duskysnail
87. Wenatchee Forestfly
88. Western Bumblebee
89. Western Pearlshell
90. Western Ridged Mussel
91. White-belted Ringtail
92. Winged Floater
93. Yosemite Springfly
95. Yuma Skipper

**Table 3-7 SGCN Invertebrates: SUMMARY OF CONSERVATION STATUS**

Please see Appendix A for a complete discussion of key threats and conservation actions needed for these species.

Please see Section 3.4 at the end of this chapter for an explanation of the terms used in the headings.

| INVERTEBRATE SPECIES | Federal Status | State Status | PHS | Population size/trend | Climate Vulnerability | Summary of Conservation Concern |
|---|---|---|---|---|---|---|
| **MILLIPEDE** | | | | | | |
| Leschi's Millipede | None | Candidate | Yes | Unknown/unknown | N/A | Very little is known of this cryptic species, which was discovered and identified in 2004. It has only been detected within a small area in Thurston County. |
| **MAYFLIES** | | | | | | |
| *Cinygmula gartrelli* | None | None | No | Low/unknown | Low-Moderate | These mayfly species are generally rare and have very restricted distributions. Mayflies are very sensitive to pollution, and as such are usually only found at high quality, minimally polluted sites. Mayflies are a commonly used index of water quality and aquatic ecosystem health. |
| *Paraleptophlebia falcula* | None | None | No | Low/unknown | Low-Moderate | |
| *Paraleptophlebia jenseni* | None | None | No | Low/unknown | Low-Moderate | |
| *Siphlonurus autumnalis* | None | None | No | Low/unknown | Low-Moderate | |
| **DRAGONFLIES AND DAMSELFLIES** | | | | | | |
| Subarctic Bluet | None | None | No | Low/unknown | Moderate-High | The Subarctic Bluet is a species of damselfly that is restricted to boreal fens and bogs in the northeastern corner of the state. Only two populations of Subarctic Bluet have been located in Washington. |
| **Family Gomphidae – CLUBTAIL DRAGONFLIES** | | | | | | |
| Columbia Clubtail | None | Candidate | Yes | Low/unknown | Moderate-High | These three dragonflies in the Gomphidae family are SGCN in Washington due to the small number of isolated populations and continued threats to aquatic habitats. |
| Pacific Clubtail | None | Candidate | Yes | Critical/declining | Moderate-High | |
| White-belted Ringtail | None | None | No | Low/unknown | Moderate-High | |
| **STONEFLIES** | | | | | | |
| Sasquatch Snowfly | None | None | No | Low/unknown | Moderate | Stoneflies generally require cold, clear, running water and are especially sensitive to human disturbance; they are excellent indicators of water quality. An estimated 43% of North American stoneflies are vulnerable to extinction, imperiled, or extinct. Adults are weak fliers, and there is a high level of endemism; four of these species have only been found in Washington. Some of these species are restricted to glacier-fed streams, and likely to be at-risk due to climate change. |
| Northern Forestfly | Candidate | None | No | Low/unknown | High | |
| Wenatchee Forestfly | None | None | No | Low/unknown | Moderate-High | |
| Pacific Needlefly | None | None | No | Low/unknown | Moderate-High | |
| Cascades Needlefly | None | None | No | Low/unknown | Moderate-High | |
| Yosemite Springfly | None | None | No | Low/unknown | High | |
| Talol Springfly | None | None | No | Low/unknown | Moderate | |
| Rainier Roachfly | None | None | No | Low/unknown | Moderate-High | |
| **BEETLES** | | | | | | |
| Hatch's Click Beetle | None | Candidate | Yes | Low/declining | Moderate-High | Hatch's Click Beetle is a species of conservation concern due to its small number of isolated populations, highly limited distribution and range, and use of specialized, highly restricted, and threatened Sphagnum moss bog habitat. |
| **Family Carabidae – GROUND AND TIGER BEETLES** | | | | | | |

| INVERTEBRATE SPECIES | Federal Status | State Status | PHS | Population size/trend | Climate Vulnerability | Summary of Conservation Concern |
|---|---|---|---|---|---|---|
| Mann's Mollusk-eating Ground Beetle | None | Candidate | Yes | Low/unknown | Moderate-High | These four beetle species are Species of Greatest Conservation Need due to the small number of isolated populations, highly limited distribution and range, and dependence on specialized, restricted and threatened habitats. |
| Beller's Ground Beetle | None | Candidate | Yes | Low/unknown | Moderate-High | |
| Columbia River Tiger Beetle | None | Candidate | Yes | Possibly Extirpated | Moderate | |
| Siuslaw Sand Tiger Beetle | None | Monitor | No | Critical/unknown | Moderate-High | |
| **CADDISFLIES** | | | | | | |
| *Allomyia acanthis* | None | None | No | Low/unknown | High | Caddisflies are aquatic insects. They are very sensitive to water quality and changes in water flow. Certain species have been used as biotic indicators of pollution. |
| *Goereilla baumanni* | None | None | No | Low/unknown | High | |
| *Limnephilus flavastellus* | None | None | No | Low/unknown | Moderate-High | |
| *Psychoglypha browni* | None | None | No | Low/unknown | Moderate-High | |
| *Rhyacophila pichaca* | None | None | No | Low/unknown | Moderate | |
| *Rhyacophila vetina* | None | None | No | Low/unknown | High | |
| **MOTHS** | | | | | | |
| **Genus Copablepharon** | | | | | | |
| Sand Verbena Moth | In review | Candidate | No | Low/unknown | Moderate-High | These four Copablepharon moths (Family Noctuidae) are imperiled due to rare habitat types, small number of isolated populations, extremely limited range, and known threats to their habitats. Sand Verbena Moth was petitioned for listing under the Endangered Species Act and received a positive 90-day finding indicating that "the petition presents substantial information indicating that listing the sand verbena moth may be warranted". |
| *Copablepharon columbia* | None | None | No | Critical/declining | Moderate | |
| *Copablepharon mutans* | None | None | No | Critical/declining | Moderate | |
| *Copablepharon viridisparsa hopfingeri* | None | None | | Critical/declining | Moderate | |
| **BUTTERFLIES** | | | | | | |
| Great Arctic | None | Candidate | Yes | Critical/unknown | Low-Moderate | A Pacific Northwest endemic, this butterfly has been found on a single site within the United States, in northwestern Washington; it also occurs in southwestern British Columbia, and may occur on other sites with similar habitat. It is a species of conservation concern due to its restricted range and many threats to its grassland-forest edge habitat. |
| Island Marble | In review | Candidate | Yes | Critical/declining | Moderate-High | The Island Marble is a rare butterfly, restricted to two San Juan Islands. The species was petitioned for listing under the Endangered Species Act and received a positive 90-day finding indicating that "the U.S. Fish and Wildlife Service found "listing the island marble butterfly as an endangered species may be warranted". |

| INVERTEBRATE SPECIES | Federal Status | State Status | PHS | Population size/trend | Climate Vulnerability | Summary of Conservation Concern |
|---|---|---|---|---|---|---|
| Monarch Butterfly | In review | None | No | Low/declining | Moderate | The Monarch butterfly faces significant threats in both summer and winter habitats, and action is needed to restore populations. Western Monarchs, including those breeding within Washington have declined by more than 50% since 1997. |
| Taylor's Checkerspot | Endangered | Endangered | Yes | Critical/stable | Moderate-High | This subspecies is currently restricted to a small scattering of 8 populations in Washington, a single population in British Columbia, and 2 populations in Oregon. The decline of Taylor's Checkerspot has accompanied the loss of open, prairie and grassland habitats. Taylor's Checkerspot was listed by the Washington Fish and Wildlife Commission as endangered in 2006, and listed as federally endangered by the U.S. Fish and Wildlife Service in 2013. |
| **Family Lycaenidae – GOSSAMER WING BUTTERFLIES** | | | | | | |
| Makah Copper | None | Candidate | Yes | Low/declining | Moderate-High | Seven Lycaenid butterflies were recognized as Species of Greatest Conservation Need due to their rare and restricted host plants and habitat types, small number of isolated populations, highly limited range and distribution, and threats to their habitat. |
| Golden Hairstreak | None | Candidate | Yes | Critical/declining | N/A | |
| Johnson's Hairstreak | None | Candidate | Yes | Low/unknown | Moderate-High | |
| Juniper Hairstreak | None | Candidate | Yes | Low/unknown | Moderate | |
| Hoary Elfin | None | Monitor | No | Critical/declining | Low-Moderate | |
| Puget (Blackmore's) Blue | None | Candidate | Yes | Low/declining | N/A | |
| Straits Acmon Blue | None | None | No | Critical/declining | Moderate-High | |
| **Subfamily Heliconiinae – FRITILLARY BUTTERFLIES** | | | | | | |
| Puget Sound Fritillary | None | None | No | Low/declining | Low-Moderate | These species were recognized as Species of Conservation Need in Washington due to their rare and restricted host plants and habitat types, small number of isolated populations, limited range and distribution, and known threats to their habitats. |
| Valley Silverspot | None | Candidate | Yes | Critical/declining | Low-Moderate | |
| Oregon Silverspot | Threatened | Endangered | Yes | Extirpated | Moderate | |
| Meadow Fritillary | None | None | No | Low/declining | Low-Moderate | |
| Silver-bordered Fritillary | None | Candidate | Yes | Low/declining | Moderate-High | |
| **Family Hesperiidae – SKIPPER BUTTERFLIES** | | | | | | |
| Propertius Duskywing | None | None | No | Low/declining | Moderate | These five butterflies in the Skipper Family were recognized as Species of Greatest Conservation Need throughout their ranges due to the small number of isolated populations, specialized and restricted habitat, and known threats to their habitat. |
| Oregon Branded Skipper | None | None | No | Critical/declining | Moderate | |
| Mardon Skipper | None | Endangered | Yes | Low/declining | Moderate-High | |
| Sonora Skipper | None | None | No | Critical/declining | Low-Moderate | |
| Yuma Skipper | None | Candidate | Yes | Critical/declining | Moderate | |
| **BUMBLE BEES** | | | | | | |
| **Genus Bombus – BUMBLE BEES** | | | | | | |
| Western Bumble Bee | None | None | No | Low/declining | Moderate-High | Bumble bees have recently become the focus of conservation concern and efforts due to their precipitous population |
| Morrison's Bumble Bee | None | None | No | Critical/unknown | Moderate | |

| INVERTEBRATE SPECIES | Federal Status | State Status | PHS | Population size/trend | Climate Vulnerability | Summary of Conservation Concern |
|---|---|---|---|---|---|---|
| Suckley Cuckoo Bumble Bee | None | None | No | Critical/declining | Moderate | declines and prodigious capabilities as pollinators. In a recent status assessment, IUCN (International Union of Conservation of Nature) identified three Washington species as facing high or extremely high risk of extinction: Western Bumble Bee and Morrison's Bumble Bee were ranked Vulnerable, and Suckley Cuckoo Bumble Bee was ranked Critically Endangered. |
| **MOLLUSKS** | | | | | | |
| **Family Oreohelicidae -- MOUNTAINSNAILS** | | | | | | |
| Chelan Mountainsnail | In review | None | No | Critical/declining | Low-Moderate | Many Mountainsnail species and subspecies have specialized habitat requirements and very restricted ranges, low ability to disperse, and are vulnerable to disturbances such as logging, fire, intensive grazing, or introduced predators. Most mountainsnail species and subspecies (approximately 91 percent) are considered imperiled or critically imperiled by NatureServe. |
| Hoder's Mountainsnail | None | None | No | Critical/declining | Low-Moderate | |
| Mad River Mountainsnail | None | None | No | Critical/declining | Low-Moderate | |
| Ranne's Mountainsnail | None | None | No | Critical/declining | Low | |
| Limestone Point Mountainsnail | None | None | No | Critical/declining | Low-Moderate | |
| **Family Polygyridae – FORESTSNAILS, DUSKYSNAILS, OREGONIANS, AND HESPERIANS** | | | | | | |
| Dry Land Forestsnail | None | None | No | Low/unknown | Low-Moderate | These snails are of conservation concern because they have specialized habitat requirements, such as moist mature forest with a hardwood component, or moist sites in otherwise dry environments. Snails do not readily disperse and populations are isolated. They are vulnerable to alteration of these sites, including from logging, development, use of talus for road-building, and unsustainable livestock grazing at springs. |
| Washington Duskysnail | None | None | No | Low/declining | Low-Moderate | |
| Columbia Oregonian | In review | Candidate | Yes | Critical/declining | Moderate-High | |
| Puget Oregonian | In review | None | No | Low/declining | Low-Moderate | |
| Poplar Oregonian | None | Candidate | Yes | Low/declining | Low | |
| Mission Creek Oregonian | None | None | No | Low/unknown | N/A | |
| *Cryptomastix mullani* hemphilli | None | None | No | Low/unknown | | |
| Dalles Hesperian | None | None | No | Low/unknown | Moderate-High | |
| **Family Vertiginidae** | | | | | | |
| Hoko Vertigo | In review | None | No | Critical/unknown | Low-Moderate | These three very rare Vertigo species are small snails are found in small isolated populations, perhaps remnants of a previously much wider range. These small populations, associated with old growth and/or riparian hardwoods are very vulnerable to logging, road building, fires, and other disturbances. |
| Pacific Vertigo | None | None | No | Critical/extirpated? | Low-Moderate | |
| Idaho Vertigo | None | None | No | Critical/unknown | Low-Moderate | |
| **OTHER TERRESTRIAL SNAILS** | | | | | | |
| Oregon Megomphix | None | None | No | Low/unknown | Low-Moderate | These terrestrial snails are very rare and have distributions that include small isolated populations, perhaps remnants of previously much wider ranges. These small isolated populations, often associated with old growth and/or riparian hardwoods, are very vulnerable to logging, road building, fires, and other disturbances. |
| Dalles Sideband | In review | Candidate | Yes | Low/unknown | Low-Moderate | |
| Crowned Tightcoil | None | None | No | Low/unknown | Low-Moderate | |
| Nimapuna Tigersnail | None | None | No | Critical/unknown | N/A | |

| INVERTEBRATE SPECIES | Federal Status | State Status | PHS | Population size/trend | Climate Vulnerability | Summary of Conservation Concern |
|---|---|---|---|---|---|---|
| **Families – Lymnaeidae and Hydrobiidae** | | | | | | |
| Shortface Lanx *or* Giant Columbia River Limpet | None | Candidate | Yes | Uncommon/declining | Moderate | These species require clear, cold, well-oxygenated waters, and are threatened by pollution and siltation. North America once had approximately 700 species of native freshwater snails from 16 families. Currently, 67 species (10 percent) are considered likely extinct, 278 (40 percent) endangered, 102 (15 percent), threatened, 73 (10 percent) vulnerable, and 26 (4 percent) have uncertain taxonomic status. |
| Masked Duskysnail | None | None | No | Critical/declining | Low-Moderate | |
| Olympia Pebblesnail | None | None | No | Low/unknown | Low-Moderate | |
| Salmon River Pebblesnail | None | None | No | Low/unknown | N/A | |
| Ashy Pebblesnail | None | Candidate | Yes | Uncommon/declining | Moderate | |
| **Family Pleuroceridae (Genus *Juga*) – FRESHWATER AQUATIC SNAILS** | | | | | | |
| Barren Juga | None | None | No | Low/unknown | Moderate-High | These species require cold, clear, well-oxygenated water; they are sensitive to pollution, and intolerant of warm waters, low dissolved oxygen, or major seasonal fluctuations. Destruction of springs by historical unsustainable grazing and logging practices, and diversions (e.g. for water supply, fish hatcheries) has already caused extensive extinction of species throughout western North America. |
| Dalles Juga | None | None | No | Low/unknown | Moderate-High | |
| Brown Juga | None | None | No | Low/unknown | Moderate-High | |
| Three-band Juga | None | None | No | Low/unknown | Moderate-High | |
| One-band Juga | None | None | No | Low/unknown | Moderate-High | |
| **SLUGS** | | | | | | |
| **TAILDROPPER SLUGS** | | | | | | |
| Bluegray Taildropper | None | Candidate | Yes | Low/declining | Low-Moderate | These endemic taildropper slugs are of concern due to their rarity. The Spotted Taildropper is only found in part of one county, and the rarity of both species suggest they have specific habitat needs that may make them sensitive to land use activities, such as logging and loss of coarse woody debris. |
| Spotted Taildropper | None | None | No | Critical/unknown | Low-Moderate | |
| **FRESHWATER BIVALVES** | | | | | | |
| **Families Unionidae and Margaritiferidae: FRESHWATER MUSSELS** | | | | | | |
| California Floater | None | Candidate | Yes | Low/declining | Moderate | Freshwater mussels have been greatly affected by dams and annual water drawdowns, as well as degraded water quality resulting from development and unsustainable agriculture. Many historical sites no longer support mussels, and many local populations no longer successfully reproduce. |
| Winged Floater | None | None | No | Low/declining | Moderate | |
| Western Ridged Mussel | None | None | No | Uncommon/declining | Moderate | |
| Western Pearlshell | None | None | No | Uncommon/declining | Moderate | |
| **MARINE BIVALVE** | | | | | | |
| Olympia Oyster | None | Candidate | Yes | Low/stable | High | Washington's only native oyster, it is currently present in diminished abundance (less than 5 percent) due to overharvest and habitat alterations throughout most of the species historical range (ca 1850) in Washington. Evidence of natural recruitment and restoration success observed but lack of suitable habitat limits further increases. |
| **MARINE GASTROPOD** | | | | | | |

| INVERTEBRATE SPECIES | Federal Status | State Status | PHS | Population size/trend | Climate Vulnerability | Summary of Conservation Concern |
|---|---|---|---|---|---|---|
| Pinto Abalone | Species of Concern | Candidate | Yes | Uncommon/declining | N/A | The Pinto Abalone has failed to recover from dramatic declines resulting from excessive recreational and illegal harvest, despite fishery closure. There is strong evidence of recruitment failure, perhaps because the densities of remaining populations are below the threshold for successful reproduction. |
| **EARTHWORM** | | | | | | |
| Giant Palouse Earthworm | None | Candidate | Yes | Unknown/unknown | Low-Moderate | Data on this species are sparse. It is difficult to detect and few surveys have been performed to determine its distribution and abundance. There has been an obvious reduction of range in the Palouse region of Washington with conversion of prairie to cropland. Introduced worm species appear to exclude native species, including this one. |

## 3.3 Summary of Threats and Conservation Actions

### 3.3.1 Methodology

Stressors and conservation actions for each SGCN species were categorized in "TRACS" (Tracking and Reporting Actions for the Conservation of Species) terminology, which comes from the tracking and reporting system for conservation and related actions funded by the US Fish and Wildlife Services (USFWS), and the Wildlife and Sport Fish Restoration (WSFR) Program. We used this tracking and reporting system for categorizing stressors and conservation actions for the following reasons:

- The State Wildlife Action Best Practices guide encourages the use of standardized descriptions of threats and actions.
- The Wildlife TRACS system will be used for application for and reporting on State Wildlife Grants (SWG). Understanding stressors and needed actions for SGCN in terms of this language will help in identifying projects appropriate for funding through the SWG program.
- The Wildlife TRACS system potentially enables cross referencing of Washington's data on key stressors with other states or other organizations also using this system.
- Standardized descriptions facilitate "roll up" of data to determine trends or patterns for additional investigation.

For each threat or stressor, a conservation action was identified and several qualifiers added to the action, including adequacy of investment and lead. The adequacy of investment in the conservation action was based on whether it was sufficient (action is currently underway and we should stay the course), or insufficient (some action underway, but more needed), or whether a new action was needed (meaning no action was underway and new action needed to be initiated). The lead entity qualifier concerned whether WDFW or another partner was the appropriate lead for an action, or whether there was a co-lead role.

### 3.3.2 Discussion

Looking at these data collectively is a way to surface possible trends and opportunities to increase the effectiveness of our investments. For example, habitat loss and degradation as well as a lack of baseline and monitoring data were most frequently cited as the primary stressors or needs for SGCN species. Further evaluation could include assessing the adequacy of the resources dedicated towards these needs, and explore other opportunities to address these needs. For fishes, dams/barriers and overharvesting are the most frequently cited stressors, and climate change appears as a prominent threat for both fish and invertebrates as compared with the other taxa. Further evaluation of the focus of our conservation investments relative to needs may help identify ways to increase effectiveness.

The biologists preparing this information were asked if the lead for a given action was primarily WDFW, primarily an external partner, or shared by both. It is interesting to note that the vast majority ranked both WDFW and conservation partners as shared lead, emphasizing the importance of investing in partnerships in achieving our conservation outcomes. Finally, biologists were also asked to assess the adequacy of our collective (WDFW or partners) investment for each threat and corresponding action. In many instances, the adequacy was determined to be insufficient, meaning the need to secure resources and funding continues to be one of the most important overarching actions we can take.

Please see the figures below for a graphical representation of some of these data.

Figure 3-2: SGCN Threats, by taxa

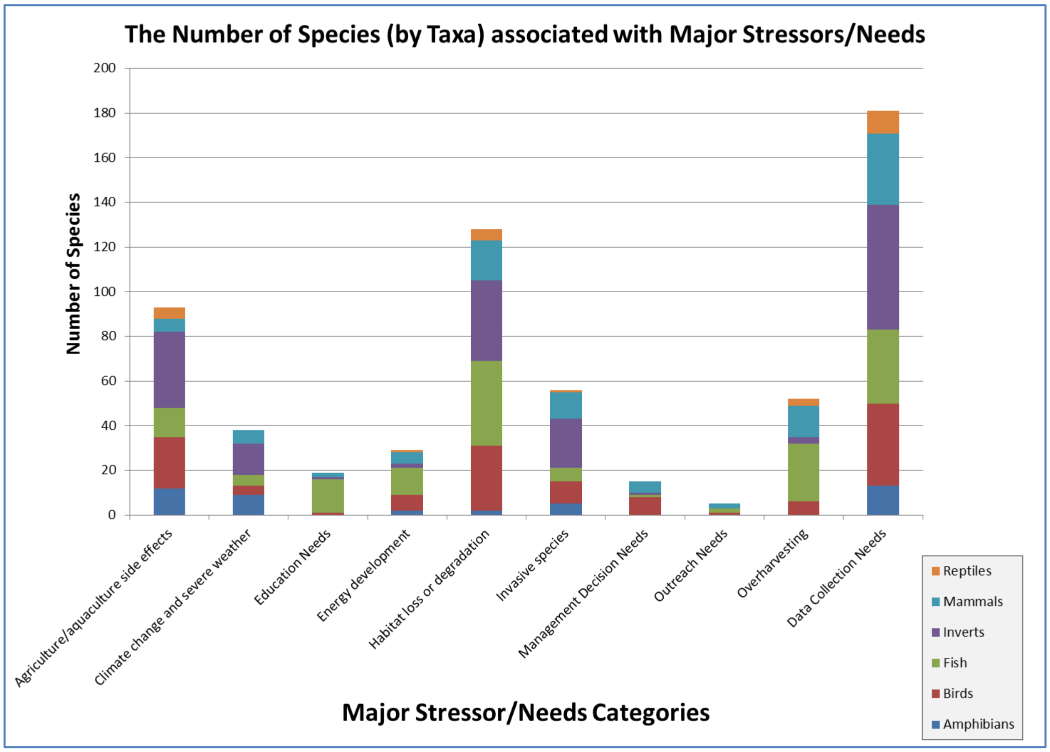



Figure 3-3: SGCN Needed Actions by Taxa

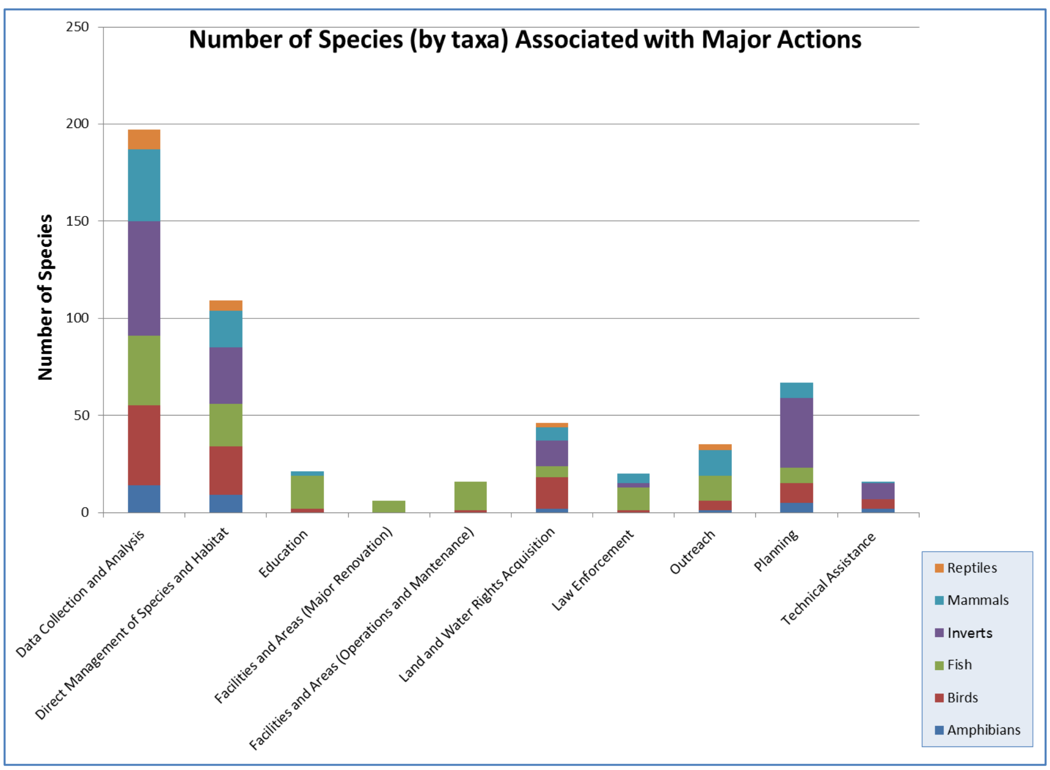


Figure 3-4: SGCN Adequacy of Investment

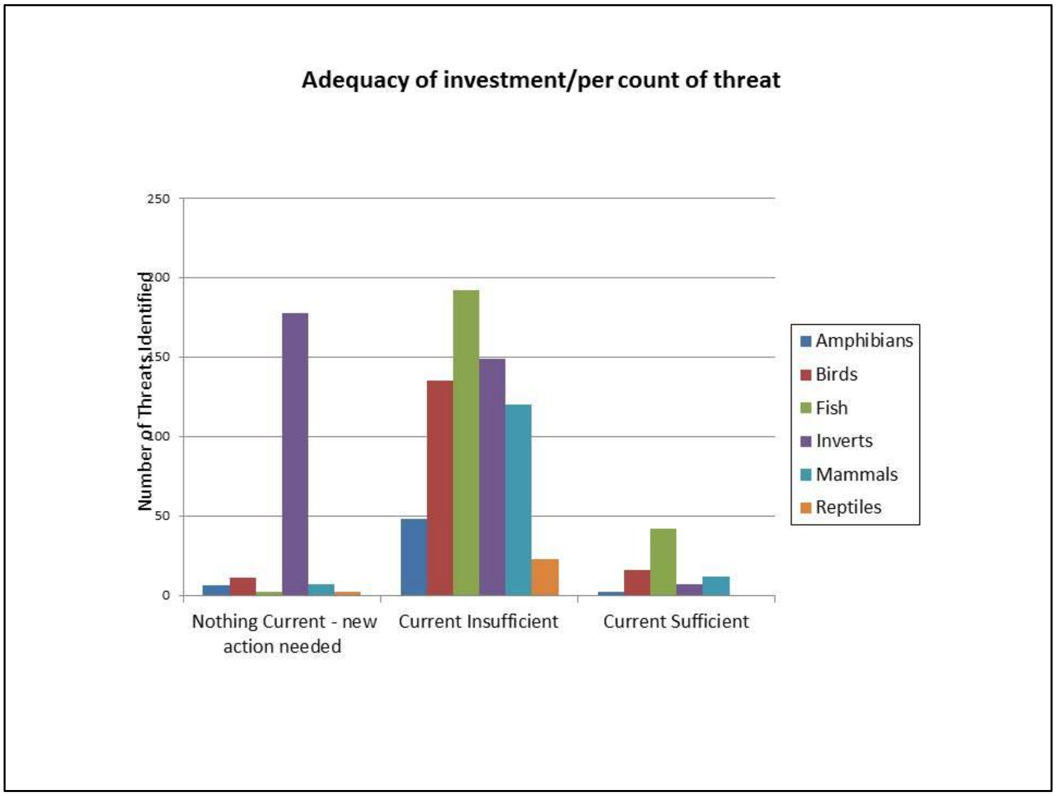
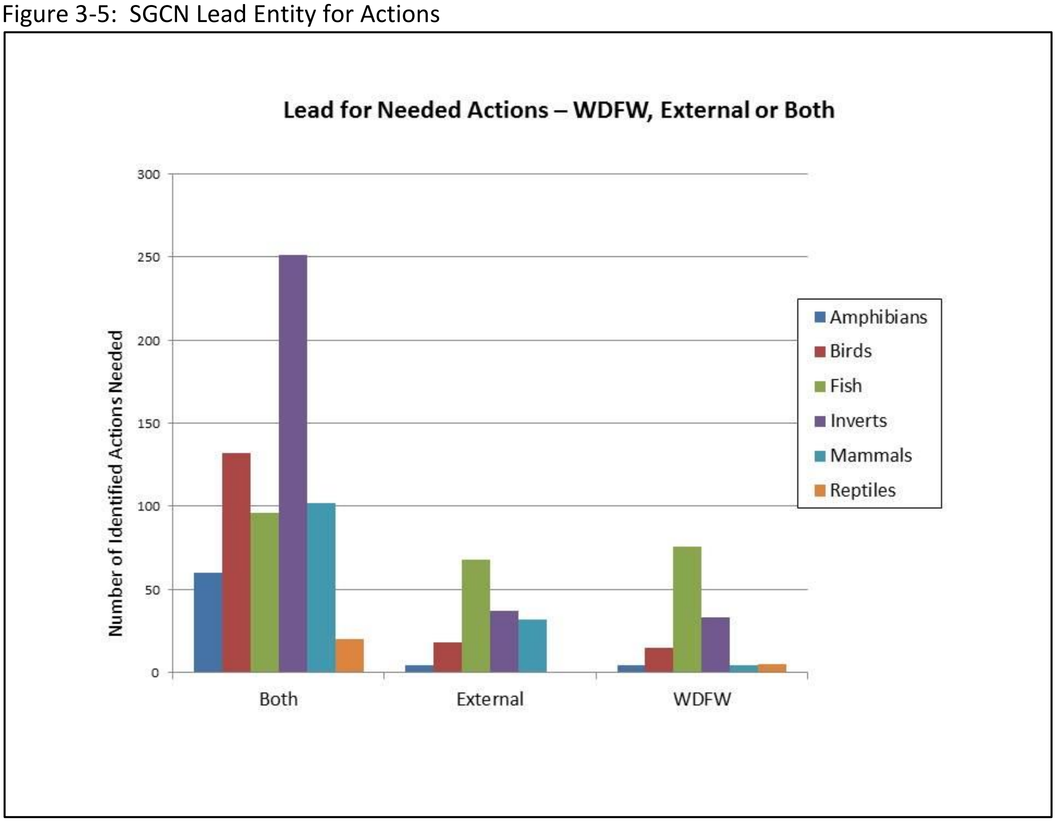



Figure 3-5: SGCN Lead Entity for Actions



## 3.4 Reference Information

### Explanation of Terms Used in Conservation Status Tables

Federal Status

Refers to legal designations under the Federal ESA (listed as Endangered or Threatened or recognized as a Candidate species for listing), or designated as a Sensitive species.

State Status

The Washington Fish and Wildlife Commission has classified 46 species as Endangered, Threatened or Sensitive, under WAC 232-12-014 and WAC 232-12-011. Species can also be designated Candidate Species for state listing by WDFW policy.

PHS (Priority Habitats and Species Program)

A species listed under the PHS program is considered to be a priority for conservation and management and requires protective measures for survival due to population status, sensitivity to habitat alteration and/or tribal, recreational or commercial importance. Management recommendations have been developed for PHS species and habitats, and can assist landowners, managers and others in conducting land use activities in a manner that incorporates the needs of fish and wildlife.

Climate Vulnerability

The vulnerability assessment method used in this process was comprised of evaluating sensitivity and exposure for each species or habitat, assessing confidence for each sensitivity and exposure evaluation, and scoring overall vulnerability and confidence for a species or habitat. Each evaluation of sensitivity includes assigned rankings as well as short summaries describing key information from the scientific literature (see Appendix C). The aim of the summaries that accompany rankings is to make transparent the rationales and assumptions underlying the rankings and confidences assigned. Each evaluation of exposure includes assigned rankings as well as a bulleted list of the key climate exposure factors for a given species or habitat. This list of exposure factors, along with the spatial location of a resource, was used to guide the literature review for future climate projections in order to assign rankings.

Based on the literature review, one of five rankings (High-5, Moderate-High-4, Moderate-3, Low-Moderate-2, or Low-1) was assigned each to sensitivity and exposure for a given species or habitat. Assigned rankings for sensitivity and exposure were then averaged (mean) to generate an overall vulnerability score for that particular species or habitat: $\textbf{Vulnerability} = \dfrac{\textbf{Climate Exposure + Sensitivity}}{\textbf{2}}$

Sensitivity and exposure evaluations were also assigned one of three confidence rankings (High-3, Moderate-2, or Low-1); confidence reflects the sureness assessors had in a given sensitivity or exposure ranking. These approximate confidence levels were based on Manomet Center for Conservation Sciences (2012), which collapsed the 5-category scale developed by Moss and Schneider (2000) for the IPCC Third Assessment Report into a 3-category scale to avoid implying a greater level of certainty precision. Confidence rankings for sensitivity and exposure were also averaged (mean) to generate an overall confidence score.

For more on the methodology, please see Chapter 5 – Climate Change.

Rankings

**Global (G) and State (S) Rankings:** Refers to NatureServe status rankings provided by the Natural Heritage Program. These conservation status ranks complement legal status designations and are based on a one to five scale, ranging from critically imperiled (1) to demonstrably secure (5). The global (G) and state (S) geographic scales were used for the SGCN species fact sheets. For more on the methodology used for these assessments, please see: Methodology for Assigning Ranks - NatureServe.

**State Rank:** characterizes the relative rarity or endangerment within the state of Washington.
**S1** = Critically imperiled
**S2** = Imperiled
**S3** = Rare or uncommon in the state – vulnerable
**S4** = Widespread, abundant, and apparently secure i
**S5** = Demonstrably widespread, abundant, and secure in the State
**SA** = Accidental in the state.
**SE** = An exotic species that has become established in the state.
**SH** = Historical occurrences only are known, perhaps not verified in the past 20 years, but the taxon is suspected to still exist in the state.
**SNR** = Not yet ranked. Sufficient time and effort have not yet been devoted to ranking of this taxon.
**SP** = Potential for occurrence of the taxon in the state but no occurrences have been documented.
**SR** = Reported in the state but without persuasive documentation which would provide a basis for either accepting or rejecting the report (e.g., misidentified specimen).
**SRF** = Reported falsely in the state but the error persists in the literature.
**SU**= Unrankable. Possibly in peril in the state, but status is uncertain. More information is need.
**SX** = Believed to be extirpated from the state with little likelihood that it will be rediscovered.
**SZ** = Not of conservation concern in the state.

Qualifiers are sometimes used in conjunction with the State Ranks described above:
**B** - Rank of the breeding population in the state.
**N** - Rank of the non-breeding population in the state.

**Global Rank:** characterizes the relative rarity or endangerment of the element world-wide.
**G1** = Critically imperiled globally
**G2** = Imperiled globally
**G3** = Either very rare and local throughout its range or found locally (even abundantly at some of its locations) in a restricted range - vulnerable
**G4** = Widespread, abundant, and apparently secure globally
**G5** = Demonstrably widespread, abundant, and secure globally, though it may be quite rare in parts of its range
**GH** = Historical occurrences only are known, perhaps not verified in the past 20 years, but the taxon is suspected to still exist somewhere in its former range.
**GNR** = Not yet ranked. Sufficient time and effort have not yet been devoted to ranking of this taxon.
**GU** = Unrankable. Possibly in peril range-wide but status uncertain. More information is needed.
**GX** = Believed to be extinct and there is little likelihood that it will be rediscovered.

Qualifiers are used in conjunction with the Global Ranks described above:
**Tn** Where n is a number or letter similar to those for Gn ranks, above, but indicating subspecies or variety rank. For example, G3TH indicates a species that is ranked G3 with this subspecies ranked as historic.

# CHAPTER 4

# HABITATS OF GREATEST CONSERVATION NEED

## Table of Contents

**LIST OF TABLES**



**LIST OF FIGURES**

# Chapter 4
# Habitats of Greatest Conservation Need

## 4.1 Introduction and Overview

This chapter discusses the habitats and community types essential to the conservation of Species of Greatest Conservation Need (SGCN) in Washington. It overviews the status and condition of those habitats, lists key stressors and research needs, and highlights actions to ensure their conservation. The information provided in this chapter addresses Elements 2, 3, and 4 of the eight required to be included in the State Wildlife Action Plan. In this document, "species" is used to refer to species, subspecies, evolutionarily distinct units (ESU), and distinct population segments (DPS).

Three guiding principles informed and shaped the discussion of habitats in the SWAP:

***1. Using a coarse filter/fine filter approach to leverage conservation investment***

Our framework uses both a coarse filter (vegetation formation) and a fine filter (ecological system) to address the conservation needs of individual species, but also importantly, to leverage conservation investment by identifying where on the landscape habitat conservation actions can benefit multiple SGCN .

***2. Adopting standardized classifications to represent habitat***

The SWAP associates SGCN with two vegetation levels using standard vegetation classification: vegetation formations as described in the National Vegetation Classification System; and ecological systems, as described by NatureServe. These two vegetation levels provide the coarse filter (formation level) and fine filter (ecological system level) for distinct vegetative communities. The ecological systems for marine environments are described using the Coastal and Marine Ecological Classification Standard for nearshore, offshore, and oceanic ecological systems. These systems are subdivided by geographic regions of Puget Sound and the outer coast of Washington. The SWAP also associates SGCN with what are considered cultural or human created habitats (urban environments, agricultural fields, managed timberlands).

The use of these standardized classifications will facilitate cross referencing of conservation needs and objectives across state and international borders, promote collaborative efforts with other organizations, and provide access to enhanced mapping tools and products.

***3. Focusing on collaborative, on-the-ground conservation action***

Recognizing that all conservation entails collaboration and multiple partners, WDFW oriented this work with an eye towards being able to identify where habitat conservation priorities identified through the SWAP are shared by other entities, and where on the landscape are the most productive places to achieve on-the-ground conservation.

## Chapter Organization

This chapter begins with a few "at a glance" tables and summaries of the key features of the habitats discussed in the SWAP. Table 1 shows the full list of ecological systems found in Washington, and highlights those addressed in this chapter. Table 2 shows marine ecological systems in Washington, as defined for the SWAP. Table 3 summarizes information about the vegetation formations and Table 4 shows the relationship between ecoregions, vegetation formations, and ecological systems of concern. Ecoregions are broad areas that share similar flora and fauna, geology, hydrology, and landforms. Table 5 provides a summary of stressors present in the vegetative formations and ecological systems of concern.

The next section includes an overview fact sheet for each of the 17 vegetation formations found in Washington, representing the coarse filter scale – Figure 1 shows the distribution of these vegetation formations throughout Washington. These fact sheets provide an overview of the vegetation and distribution and an assessment of condition from ecological integrity assessments conducted by the Washington Natural Heritage Program. They also summarize the number of Species of Greatest Conservation Need that have close association with that vegetation formation, and those that have general association. These fact sheets indicate the number of ecological systems of concern, major stressors to the vegetation formations (including climate change, if appropriate), examples of actions needed to provide and maintain habitat for SGCN, and key research and data needs.

More detailed information is provided for the most imperiled ecological systems within each vegetation formation, representing the fine filter scale. In many cases, conservation attention will need to be focused at this scale to conserve highly vulnerable SGCN or the ecological values represented through the system.

The information for ecological systems of concern includes Natural Heritage Program rank, status and trend, a list of species closely and generally associated with the ecological system of concern and, if there is one, the name that refers to this habitat type, generally, in the WDFW Priority Habitats and Species (PHS) Program. Stressors, and actions to address stressors, are also summarized and discussed.

The final section of the chapter discusses how the conservation needs discussed in this chapter can be applied to on-the-ground conservation through our Priority Landscapes Initiative.

References can be found in Section 4.6, and an explanation of terms and abbreviations used in the chapter can be found in Section 4.5.

## Why use Ecological Systems?

Ecological systems are ecological units useful for standardized mapping and conservation assessments of habitat diversity and landscape conditions. They have been adopted nation-wide by many organizations as a vehicle for considering relationships to fish and wildlife species. Each ecological system type describes complexes of plant communities influenced by similar physical environments and dynamic ecological processes such as fire or flooding (NatureServe http://www.natureserve.org/conservation-tools/terrestrial-ecological-systems-united-states). Vegetation formations and ecological systems within Washington are mapped and maps are maintained and updated by Washington Department of Fish and Wildlife. Because ecological systems provide clear descriptions of vegetation structure and type, and can be identified on the ground and mapped, they have tremendous value in assessing and determining the quality of wildlife habitat.

### Ecoregions

This chapter also references the locations of formations and ecological systems by ecoregion. Ecoregions are based on broad patterns on the landscape and can provide another useful scale and spatial context for conservation planning. Further, several national and state based organizations use ecoregions in various planning initiative and crosswalks between ecological systems, formations and ecoregions can help to support collaborative efforts.  There are 63 ecoregions delineated in North America, and nine of these ecoregions occur partly or completely within Washington (Figure 2.1).

**Figure 4-1:  Ecoregions in Washington**


## Methodology

**Associating species with ecological systems**
Species of Greatest Conservation Need were associated with their use of ecological systems and vegetation formations to determine the relative values of each to wildlife.  This step was a central and necessary component of our approach to defining and prioritizing habitats and community types important for species conservation.   However, in doing so we recognized that using an ecological system based approach for habitat association purposes might not account for specific vegetative conditions (old-growth forest, for example), that can be critical components of habitat suitability.  Ecological systems describe vegetation communities but do not account for ecological condition of those systems, or presence of habitat features (such as cavities in snags) that may be critical to wildlife.  To address this, we included specific habitat features important to SGCN in each of the species fact sheets (see Appendix A), and included some of the most important habitat needs in the ecological system fact sheets included in this chapter.

We also noted that there has been almost no effort to formally describe the association of wildlife species with ecological systems.  In the absence of published literature, we opted to apply the principles of habitat use and preference to determine varying levels of association with a particular system.  Incorporating these levels of relative habitat value made the data useful for multiple types of analyses.  We associated species and systems with four categories:  closely associated, generally associated, unsuitable, and unknown.  These associations are defined below.

**1. Closely Associated.** The species demonstrates preference for the ecological system, as indicated by greater occurrence, high densities, greater reproductive output, or other indicators of preference, as compared to other ecological systems. A species that is closely associated with individual ecological systems often relies on one to a few ecological systems for a significant part, or all, of its life history requirements.

**2. Generally Associated.** The species occurs in, but does not prefer, the ecological system, as indicated by relatively low occurrence or densities, or other indicators of a general relationship with the ecological system. A species that is generally associated with individual ecological systems can typically rely on numerous ecological systems to meet its life history requirements.

Note: A species can be closely associated with some ecological systems and generally associated with others, due to differences in occurrence, densities, reproductive output, or other indicators of preference.

**3. Unsuitable.** The species demonstrates no use or only occasional use of an ecological system.

**4. Unknown.** The species' use of the ecological system is unknown. There were questions or uncertainty whether or not a species used an ecological system.

Assessments were based upon our current understanding of information such as distribution, range, abundance, and density. Assessments were often based on an individual's knowledge of occurrence in Washington or nearby states and provinces and reflected best professional judgement given the lack of published biological information on these associations. For situations where ecological systems are currently functioning differently than they have historically, we associated species based on our understanding of the former functionality of the ecological system.

It is important to note that a species can be closely associated with habitats within an ecological system in which it is only generally associated. For example, spotted owls are closely associated with forests with complex structure (e.g. mature and old-growth forest), but are only generally associated with multiple ecological systems within their range. In this case, association with ecological systems does not reflect the specific habitat requirements or needs of the species.

For recovering species, we made associations with ecological systems based on an anticipated association during or following recovery. For some species, an association with one or more ecological system(s) may dramatically over-represent current distribution, as they may be associated with extremely small areas within the ecological system. For this reason, it must also be understood that the distribution of the ecological system does not imply that the SGCN is present everywhere that the ecological system is found. For certain species, including many slugs and snails, distribution, abundance, species needs, and habitat conditions are not well known, and that lack of knowledge made the determination of their association with ecological systems difficult.

**Identifying Ecological Systems of Concern**

We identified Ecological Systems of Concern based on the conservation status rank of each ecological system. The Washington Natural Heritage Program assigned conservation status ranks to Washington's ecological systems using NatureServe's Conservation Status Rank calculator. The Conservation Status Rank is a measure of an ecological system's elimination risk. The rank is calculated using a measure of eight core factors relevant to risk assessment of elimination. The factors are organized into three categories: rarity, threats, and trends. Factors are scaled and weighted and subsequently scored according to their impact on risk. Scores are combined by category resulting in an overall calculated rank, which is reviewed by the evaluator, and a final conservation status rank is assigned. The Conservation Status Rank calculator automates the process of assigning conservation status ranks across the network thereby improving standardization of rank assignments. WDFW identified systems with S1, S1S2, and S2 ranks as Ecological Systems of Concern.

**Identifying Vulnerability to Climate Change**

Vulnerability to climate change was assessed by evaluating both inherent sensitivity to climatic changes and the degree of change the ecological system is likely to experience. We assigned a rank to each of the ecological systems of concern, ranging from low, moderate or high, and incorporated climate change into the discussion of key stressors for each of the vegetation formations and ecological systems, when appropriate. See Chapter 5 for more discussion on the methodology and full results of this ranking.

**References for introduction (complete list at end of chapter)**

Faber-Langendoen, D., J. Nichols, L. Master, K. Snow, A. Tomaino, R. Bittman, G. Hammerson, B. Heidel, L. Ramsay, A. Teucher, and B. Young. 2012. NatureServe Conservation Status Assessments: Methodology for Assigning Ranks. NatureServe, Arlington VA.

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Master, L., D. Faber-Langendoen, R. Bittman, G. A. Hammerson, B. Heidel, J. Nichols, L. Ramsay, and A. Tomaino (2009). NatureServe conservation status assessments: factors for assessing extinction risk. *NatureServe, Arlington, Virginia*.

Rocchio, J. and R. Crawford. 2008. Draft Field Guide to Washington's Ecological Systems. Washington Department of Natural Resources.

## 4.2 SUMMARY OF KEY HABITAT FEATURES

The following tables present summary information regarding distribution, SGCN association and key stressors and actions for each of the Ecological Systems of Concern:

## Vegetation Formations and Terrestrial Ecological Systems Found in Washington

All major habitat types occurring in Washington are described and discussed in this chapter, with a focus on the values they provide for wildlife (see Figure 4-1 for a map of the distribution of the vegetation formations throughout Washington). Highlighted ecological systems of concern are discussed in greater detail within each formation; either because they are imperiled and/or because they are of particularly high conservation value to fish and wildlife.

☐ Ecologically imperiled and/or important to the conservation of SGCN (these systems are profiled in this chapter)

* High vulnerability to climate change (see Chapter 5 for more information)

Table 4-1: Vegetation Formations and Ecological Systems Found in Washington

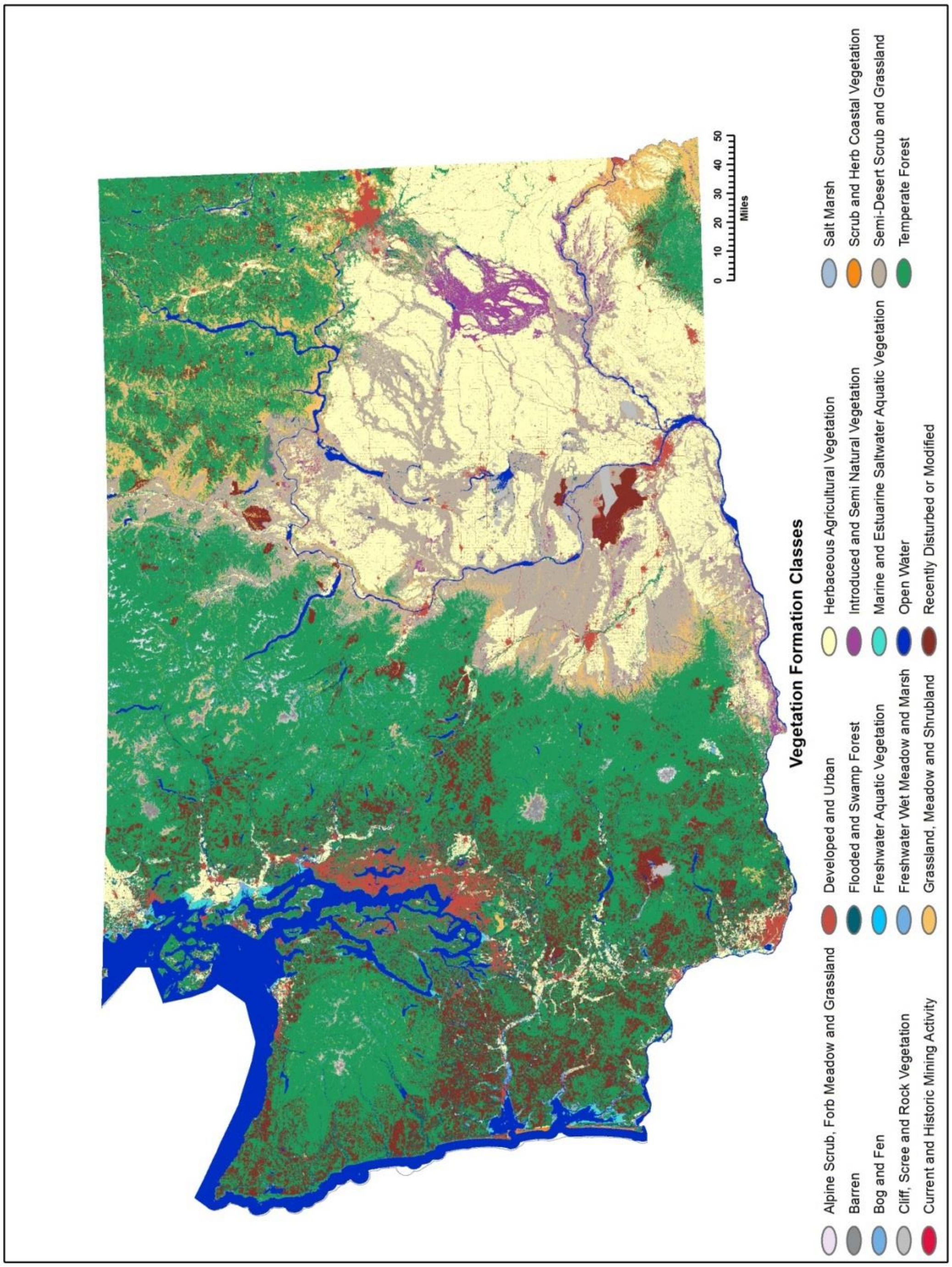
| VEGETATION FORMATION | TERRESTRIAL ECOLOGICAL SYSTEM |
|---|---|
| **Alpine Scrub, Meadow & Grassland** | North Pacific Dry and Mesic Alpine Dwarf-Shrubland, Fell-field and Meadow |
| | Rocky Mountain Alpine Dwarf Shrubland, Fell-field and Turf |
| **Barren** | North American Alpine Ice Field |
| | Unconsolidated Shore |
| **Bog & Fen** | *North Pacific Bog and Fen |
| | Rocky Mountain Subalpine-Montane Fen |
| **Cliff, Scree & Rock Vegetation** | Inter-Mountain Basins Active and Stabilized Dune |
| | Inter-Mountain Basins Cliff and Canyon |
| | North Pacific Active Volcanic Rock and Cinder Land |
| | North Pacific Alpine and Subalpine Bedrock and Scree |
| | North Pacific Montane Massive Bedrock, Cliff and Talus |
| | North Pacific Serpentine Barren |
| | Rocky Mountain Alpine Bedrock and Scree |
| | Rocky Mountain Cliff, Canyon and Massive Bedrock |
| **Developed & Urban** | Developed, High Intensity |
| | Developed, Low Intensity |
| | Developed, Medium Intensity |
| | Developed, Open Space |
| **Flooded and Swamp Forest** | *Columbia Basin Foothill Riparian Woodland and Shrubland |
| | Great Basin Foothill and Lower Montane Riparian Woodland & Shrubland |
| | Inter-Mountain Basins Montane Riparian Systems |
| | North Pacific Hardwood-Conifer Swamp |
| | North Pacific Lowland Riparian Forest and Shrubland |
| | North Pacific Montane Riparian Woodland and Shrubland |
| | North Pacific Shrub Swamp |
| | Northern Rocky Mountain Conifer Swamp |
| | *Northern Rocky Mountain Lower Montane Riparian Woodland & Shrubland |
| | Rocky Mountain Lower Montane Riparian Woodland and Shrubland |

| VEGETATION FORMATION | TERRESTRIAL ECOLOGICAL SYSTEM |
|---|---|
| | Rocky Mountain Subalpine-Montane Riparian Woodland |
| **Freshwater Aquatic Vegetation, Wet Meadow, & Marsh** | *Columbia Plateau Vernal Pool |
| | North American Arid West Emergent Marsh |
| | North Pacific Avalanche Chute Shrubland |
| | North Pacific Intertidal Freshwater Wetland |
| | Rocky Mountain Alpine-Montane Wet Meadow |
| | Rocky Mountain Subalpine-Montane Riparian Shrubland |
| | Temperate Pacific Freshwater Aquatic Bed |
| | Temperate Pacific Freshwater Emergent Marsh |
| | Temperate Pacific Freshwater Mudflat |
| | Temperate Pacific Montane Wet Meadow |
| | Willamette Valley Wet Prairie |
| **Grassland, Meadow and Shrubland** | Columbia Basin Foothill and Canyon Dry Grassland |
| | Columbia Basin Palouse Prairie |
| | North Pacific Alpine and Subalpine Dry Grassland |
| | North Pacific Herbaceous Bald and Bluff |
| | North Pacific Hypermaritime Shrub and Herbaceous Headland |
| | North Pacific Montane Shrubland |
| | Northern Rocky Mountain Lower Montane, Foothill and Valley Grassland |
| | Northern Rocky Mountain Montane-Foothill Deciduous Shrubland |
| | Northern Rocky Mountain Subalpine Deciduous Shrubland |
| | Northern Rocky Mountain Subalpine-Upper Montane Grassland |
| | Rocky Mountain Subalpine-Montane Mesic Meadow |
| | Willamette Valley Upland Prairie and Savanna |
| **Herbaceous Agricultural Vegetation** | Cultivated Cropland |
| | Pasture/Hay |
| **Introduced & Semi Natural Vegetation** | Introduced Riparian and Wetland Vegetation |
| | Introduced Upland Vegetation - Annual Grassland |
| | Introduced Upland Vegetation - Perennial Grassland and Forbland |
| | Introduced Upland Vegetation - Shrub |
| | Introduced Upland Vegetation - Treed |
| **Open Water** | Open Water (Fresh) |
| **Recently Disturbed or Modified** | Disturbed non-specific |
| | Harvested Forest - Grass/Forb Regeneration |
| | Harvested Forest - Northwestern Conifer Regeneration |
| | Harvested Forest-Shrub Regeneration |
| | Recently Burned Forest |
| | Recently Burned Grassland |

| VEGETATION FORMATION | TERRESTRIAL ECOLOGICAL SYSTEM |
| --- | --- |
| | Recently Burned Shrubland |
| **Salt Marsh** | Inter-Mountain Basins Playa and Alkaline Closed Depression |
| | Inter-Mountain Basins Greasewood Flat |
| | Temperate Pacific Tidal Salt and Brackish Marsh |
| **Scrub and Herb Coastal Vegetation** | North Pacific Coastal Cliff and Bluff |
| | North Pacific Maritime Coastal Sand Dune and Strand |
| **Semi-Desert Scrub & Grassland** | Columbia Plateau Low Sagebrush Steppe |
| | Columbia Plateau Scabland Shrubland |
| | Columbia Plateau Steppe and Grassland |
| | Inter-Mountain Basins Big Sagebrush Shrubland |
| | *Inter-Mountain Basins Big Sagebrush Steppe |
| | Inter-Mountain Basins Mixed Salt Desert Scrub |
| | Inter-Mountain Basins Montane Sagebrush Steppe |
| | Inter-Mountain Basins Semi-Desert Grassland |
| | Inter-Mountain Basins Semi-Desert Shrub Steppe |
| **Temperate Forest** | Columbia Plateau Western Juniper Woodland and Savanna |
| | East Cascades Mesic Montane Mixed-Conifer Forest and Woodland |
| | East Cascades Oak-Ponderosa Pine Forest and Woodland |
| | Inter-Mountain Basins Aspen-Mixed Conifer Forest and Woodland |
| | Inter-Mountain Basins Curl-leaf Mountain Mahogany Woodland and Shrubland |
| | Middle Rocky Mountain Montane Douglas-fir Forest and Woodland |
| | North Pacific Broadleaf Landslide Forest and Shrubland |
| | North Pacific Dry Douglas-fir-(Madrone) Forest and Woodland |
| | North Pacific Dry-Mesic Silver Fir-Western Hemlock-Douglas-fir Forest |
| | North Pacific Hypermaritime Sitka Spruce Forest |
| | North Pacific Hypermaritime Western Red-cedar-Western Hemlock Forest |
| | North Pacific Lowland Mixed Hardwood-Conifer Forest and Woodland |
| | North Pacific Maritime Dry-Mesic Douglas-fir-Western Hemlock Forest |
| | North Pacific Maritime Mesic Subalpine Parkland |
| | North Pacific Maritime Mesic-Wet Douglas-fir-Western Hemlock Forest |
| | North Pacific Mesic Western Hemlock-Silver Fir Forest |
| | North Pacific Mountain Hemlock Forest |
| | North Pacific Oak Woodland |
| | North Pacific Wooded Volcanic Flowage |
| | Northern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest |
| | Northern Rocky Mountain Mesic Montane Mixed Conifer Forest |
| | *Northern Rocky Mountain Ponderosa Pine Woodland and Savanna |
| | Northern Rocky Mountain Subalpine Woodland and Parkland |

| VEGETATION FORMATION | TERRESTRIAL ECOLOGICAL SYSTEM |
|---|---|
| | Northern Rocky Mountain Western Larch Savanna |
| | *Rocky Mountain Aspen Forest and Woodland |
| | Rocky Mountain Lodgepole Pine Forest |
| | Rocky Mountain Poor-Site Lodgepole Pine Forest |
| | Rocky Mountain Subalpine Dry-Mesic Spruce-Fir Forest and Woodland |
| | Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland |

Figure 4-2: Distribution of Vegetation Formations



## Marine Ecological Systems

Marine systems are divided into nine separate geographic regions.  Two regions comprise the Pacific Ocean marine systems, and are separated for this planning effort at Point Grenville. Puget Sound and the Strait of Juan de Fuca are divided into seven regions;  the Strait of Juan De Fuca, San Juan Islands and Georgia Basin, North Central Puget Sound, South Central Puget Sound, Hood Canal, Whidbey Island, and South Puget Sound.

Marine ecological systems include the following:

Table 4- 2:  Marine Ecological Systems

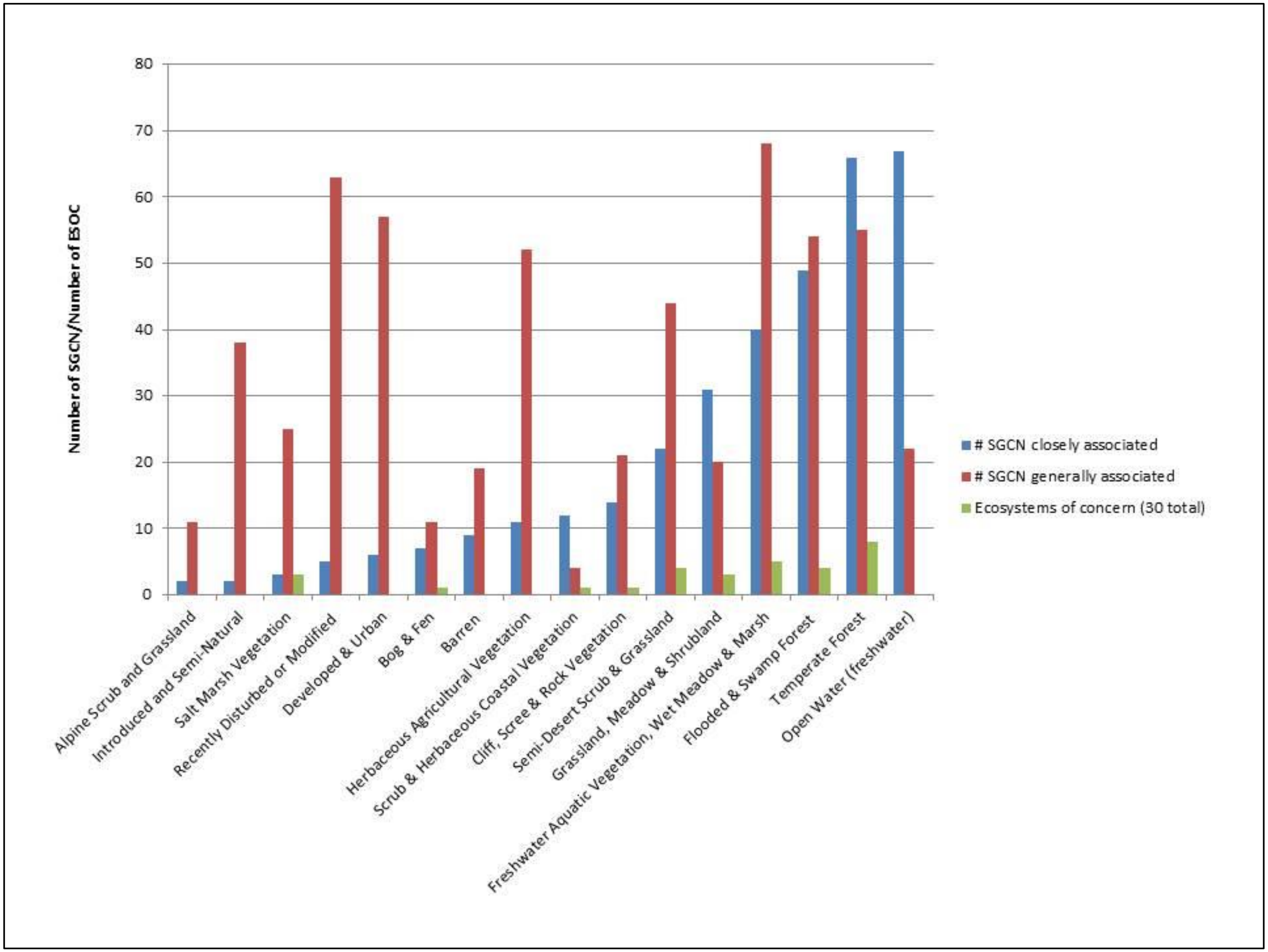
| MARINE ECOLOGICAL SYSTEM | DESCRIPTION |
|---|---|
| Temperate Pacific Tidal Salt and Brackish Marsh | The Tidal Salt and Brackish Marsh Ecological System includes emergent vegetation occurring in tidally influenced wetlands associated with estuaries, lagoons and bays, and behind sand spits. |
| Temperate Pacific  Intertidal Mudflat | Intertidal mudflats are sparsely vegetated areas within intertidal zones. |
| North Pacific Maritime Eelgrass Bed | Eelgrass beds are submerged vegetated systems found along all coastal areas, but especially abundant in the northern portion of Puget Sound between Everett and British Columbia.  They are dominated by the eelgrass *Zostera marina*. |
| Estuarine | Estuarine ecological system is the portion of the estuary with constant water. |
| Nearshore | Nearshore is aquatic ecosystem from shoreline to 100 feet (30 meters) deep and may include marine algae communities, such as kelp beds. |
| Offshore | Offshore is aquatic ecosystem from 100 feet (30 meters) deep seaward to continental shelf break and may include marine algae communities, such as kelp beds. |
| Oceanic | Oceanic is the Pacific Ocean aquatic ecosystem seaward of the continental shelf break and may include floating marine algae communities, such as *Sargassum* seaweeds. |

## Table 4-3: Summary of Vegetation Formations

| Vegetation Formation (17 total) | Distribution ($mi^2$) | # SGCN closely associated | # SGCN generally associated | Ecosystems of concern (30 total) | ECOREGIONS | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Northwest Coast | West Cascades | Puget Trough | North Cascades | Columbia | Okanogan | East Cascades | Canadian | Blue Mountains |
| Alpine Scrub and Grassland | 251 | 2 | 11 | 0 | x | x | | x | x | x | x | | x |
| Barren | 336 | 9 | 19 | 0 | x | x | x | x | | x | x | | |
| Bog & Fen | 19 | 7 | 11 | 1 | x | x | x | x | | x | x | x | |
| Cliff, Scree & Rock Vegetation | 318 | 14 | 21 | 1 | x | x | x | x | x | x | x | x | x |
| Developed & Urban | 2040 | 6 | 57 | 0 | x | x | x | x | x | x | x | x | x |
| Flooded & Swamp Forest | 1479 | 49 | 54 | 4 | x | x | x | x | x | x | x | x | x |
| Freshwater Aquatic Vegetation, Wet Meadow & Marsh | 559 | 40 | 68 | 5 | x | x | x | x | x | x | x | x | x |
| Grassland, Meadow & Shrubland | 3707 | 31 | 20 | 3 | x | x | x | x | x | x | | x | x |
| Herbaceous Agricultural Vegetation | 21,491 | 11 | 52 | 0 | x | x | x | x | x | x | x | x | x |
| Introduced and Semi-Natural | 1746 | 2 | 38 | 0 | | | x | | x | x | x | x | x |
| Open Water (freshwater) | 4400 | 67 | 22 | 0 | x | x | x | x | x | x | x | x | x |
| Recently Disturbed or Modified | 6648 | 5 | 63 | 0 | x | x | x | x | x | x | x | x | x |
| Salt Marsh Vegetation | 224 | 3 | 25 | 3 | x | | x | | x | x | x | | x |
| Scrub & Herbaceous Coastal Vegetation | 28 | 12 | 4 | 1 | x | x | x | | | | | | |
| Semi-Desert Scrub & Grassland | 199 | 22 | 44 | 4 | | x | x | x | x | x | x | x | x |
| Temperate Forest | 28,818 | 66 | 55 | 8 | x | x | x | x | x | x | x | x | x |

Table 3: Summary of Vegetation Formations

**Figure 4-3: Formations and SGCN Association**



### Table 4-4: Ecoregions, Formations, and Ecological Systems of Concern

| ECOLOGICAL SYSTEMS OF CONCERN BY VEGETATION FORMATION AND ECOREGION | ECOREGIONS | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Northwest Coast | West Cascades | Puget Trough | North Cascades | Columbia Plateau | Okanagan | East Cascades | Canadian Rocky Mountains | Blue Mountains |
| **BOG AND FEN** | | | | | | | | | |
| North Pacific Bog & Fen | X | X | X | X | | | X | | |
| **CLIFF, SCREE, AND ROCK VEGETATION** | | | | | | | | | |
| Inter-mountain Basins Active & Stabilized Dune | | | | | X | X | X | | |
| **FLOODED SWAMP AND FOREST** | | | | | | | | | |
| Columbia Basin Foothill Riparian Woodland & Shrubland | | | | | X | X | X | X | X |
| North Pacific Hardwood-Conifer Swamp | X | X | X | X | | | X | | |
| North Pacific Lowland Riparian Forest & Shrubland | X | X | X | X | X | X | X | | |
| Northern Rocky Mountain Lower Montane Riparian Woodland & Shrubland | | | | | X | X | X | X | X |
| **FRESHWATER AQUATIC VEGETATION, WET MEADOW, AND MARSH** | | | | | | | | | |
| North American Arid West Emergent Marsh | | | | | X | X | X | X | X |
| North Pacific Intertidal Freshwater Wetland | X | X | X | | | | | | |
| Temperate Pacific Freshwater Emergent Marsh | X | X | X | X | | X | X | | |
| Temperate Pacific Freshwater Mudflat | X | X | X | | | | X | | |
| Willamette Valley Wet Prairie | | | X | | | | | | |
| **GRASSLAND, MEADOW, AND SHRUBLAND** | | | | | | | | | |
| Columbia Basin Foothill and Canyon Dry Grassland | | | | | X | X | X | X | X |
| Columbia Basin Palouse Prairie | | | | | X | X | X | X | X |
| Willamette Valley Upland Prairie and Savanna | X | X | X | | | | | | |
| **SALT MARSH VEGETATION** | | | | | | | | | |
| Inter-mountain Basins Greasewood Flat | | | | | X | X | X | | X |
| Inter-mountain Basins Playa and Alkaline Closed Depression | | | | | X | X | X | | X |

| ECOLOGICAL SYSTEMS OF CONCERN BY VEGETATION FORMATION AND ECOREGION | ECOREGIONS | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Northwest Coast | West Cascades | Puget Trough | North Cascades | Columbia Plateau | Okanagan | East Cascades | Canadian Rocky Mountains | Blue Mountains |
| Temperate Pacific Tidal Salt and Brackish Marsh | X | | X | | | | | | |
| **SCRUB AND HERBACEOUS COASTAL VEGETATION** | | | | | | | | | |
| North Pacific Maritime Coastal Sand Dune and Strand | X | X | X | | | | | | |
| **SEMI-DESERT SCRUB AND GRASSLAND** | | | | | | | | | |
| Columbia Plateau Low Sagebrush Steppe | | | | | X | X | X | | X |
| Columbia Plateau Steppe and Grassland | | | | | X | X | X | X | X |
| Inter-mountain Basins Big Sagebrush Steppe | | | X | X | X | X | X | X | X |
| Inter-mountain Basins Semi-desert Shrub Steppe | | | | | X | X | X | | X |
| **TEMPERATE FOREST** | | | | | | | | | |
| East Cascades Oak-ponderosa Pine Forest and Woodland | | X | | | X | X | X | | |
| North Pacific Dry Douglas-fir-(Madrone)Forest and Woodland | X | X | X | X | | | | | |
| North Pacific Hypermaritime Sitka Spruce Forest | X | | X | | | | | | |
| North Pacific Hypermaritime Western Red-cedar Western Hemlock Forest | X | | X | | | | | | |
| Northern Rocky Mountain Ponderosa Pine Woodland and Savanna | | X | | X | X | X | X | X | X |
| Northern Rocky Mountain Western Larch Savanna | | | | | X | X | X | X | X |
| North Pacific Oak Woodland | X | X | X | | X | X | X | | |
| Rocky Mountain Aspen Forest and Woodland | | | | X | X | X | X | X | X |

## Table 4-5: Key Stressors and Conservation Actions

| VEGETATION FORMATION | ECOLOGICAL SYSTEMS OF CONCERN | STRESSORS | | | | | | | | | | | | ACTIONS | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Energy Development | Roads & Development | Alteration of Hydrology | Altered Fire Regime | Dams and Diversions | Agricultural side effects | Climate Change | Overharvesting | Invasive Species | Habitat Loss /degradation | Recreation Impacts | Need for Outreach/Ed | Habitat Conservation | Partner/Stakeholder Eng. | Water Management | Fire Management | Invasive Species Control | Create New Habitat | Grazing/Farm Mgmt | Water rights | Research or Surveys | Restoration | Land Use Planning | Private Lands Incentives |
| Alpine Scrub, Forb Meadow & Grassland Vegetation | | | | | | | | x | | | x | x | | | | | x | x | | | | | | | |
| Barren | | | | | | | | x | | | | | | x | | | | | | | | | | x | |
| Bog & Fen | North Pacific Bog & Fen | | x | x | | | x | x | | | | | | x | | | | | | | | | | | |
| Cliff, Scree and Rock Vegetation | Inter-Mountain Basins Active and Stabilized Dune | | | | | | | x | | | | x | | | | | | | | | | | | x | |
| Developed and Urban | | | x | | x | | | | | | x | | x | | x | | | | | | | | | x | |
| Flooded & Swamp Forest | Columbia Basin Foothill Riparian Woodland & Shrubland | | | | | x | x | x | x | x | | | | | x | x | | x | | x | x | x | x | | |
| Flooded & Swamp Forest | North Pacific Hardwood Conifer Swamp | | | | | | | | | x | x | | | | | | | x | | | | | | x | |
| Flooded & Swamp Forest | North Pacific Lowland Riparian Forest & Shrubland | | x | | | x | x | x | | | | | | | x | x | | | | | x | x | | x | |
| Flooded & Swamp Forest | Northern Rocky Mountain Lower Montane Riparian Woodland & Shrubland | | | | | | x | x | | x | | | | | | | | x | | x | | | | | |

| VEGETATION FORMATION | ECOLOGICAL SYSTEMS OF CONCERN | STRESSORS | | | | | | | | | | | | ACTIONS | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Energy Development | Roads & Development | Alteration of Hydrology | Altered Fire Regime | Dams and Diversions | Agricultural side effects | Climate Change | Overharvesting | Invasive Species | Habitat Loss /degradation | Recreation Impacts | Need for Outreach/Ed | Habitat Conservation | Partner/Stakeholder Eng. | Water Management | Fire Management | Invasive Species Control | Create New Habitat | Grazing/Farm Mgmt | Water rights | Research or Surveys | Restoration | Land Use Planning | Private Lands Incentives |
| Freshwater Aquatic Vegetation, Wet Meadow & Marsh | North American Arid West Emergent Marsh | | | | | | x | x | | x | x | | | | | x | | x | | x | x | | | | x |
| Freshwater Aquatic Vegetation, Wet Meadow & Marsh | North Pacific Intertidal Freshwater wetland | | | x | | | | x | | x | x | | | | | | | x | x | | | | x | | |
| Freshwater Aquatic Vegetation, Wet Meadow & Marsh | Temperate Pacific Freshwater Emergent Marsh | | x | | | | | | | x | | | | | | | | x | | | | | | x | |
| Freshwater Aquatic Vegetation, Wet Meadow & Marsh | Temperate Pacific Freshwater Mudflat | x | | x | | | | | | x | x | | | | | x | | x | x | | | | x | | |
| Freshwater Aquatic Vegetation, Wet Meadow & Marsh | Willamette Valley Wet Prairie | | | | | | | | | | x | | | x | | | | | | | | x | | | x |
| Grassland, Meadow & Shrubland | Columbia Basin Foothill & Canyon Dry Grassland | | | | x | | x | | | x | x | | | | | | x | x | | x | | | x | | x |
| Grassland, Meadow & Shrubland | Columbia Basin Palouse Prairie | | | | x | | | | | x | x | | | | | | x | x | | | | | x | | |
| Grassland, Meadow & Shrubland | Willamette Valley Upland Prairie & Savanna | | x | | x | | | | | x | x | | | x | x | | x | x | | | | | x | | x |
| Herbaceous Agricultural Vegetation | | | | x | | | x | | | | | | | | | x | | | | x | | | | | |
| Introduced and Semi-natural | | | | | | | x | | | | | | | | | | | | | x | | | x | | |

| VEGETATION FORMATION | ECOLOGICAL SYSTEMS OF CONCERN | STRESSORS | | | | | | | | | | | | ACTIONS | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Energy Development | Roads & Development | Alteration of Hydrology | Altered Fire Regime | Dams and Diversions | Agricultural side effects | Climate Change | Overharvesting | Invasive Species | Habitat Loss /degradation | Recreation Impacts | Need for Outreach/Ed | Habitat Conservation | Partner/Stakeholder Eng. | Water Management | Fire Management | Invasive Species Control | Create New Habitat | Grazing/Farm Mgmt | Water rights | Research or Surveys | Restoration | Land Use Planning | Private Lands Incentives |
| Open Water | | | x | x | | | x | x | | | | | | x | | | | | | x | | x | x | x | |
| Recently Disturbed or Modified | | | | | | | | | | x | x | | | x | | | x | x | | | | | x | | |
| Salt Marsh Vegetation | Inter-mountain Basins Greasewood Flat | | x | x | | | x | | | x | x | | | x | | | | x | | x | | | | | |
| Salt Marsh Vegetation | Inter-mountain Basins Playa & Alkaline Closed Depression | | x | x | | | x | | | x | x | | | x | | | | x | | x | | | x | | |
| Salt Marsh Vegetation | Temperate Pacific Tidal Salt & Brackish Marsh | | x | | | | | | | x | x | | | | | | | x | | | | | x | | |
| Scrub & Herbaceous Coastal Vegetation | North Pacific Maritime Coastal Sand Dune & Strand | | x | | | | | | | x | x | x | | x | | | | x | | | | | x | x | |
| Semi-desert Scrub & Grassland | Columbia Plateau Low Sagebrush Steppe | | | | | | x | | | x | x | | | | | | | x | | x | | | | | |
| Semi-desert Scrub & Grassland | Columbia Plateau Steppe & Grassland | x | x | | x | | x | | | x | x | | | x | | | x | x | | x | | | x | | x |
| Semi-desert Scrub & Grassland | Inter-mountain Basins Big Sagebrush Steppe | x | x | | x | | x | x | | x | x | | | x | | | x | x | | x | | | x | | x |
| Semi-desert Scrub & Grassland | Inter-mountain Basins Semi-desert Shrub Steppe | | x | | x | | x | x | | x | x | | | x | | | x | x | | x | | | x | | x |
| Temperate Forest | East Cascades Oak-Ponderosa Pine Forest & Woodland | | x | | x | | | x | | x | x | | | x | | | x | x | | | | | x | | x |

| VEGETATION FORMATION | ECOLOGICAL SYSTEMS OF CONCERN | STRESSORS | | | | | | | | | | | | ACTIONS | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Energy Development | Roads & Development | Alteration of Hydrology | Altered Fire Regime | Dams and Diversions | Agricultural side effects | Climate Change | Overharvesting | Invasive Species | Habitat Loss /degradation | Recreation Impacts | Need for Outreach/Ed | Habitat Conservation | Partner/Stakeholder Eng. | Water Management | Fire Management | Invasive Species Control | Create New Habitat | Grazing/Farm Mgmt | Water rights | Research or Surveys | Restoration | Land Use Planning | Private Lands Incentives |
| Temperate Forest | North Pacific Dry Douglas-fir (Madrone) Forest & Woodland | | x | | x | | | | x | x | x | | | x | | | x | x | | | | | x | | x |
| Temperate Forest | North Pacific Hypermaritime Sitka Spruce Forest | | x | | x | | | | x | x | x | | | x | | | x | x | | | | | x | | x |
| Temperate Forest | North Pacific Hypermaritime Western Red-cedar-Western Hemlock Forest | | x | | | | | x | x | x | x | | | x | | | | x | | | | | x | | x |
| Temperate Forest | North Pacific Oak Woodland | | x | | x | | | | | x | x | | | x | | | x | x | | | | | x | | x |
| Temperate Forest | Northern Rocky Mountain Ponderosa Pine Woodland & Savanna | | | | x | | | x | | x | x | | | x | | | x | x | | | | | x | | x |
| Temperate Forest | Northern Rocky Mountain Western Larch Savanna | | x | | x | | | X | | x | x | | | x | | | x | x | | | | | x | | x |
| Temperate Forest | Rocky Mountain Aspen Forest & Woodland | | x | | x | | | x | | x | x | | | x | | | x | x | | | | | x | | x |

# 4.3 DESCRIPTIONS OF VEGETATION FORMATIONS AND ECOLOGICAL SYSTEMS OF CONCERN

## MARINE ECOLOGICAL SYSTEMS

**Overview**
Marine systems are divided into nine separate geographic regions. Two regions comprise the Pacific Ocean marine systems, and are separated for this planning effort at Point Grenville. Puget Sound and the Strait of Juan de Fuca are divided into seven regions: Strait of Juan de Fuca, San Juan Islands, North Central Puget Sound, South Central Puget Sound, Hood Canal, Whidbey Island Basin, and South Puget Sound.

Marine ecological systems are described in Table 2 and include seven systems: Temperate Pacific Tidal Salt and Brackish Marsh, Temperate Pacific Intertidal Mudflat, North Pacific Maritime Eelgrass Bed, Estuarine, Nearshore, Offshore, and Oceanic.

| Overall Distribution | # of SGCN with close association | # of SGCN with general association |
|---|---|---|
| Washington Coast and Puget Sound | 25 | 61 |

| Ecological System | SGCN with close*and general association |
|---|---|
| TEMPERATE PACIFIC TIDAL AND BRACKISH MARSH | **MAMMALS:** Sea Otter<br>**BIRDS:** Bald Eagle, Brown Pelican, Dusky Canada Goose*, Peregrine Falcon, Western High Arctic Brant<br>**FISH:** Eulachon-southern DPS, Pacific Lamprey, Puget Sound Chinook Salmon ESU, Lower Columbia River Chinook Salmon ESU, Lower Columbia Coho ESU, Hood Canal Summer Chum Salmon ESU, Columbia River Chum salmon ESU, Puget Sound Steelhead DPS, Lower Columbia Steelhead DPS, Middle Columbia Steelhead DPS, Upper Columbia Steelhead DPS, Snake River Basin Steelhead DPS, Bull Trout-Coastal Recovery Unit<br>**INVERTEBRATES:** Island Marble* |
| NORTH PACIFIC MARITIME EELGRASS BED | **MAMMALS:** Sea Otter<br>**BIRDS:** Bald Eagle, Brown Pelican, Dusky Canada Goose*, Common Loon, Marbled Godwit*, Peregrine Falcon, Red Knot*, Surf Scoter, Western High Arctic Brant*<br>**FISH:** Broadnose Sevengill Shark, Bocaccio-Puget Sound/Georgia Basin DPS, Brown Rockfish, Copper Rockfish, Quillback Rockfish, Pacific Cod-Salish Sea population, Pacific Herring-Georgia Basin DPS*, Pacific Sand Lance, Surf Smelt, Walleye Pollock-South Puget Sound, Pacific Lamprey, River Lamprey, Green Sturgeon-southern DPS, White Sturgeon-Columbia River, Puget Sound Chinook Salmon ESU, Lower Columbia River Chinook Salmon ESU, Upper Columbia River Spring Chinook Salmon ESU, Snake River Spring/summer Chinook Salmon ESU, Snake River Fall Chinook Salmon ESU, Lower Columbia Coho ESU, Hood Canal Summer Chum Salmon ESU, Columbia River Chum Salmon ESU, Puget Sound Steelhead DPS, Lower Columbia Steelhead DPS, Middle Columbia Steelhead DPS, Upper Columbia Steelhead DPS, |

| Ecological System | SGCN with close*and general association |
|---|---|
| | Snake River Basin Steelhead DPS, Bull Trout-Coastal Recovery Unit |
| **TEMPERATE PACIFIC INTERTIDAL MUDFLAT** | **BIRDS:** Bald Eagle, Brown Pelican, Dusky Canada Goose*, Marbled Godwit*, Peregrine Falcon, Red Knot*, Surf Scoter, Western High Arctic Brant<br>**FISH:** Green Sturgeon-southern DPS, White Sturgeon-Columbia River, Puget Sound Chinook Salmon ESU, Hood Canal Summer Chum Salmon ESU, Columbia River Chum Salmon ESU |
| **ESTUARINE** | **MAMMALS:** Killer Whale, Sea Otter<br>**BIRDS:** Bald Eagle, Brown Pelican, Common Loon, Dusky Canada Goose*, Harlequin Duck, Marbled Murrelet, Peregrine Falcon, Red-necked Grebe, Surf Scoter*, Western Grebe, Western High Arctic Brant*, White-winged Scoter*<br>**FISH:** Bluntnose Sixgill Shark, Broadnose Sevengill Shark*, Pacific Herring-Georgia Basin DPS, Pacific Sand Lance, Surf Smelt, Eulachon-southern DPS, Pacific Lamprey, River Lamprey, Green Sturgeon-southern DPS, White sturgeon-Columbia River*, Puget Sound Chinook Salmon ESU, Lower Columbia River Chinook Salmon ESU*, Upper Columbia River Spring Chinook Salmon ESU, Snake River Spring/summer Chinook Salmon ESU, Snake River Fall Chinook Salmon ESU, Lower Columbia Coho ESU, Hood Canal Summer Chum Salmon ESU*, Columbia River Chum Salmon ESU*, Puget Sound Steelhead DPS, Lower Columbia Steelhead DPS, Middle Columbia Steelhead DPS, Upper Columbia Steelhead DPS, Snake River Basin Steelhead DPS, Bull Trout-Coastal Recovery Unit |
| **NEARSHORE** | **MAMMALS:** Gray Whale, Harbor Porpoise, Humpback Whale, Killer Whale, Sea Otter<br>**BIRDS:** Bald Eagle, Barrow's Goldeneye, Brown Pelican, Clark's Grebe, Common Loon*, Dusky Canada Goose*, Harlequin Duck, Marbled Murrelet*, Peregrine Falcon, Red-necked Grebe*, Surf Scoter*, Tufted Puffin, Western Grebe*, Western High Arctic Brant, White-winged Scoter*<br>**FISH:** Bluntnose Sixgill Shark, Broadnose Sevengill Shark*, Bocaccio-Puget Sound/Georgia Basin DPS, Brown Rockfish, Canary Rockfish-Puget Sound/Georgia Basin DPS, Copper Rockfish*, Greenstriped Rockfish, Redstripe Rockfish, Tiger Rockfish, Quillback Rockfish, Yelloweye Rockfish-Puget Sound/Georgia Basin DPS, Pacific Cod-Salish Sea Population, Pacific Hake-Georgia Basin DPS, Pacific Herring-Georgia Basin DPS*, Pacific Sand Lance*, Surf Smelt*, Walleye Pollock-South Puget Sound, Eulachon-Southern DPS, Pacific Lamprey, River Lamprey, Green Sturgeon-Southern DPS, White Sturgeon-Columbia River*, Puget Sound Chinook Salmon ESU, Lower Columbia River Chinook Salmon ESU, Upper Columbia River Spring Chinook Salmon ESU, Snake River Spring/summer Chinook Salmon ESU, Snake River Fall Chinook Salmon ESU, Lower Columbia Coho ESU, Hood Canal Summer Chum Salmon ESU*, Columbia River Chum Salmon ESU, Puget Sound Steelhead DPS, Lower Columbia Steelhead DPS, Middle Columbia Steelhead DPS, Upper Columbia Steelhead DPS, Snake River Basin Steelhead DPS, Ozette Sockeye ESU, Bull Trout-Coastal Recovery Unit |

| Ecological System | SGCN with close*and general association |
|---|---|
| **OFFSHORE** | **MAMMALS:** Gray Whale, Harbor Porpoise, Humpback Whale, Killer Whale, Minke Whale, Sea Otter,<br>**BIRDS:** Clark's Grebe, Common Loon*, Dusky Canada Goose*, Marbled Murrelet*, Peregrine Falcon, Red-necked Grebe*, Surf Scoter*, Tufted Puffin, Short-tailed Albatross, Western Grebe*, Western High Arctic Brant, White-winged Scoter*<br>**FISH:** Bluntnose Sixgill Shark, Broadnose Sevengill Shark, Bocaccio-Puget Sound/Georgia Basin DPS, Brown Rockfish, Canary Rockfish-Puget Sound/Georgia Basin DPS, Copper Rockfish, Greenstriped Rockfish, Redstripe Rockfish, Tiger Rockfish, Quillback Rockfish, Yelloweye Rockfish-Puget Sound/Georgia Basin DPS, Pacific Cod-Salish Sea Population, Pacific Hake-Georgia Basin DPS, Pacific Herring-Georgia Basin DPS, Pacific Sand Lance, Surf Smelt, Walleye Pollock-South Puget Sound, Eulachon-southern DPS, Pacific Lamprey, Green Sturgeon-southern DPS, White Sturgeon-Columbia River, Puget Sound Chinook Salmon ESU, Lower Columbia River Chinook Salmon ESU, Upper Columbia River Spring Chinook Salmon ESU, Snake River Spring/summer Chinook Salmon ESU, Snake River Fall Chinook Salmon ESU, Lower Columbia Coho ESU, Hood Canal Summer Chum Salmon ESU, Columbia River Chum salmon ESU, Puget Sound Steelhead DPS, Lower Columbia Steelhead DPS, Middle Columbia Steelhead DPS, Upper Columbia Steelhead DPS, Snake River Basin Steelhead DPS, Ozette Sockeye ESU, Bull Trout-Coastal Recovery Unit |
| **OCEANIC** | **MAMMALS:** North Pacific Right Whale*, Blue Whale*, Fin Whale*, Gray Whale, Harbor Porpoise, Humpback Whale, Killer Whale, Minke Whale, Sei Whale*, Sperm Whale*<br>**BIRDS:** Short-tailed Albatross*, Tufted Puffin<br>**FISH:** Bluntnose Sixgill Shark*, Puget Sound Chinook Salmon ESU, Lower Columbia River Chinook Salmon ESU, Upper Columbia River Spring Chinook Salmon ESU, Snake River Spring/summer Chinook Salmon ESU, Snake River Fall Chinook Salmon ESU, Lower Columbia Coho ESU, Hood Canal Summer Chum Salmon ESU, Puget Sound Steelhead DPS, Lower Columbia Steelhead DPS, Middle Columbia Steelhead DPS, Upper Columbia Steelhead DPS, Snake River Basin Steelhead DPS |

*SGCN is closely associated with this system

**Major Stressors**

Invasive species (e.g., saltmarsh cordgrass (*Spartina alterniflora*), Green Crab), coastal development, overharvesting (fish and shellfish species), degraded water quality and climate change are all stressors which threaten the habitat values provided by these systems.

Degraded water quality resulting from land use practices have altered significant portions of the shallow marine systems and continue to alter remaining areas. The physical and chemical conditions of these habitats are degraded by the discharge of municipal, industrial, and agricultural effluents. Invasions of exotic plants and animals pose significant, long-term ecological and economic threats to this habitat.

Sea level rise is the most significant climate change stressor for the salt and brackish marshes, leading to submergence of tidal salt marshes and declines in vegetation unless they are able to migrate inwards through sediment accretion.  Nearshore and estuarine systems will also be affected by sea level rise, as well as impacts from increased wave height and intensity and increasing water temperatures.  Oceanic systems are at risk from changing ocean chemistry and rising levels of acidification, which has already been affecting the viability of oysters and other shellfish in Puget Sound.

**Habitat needs for SGCN associated with marine systems**

| | |
|---|---|
| **Fish/invertebrate spawning grounds** | Many of these systems provide essential spawning habitat for forage fish and other species. |
| **High invertebrate diversity/abundance** | Invertebrates in mudflats are food for many of these species like Harlequin Duck and Marbled Godwit. |
| **High water quality** | Water must lack high levels of pollutants and have appropriate physiochemical attributes (temperature, salinity, etc.). |

**Actions needed to maintain habitat quality for SGCN**

- Invasive species control.
- Improvements to water quality, discharge from human development (variety of sources)
- Minimize risks from oil spills.
- Develop appropriate land use planning that adequately protects spawning beaches for sand lance and surf smelt.

**Research and Data Needs**

- Areas used by life history stages and movements of juveniles before selection of adult habitat is poorly understood for many of our SGCN marine fishes, especially rockfish.
- Population, life history, and distribution information is needed for both shark species.
- Track and monitor evidence and effects of changing sea levels.

# ALPINE SCRUB, FORB MEADOW AND GRASSLAND VEGETATION

**Overview**

Alpine scrub, forb meadow and grassland vegetation formation includes two closely related ecological systems, Rocky Mountain Alpine Dwarf Shrubland, Fell-Field and Turf, and North Pacific Dry and Mesic Alpine Dwarf-shrubland, Fell-field and Meadow. These are vegetated areas found above the environmental limit of trees, at the highest elevations of the Olympic and Cascade Mountains. Cold, windblown areas supporting a mosaic of dwarf-shrublands, fell fields, tundra (sedge tufts), and sparsely vegetated snowbed communities. Small patches of krummholz (shrub-form trees) are also part of this system and occur at the lower elevations. These systems differ primarily in geographic distribution and resulting difference in associated flora.

Sites are slopes and depressions where snow lingers, where the soil has become relatively stabilized, and where the water supply is more or less constant. Dwarf shrublands are often found on level or concave glacial topography, with late-lying snow and sub irrigation from surrounding slopes. Fell fields are found in wind-scoured areas such as ridgetops and exposed saddles. Species with close association within these ecological systems include White-tailed Ptarmigan and Olympic Marmot. Species with general association include Golden Eagle, American Pika, Cascade Red Fox, Grizzly Bear, Northern Bog Lemming, Wolverine, Cascades Needlefly and Northern Forestfly. This formation contains no ecological systems of concern.

| Distribution | Public Land | Private Land | SGCN with close association (#) | SGCN with general association (#) | Ecological systems of concern (#) |
|---|---|---|---|---|---|
| 156 $mi^2$ | >99% | <1% | 2 | 11 | 0 |

**Major stressors**

Climate change, which may result in reduced snowpack and encroachment by trees and shrubs, is a major stressor. Trampling and associated recreational impacts are a major source of human disturbance. In recent years, Olympic marmots have disappeared from some of the driest meadows in the northeast Olympic Mountains.

**Habitat needs for SGCN associated with this system.**

| | |
|---|---|
| **Prevent encroachment of trees and large shrubs** | Trees and large shrubs are encroaching on habitat on the Olympic Peninsula and the Cascades, providing a potential threat to species like the Olympic Marmot and White-tailed Ptarmigan, both closely associated with these systems. |

**Actions needed to maintain habitat quality for SGCN**

- Fire management (establishment of natural fire regimes and prescribed fire).
- Control of invading species, primarily native trees and shrubs.

**Key research and data needs**

- Conducting prescribed fire to enhance habitat and minimize public concerns.

**Specific Ecological System References (complete list at end of chapter)**

Edelman, A. J. 2003. *Marmota olympus*. Mammalian Species 736: 1-5.

Schroeder, M. A. 2005. White-tailed ptarmigan. Page 68 in T. R. Wahl, B. Tweit, and S. G. Mlodinow, editors. Birds of Washington. Oregon State University Press, Corvallis, Oregon.

## BARREN

**Overview**

Barren vegetation formation includes two ecological systems, Alpine Ice Field and Unconsolidated Shore. Unconsolidated shore is material such as silt, sand, or gravel that is subject to inundation and, most importantly, redistribution due to the action of water in high energy environments (e.g. beaches, rivers). It is characterized by substrates lacking vegetation except for pioneering plants that become established during brief periods when growing conditions are favorable. Erosion and deposition by waves, currents, and seasonal flooding produce a number of landforms representing this class; the most common examples include sand and rock beaches along the outer coast and braided gravel beds associated with rivers and streams. Alpine ice field includes glaciers and perennial snow and ice features.

Nine Species of Greatest Conservation Need have a close association to these systems: American White Pelican, Brown Pelican, Snowy Plover, Streaked Horned Lark, Rock Sandpiper, Dusky Canada Goose, Peregrine Falcon, Harlequin Duck and Puget Sound Chinook Salmon ESU. The bird species are associated with the unconsolidated shore system only. A complete analysis of habitat association has not been done for all SGCN anadromous and freshwater fishes, thus it is possible that other SGCN fishes may be closely associated with this system. This formation contains no ecological systems of concern.

| Distribution | Public Land | Private Land | SGCN with close association (#) | SGCN with general association (#) | Ecological systems of concern (#) |
|---|---|---|---|---|---|
| 209 $mi^2$ | 84% | 1% | 9 | 13 | 0 |

**Major stressors**

Climate change is a significant stressor for the Alpine Ice Field Ecological System (decline of glaciers and reduction in snowpack) and unconsolidated shore in coastal areas (rise of sea level, shoreline armoring limits the flow of sediment in unconsolidated shorelines).

**Habitat needs for SGCN associated with unconsolidated shore**

| | |
|---|---|
| **Unvegetated condition** | Species use in these systems results from an absence of vegetation and re-setting of succession cause by disturbance and perhaps to some extent to its proximity to open water. This system is used for nesting (e.g. Snowy Plover), roosting (e.g. Brown Pelican) and foraging (e.g. Rock Sandpiper). |
| **High invertebrate abundance/ diversity** | Invertebrates are important food for Harlequin Duck and Rock Sandpiper, among others. |
| **Floodplain gravel beds** | Gravels beds within river floodplains are important for maintaining spawning habitat for salmonids and contributing to instream habitat for other fishes. |

**Actions needed to maintain habitat quality for SGCN**

Use of alternative techniques to shoreline and river armoring can protect both development and fresh and salt water shorelines. Restoration of floodplains, such as by dike removal or set-back, can allow gravel beds to develop and increase. There are few threats to these systems beyond the threat of climate change. Oil spills could significantly impact wildlife using unconsolidated shore.

## BOG AND FEN

**Overview**

Bog and fen vegetation formation includes two ecological systems in Washington, North Pacific Bog and Fen, and Rocky Mountain Subalpine –Montane Fen. Most bogs and fens are less than 12 acres in size. The North Pacific Bog and Fen ecological system is composed of peatlands that occur as small patches along the Pacific coast from southeastern Alaska to northern California, in and west of the coastal mountain summits including the Puget Sound lowlands. The Rocky Mountain Subalpine-Montane Fen Ecological System includes high elevation wetlands with organic soils in eastern Washington. It is confined to specific environments where perennial groundwater discharge occurs, such as low points in the landscape or near slopes where groundwater intercepts the soil surface, or along pond/lake shorelines.

Bogs and fens differ from other wetlands in having a substrate composed of organic material, typically in the form of peat and muck. The origin of the peat can be *Sphagnum* moss, 'brown' mosses, sedges, or woody species. Within the North Pacific Bog and Fen Ecological System, vegetation is usually a mix of conifer-dominated overstory, shrubs, and open *Sphagnum* or sedge lawns, often with small ponds and pools interspersed. Graminoids, evergreen or deciduous broadleaf shrubs, or evergreen needleleaf trees are commonly dominant. Many plant species are confined to this system.

| Distribution | Public Land | Private Land | SGCN with close association (#) | SGCN with general association (#) | Ecological systems of concern (#) |
|---|---|---|---|---|---|
| 13 $mi^2$ | 43% | 57% | 7 | 11 | 1 |

**Habitat needs for SGCN associated with this system.**

| | |
|---|---|
| **High ecological integrity** | Many of the invertebrates associated with this system are associated with native plants, high ecological integrity, and are sensitive to invasive shrubs and grasses. |
| **Adequate groundwater level** | Fish that use ponds and pools of this system, such as Olympic Mudminnow, require adequate ground water levels to maintain the water bodies. |

**Climate Change**

Climate changes such as decreased precipitation, reduced snowpack, or prolonged drought that reduces water availability and recharge may lead to range contraction and/or habitat conversion, increased invasion of dry-adapted species, or tree encroachment in bog and fen habitats. Shifts from snow to rain that enhances winter/spring flood risk may increase erosion of moist peat and topsoil, reduce opportunities for recharge, and/or lead to drying of habitats.

**Actions needed to maintain habitat quality for SGCN**
Site protection; sites with high ecological integrity and corresponding SGCN should be identified and protected. Groundwater withdrawals should be regulated to preserve groundwater levels needed to maintain aquatic habitat conditions.

**Research and data needs**
While some bogs have been surveyed in detail, most have not. The range of rare species, including several beetles and Makah Copper are not thoroughly documented.

**Ecological systems discussed in greater detail in this chapter**
Of the two ecological systems found in this formation, North Pacific Bog and Fen is discussed in greater detail here. It is considered an ecological system of concern because of its imperiled conservation status and because of its importance to SGCN.

## North Pacific Bog and Fen

**Description and Distribution**
The North Pacific Bog and Fen Ecological System is located primarily in the North Pacific Ecoregion, but is sporadically distributed through the west side and eastern slopes of the Cascades. Elevations are mostly under 1500 feet, and annual precipitation ranges from 35 to 120 inches. However, fens are also found within the Cascades and Olympic Mountains. The system is found in primarily in glaciated terrain but also in river valleys, around lakes and marshes, behind coastal sand dunes, or on slopes. Four Species of Greatest Conservation Need are closely associated with this Ecological system: Olympic Mudminnow, Beller's Ground Beetle, Hatch's Click Beetle, and Makah Copper.

| PHS | NHP Rank | Status and trend | SGCN closely and generally associated with this ecological system |
|---|---|---|---|
| Yes Freshwater Wetlands | S2 | Imperiled/ declining.<br><br>Declines of 30-50% in last 50 years and from historical condition. | **MAMMALS:** Wolverine, Western Spotted Skunk, Townsend's Big-eared Bat, Northern Bog Lemming, Keen's Myotis, Hoary Bat* |
| | | | **BIRDS:** Sandhill Crane |
| | | | **FISH:** Olympia Mudminnow |
| | | | **INVERTEBRATES:** Beller's Ground Beetle*, Hatch's Click Beetle*, and Makah Copper |

* SGCN is closely associated with this ecological system

**Stressors and Actions Needed**
Historical and contemporary land use practices have impacted hydrologic, geomorphic, and biotic structure and function of peatlands in western Washington. Conversion of peatlands for agriculture has resulted in significant loss of peatland extent. These areas are often cultivated for food crops such as blueberries and cranberries.

Reservoirs, water diversions and withdrawals, ditches, roads, and human land uses in the contributing watershed (fens) or surrounding landscape can also have a substantial impact on the hydrological regime. Direct alteration of hydrology (i.e., channeling, draining, damming) or indirect alteration (i.e., roads or removing vegetation on adjacent slopes) results in changes in species composition and wetland extent. Water diversions and ditches can have a substantial impact on the hydrology as well as biological integrity of peatland.

Climate change poses a particular future threat to this system. Bog and fen habitats, particularly those that depend on surface water, are sensitive to drier climate conditions that can lead to habitat conversion or range contraction, increased invasion of dry-adapted species.

| STRESSOR | DESCRIPTION | ACTION CATEGORY | ACTION DESCRIPTION |
|---|---|---|---|
| Agriculture and aquaculture side effects | Conversion to agriculture eliminates and degrades habitat | • Grazing/farm management<br>• Land acquisition<br>• Land use planning<br>• Private lands agreements | Protect key sites through acquisition, easement, planning, and protection of hydrology |
| Roads and development | Development near bogs and fens degrades habitat | • Land acquisition<br>• Land use planning<br>• Environmental review<br>• Private lands agreements | Protect key sites through acquisition, easement, planning and protection of hydrology |
| Alteration of hydrology | Alteration of hydrology degrades habitat | • Water management | Maintain or re-configure hydrological sources and routes |
| Climate change | Drier conditions may lead to habitat conversion or range contraction | • Address existing stressors | Build resilience for added stress of climate change by addressing existing stressors |

# CLIFF, SCREE AND ROCK VEGETATION

**Overview**

Cliff, scree, and rock vegetation include eight systems that generally have little or no vegetation or soil development.  These systems include steep cliff faces, narrow canyons, and larger rock outcrops of various igneous, sedimentary, and metamorphic bedrock types.  Some systems are characterized by the presence of unstable scree and talus that typically occur below cliff faces as well as sand dunes.  Small patches of dense vegetation, typically scattered trees or shrubs, can occupy rock fractures and less steep or more stable slopes. .  Although herbaceous cover tends to be limited in these systems mosses or lichens may be very dense and well-developed, displaying well over 10 percent cover.

| Distribution | Public Land | Private Land | SGCN with close association (#) | SGCN with general association (#) | Ecological systems of concern (#) |
|---|---|---|---|---|---|
| 610 $mi^2$ | 91% | 9% | 14 | 22 | 1 |

**Major Stressors**

- Much of this system occurs in designated wilderness areas and is not exposed to serious threats. This system is generally inaccessible which precludes most human activities.
- Global climate change could alter species composition of this system possibly by allowing more vascular plant species to establish as well as a shift in species composition.
- Invasive plants is mainly a threat within the Inter-Mountain Basins Active and Stabilized Dune Ecological System.  This is generally not much of a threat to the other ecological systems associated with Cliff, Scree, and Rock vegetation.

**Habitat needs for SGCN associated with this system**

| | |
|---|---|
| **Nesting habitat** | Golden Eagle and Peregrine Falcon nest on cliffs and rock faces. |
| **Habitat complexity** | Voids and fissures in rock and talus provide roosting habitat for Townsend's Big-eared Bats and denning habitat for American Pika, Wolverine, and Olympic Marmot. |

**Actions needed to maintain habitat quality for SGCN**

- Activities that disturb or displace species that use the system should be discouraged or not allowed during sensitive times.  Those activities may include mining or recreation such as rock climbing.
- Activities that remove habitat such as substrate mining should be discouraged.

**Ecological systems discussed in greater detail in this chapter include:**

A. Inter-Mountain Basins Active and Stabilized Dune

## Inter-Mountain Basins Active and Stabilized Dune

**Conservation Status and Concern**
Most examples of this system in Washington have either been converted over by various land use activities or have been significantly altered. Seventeen SGCN are associated with Inter-mountain Basins Active and Stabilized Dunes; more than half of which are closely associated with this ecological system. It is an especially important habitat for many of the SGCN amphibian and reptiles of eastern Washington.

**Description and Distribution**
Although these dunes are primarily restricted to the Columbia Plateau Ecoregion, a few occur in the Okanogan Ecoregion as far north as the boundary with British Columbia in Okanogan County. Sand dunes are highly dynamic systems and patterns of plant species composition are closely related to sand erosion, deposition and dune migration and stabilization (Chadwick and Dalke 1965). These processes may occur rapidly, leaving legacies from previous vegetation types. While repeating patterns of vegetation are observed and allow the identification of community types, they are often present in a spatially complex, fine-scale mosaic. The boundaries between community types range from distinct to highly blurred (Easterly and Salstrom 1997).

Sand dunes support vegetation if wind stress is not too great (WDFW 2008). Although vegetation tends to be variable, dunes often consist of plants common to shrub-steppe, such as antelope bitterbrush, rabbitbrush and snow buckwheat. However, some plants are more restricted to sand dune, such as, Indian Ricegrass, Lemon Scurfpea, and Veiny Dock. The vegetation cover is related to annual rainfall totals and evapotranspiration rates. The mobility of sand dunes is related to the power of the wind, while a dune's mobility becomes inhibited as vegetation cover increases. Long periods of increased precipitation and persistent presence of vegetation may lead to a sand surface covered by litter and/or mosses and lichens. These same factors also can initiate soil formation, which can cause dune stabilization. Periods of drought are generally unfavorable to vegetation and can reinitiate the mobility of sands (WDFW 2008).

| PHS | NHP Rank | Status and trend | SGCN closely and generally associated with this ecological system |
|---|---|---|---|
| Yes Inland Dunes | S1 | Critically imperiled/ declining.<br><br>Declines of 50-70% in last 50 years and 70-80% from historical condition. | **MAMMALS:** Pygmy Rabbit, Spotted Bat |
| | | | **BIRDS:** Burrowing Owl, Ferruginous Hawk*, Short-eared Owl |
| | | | **REPTILES/AMPHIBIANS:** Northern Leopard Frog*, Western Toad, Woodhouse's Toad*, Night Snake, Sagebrush Lizard*, Short-horned Lizard*, Side-blotched Lizard*, Striped Whipsnake* |
| | | | **FISH:** to be determined- research needed |
| | | | **INVERTEBRATES:** A Noctuid Moth*, Columbia River Tiger Beetle*, Morrison's Bumblebee |

* SGCN is closely associated with this ecological system

**Stressors and Actions Needed**
Washington inland sand dune systems have declined approximately 76% from the early 1970s, primarily as a result of conversion to agricultural, reservoir flooding, and dune stabilization (Hallock et al. 2007). Currently, the major threats to Washington's inland sand dunes are invasive species, agricultural

conversion, including the effects of adjacent irrigation, off-road vehicle use, dune stabilization, home development, mining, and livestock grazing (Hallock et al. 2007).

| STRESSOR | DESCRIPTION | ACTION CATEGORY | ACTION DESCRIPTION |
|---|---|---|---|
| Invasive and other problematic species | Exotic grasses invading and introduced to actively stabilize dunes are major threat. | • Invasive species control<br>• Partner/stakeholder engagement | Integrated habitat restoration using prescribed fire, weed control, and seeding with native vegetation. |
| Dams, levees and diversions | The Columbia River Irrigation Project has increased water table creating inter-dunal wetland and ponds that stabilized dunes. | • Water management<br>• Water rights acquisition<br>• Partner/stakeholder engagement | Remove water retention structures and encourage water conservation in agriculture. |

**Specific Ecological System References (complete list at end of chapter)**

Hallock, L. A., R. D. Haugo, and R. Crawford. 2007. Conservation strategy for Washington State inland sand dunes. Natural Heritage Report 2007-05. Prepared for the Bureau of Land Management. Washington Department of Natural Resources. Olympia, Washington.

Washington Department of Fish and Wildlife (WDFW). 2008. Priority Habitat and Species List. Olympia, Washington. 177 pp.

## DEVELOPED AND URBAN

**Overview**

Many think that when lands are developed they lose almost all value as fish and wildlife habitat. Although the habitat needs for most SGCN do not exist in developing and urban landscapes, development never eliminates all fish and wildlife habitat. In fact, even though trends in the number of native species decline along a gradient from rural, to suburban, to the urban core, many native species as well as some SGCN are surprisingly resilient and tolerant of the presence of people. Nesting of Peregrine Falcons on a downtown Seattle skyscraper is an example of how a SGCN can adapt.

Open spaces as well as artificial structures (e.g., bridges, eaves, and feeders) in developed landscapes can also provide suitable nesting, roosting, and foraging opportunities to SGCN and other native species. Although only three terrestrial SGCN, Peregrine Falcon, Streaked Horned Lark, and Sharptail Snake, are closely associated with any of the Developed and Urban Ecological Systems, many others use these systems as habitat in Washington. Many salmonid SCGN must migrate through rivers that run through developed and highly urbanized areas, thus effects on water quality and condition of riparian habitats are of particular concern. Some of their spawning areas are closely associated with developed areas. SGCN salmonids that migrate long distances within the Columbia Basin are exposed to multiple developed areas, resulting in a close association with this habitat form. Problems arise when unplanned development or low-density urban sprawl removes and degrades once-important habitat. With population forecasts showing an additional 2 million Washingtonians by 2040, ensuring wisely planned development will be one of our greatest challenges to conserving fish and wildlife habitat across the state.

| Distribution | Public Land | Private Land | SGCN with close association (#) | SGCN with general association (#) | Ecological systems of concern (#) |
|---|---|---|---|---|---|
| 2,039 $mi^2$ | 11% | 89% | 6 | 57 | 0 |

**Major Stressors**

- Loss and degradation of habitat and connectivity from low-density urban sprawl.
- Degraded habitat structure from fire suppression in and around rural and exurban home sites.
- Loss of habitat and connectivity in undeveloped areas to provide services (e.g., power-lines).
- Increased human-wildlife conflicts (e.g., Cougar encounters, roadkill deer).
- Harassment and predation by people and domestic animals (e.g., house cats and songbirds).
- Water quality degradation from point and non-point source pollution and water withdrawal.
- Loss and degradation of nearshore and estuarine habitats from industrial and residential development.
- Loss of stream and river habitat and connectivity due to fish passage barriers such as road crossings, culverts, dikes and dams.

**Habitat needs for SGCN associated with this system**

| | |
|---|---|
| **Habitat connectivity/ corridors** | A number of SGCN that use Developed and Urban Ecological Systems have limited mobility, inhibiting their movement across barriers such as roads and subdivisions. These low mobility SGCN primarily consist of small rodents, reptiles, and amphibians. SGCN anadromous fishes need passage improvements where various types of instream barriers currently block or impede migrations. |
| **Large unfragmented blocks of habitat** | Many SGCN are area sensitive, meaning they have a minimum size threshold for habitat to be functional for uses such as for breeding. Bald Eagle, Peregrine Falcon, Oregon Vesper Sparrow, and Western Gray Squirrel are known to require larger contiguous patches of undeveloped land. |
| **Lower development densities** | Most associated SGCN do best where development densities are low (1 home per 10 to 20 acres). However, many of the same species can exist when densities are greater (1 home per 5 acres), so long as development proposals incorporate conservation measures (e.g., cluster development) and do not degrade surface and sub-surface water quality or quantity. |
| **Public education** | A better grasp of the needs of SGCN by the public (and especially urban citizens) will help them become better stewards of landscapes and advocates for conservation. |
| **High water quality standards** | Most SGCN fishes are likely to be adversely affected by poor water quality. Pollution abatement in water run-off from urban and industrial areas often needs improvement. Sewage treatment systems in low to high intensity developed areas may also be pollution sources. Water withdrawals from rivers and aquifers may reduce flows affecting multiple aspects of water and riverscape habitat quality. |

**Actions needed to maintain habitat quality for SGCN**

- Identify important connectivity areas in developing landscapes to plan future growth.
- Assist local jurisdictions with GMA planning.
- Create database spatial priorities in developing landscapes to protect habitat for SGCN.
- WDFW staff community involvement (e.g., schools and community groups, backyard bird sanctuary enrollments, citizen science projects).
- Management and enforcement of instream flow standards.

**Research and Data Needs**

- Update management recommendations for specific SGCN which can be used by local governments in their land use ordinances and GMA/SMP updates to protect fish and wildlife and their habitats.
- Develop studies that evaluate the local land use ordinances and how those are effectively protecting SGCN associated habitats.

**Specific Ecological System References**. **(complete list at end of chapter)**

Ferguson, H. L., K. Robinette, K. Stenberg. 2001. Wildlife of urban habitats. Pages 317-341 *in* D. H. Johnson and T. A. O'Neil, Managing Directors. Wildlife-habitat relationships in Oregon and Washington. Oregon State University Press, Corvallis, Oregon.

Linders, M. J., W. M. Vander Haegen, J. M. Azerrad, R. Dobson, and T. Labbe. 2010. Management Recommendations for Washington's Priority Species: Western Gray Squirrel. Washington Department of Fish and Wildlife, Olympia, Washington.
Washington Department of Fish and Wildlife (WDFW). 2009. Wildlife in a developing landscape. Pages 1-1 to 1-3 *in* Landscape planning for Washington's wildlife: managing for biodiversity in developing areas. J. Azerrad, J. Carleton, J. Davis, T. Quinn, C. Sato, M. Tihri, S, Tomassi, G. Wilhere, authors. WDFW, Olympia, Washington.
Washington Office of Financial Management. 2014. State of Washington forecast of the state population: November 2014 forecast.

## FLOODED AND SWAMP FOREST

**Overview**
Flooded and swamp forests include 11 riparian and swamp systems comprised primarily of facultative and facultative-wetland vegetation. Although some of these systems are found at higher elevations, most are at low-to mid-elevations and are widely distributed throughout Washington. In eastern Washington, lower to mid-elevation systems are dominated by deciduous trees, while conifers tend to dominate higher elevations. Systems in western Washington have more of a mix of conifer and deciduous trees. The riparian flooded and swamp forest systems hold a special significance to Washington's fauna. Most terrestrial species hold some association with riparian habitat, and all anadromous and freshwater SGCN fish species are closely or generally associated with it. The condition of riparian habitat has large influences on habitat conditions vital for all aquatic organisms (e.g., temperature moderation, instream structure and complexity).

Flooded and swamp forests are generally adapted to high moisture levels, making them vulnerable to projected climate changes in hydrology and fluvial processes resulting from precipitation shifts, reduced snowpack and earlier snowmelt, drought, and altered flow regimes. Declining summer and spring stream flows, particularly when combined with drought, could reduce available water for riparian communities, affecting seedling germination and adult survival and potentially contributing to shifts to more xeric and drought-adapted vegetation. Drought periods may exacerbate fire risk.

| Distribution | Public Land | Private Land | SGCN with close association (#) | SGCN with general association (#) | Ecological systems of concern (#) |
|---|---|---|---|---|---|
| 1479 $mi^2$ | 33% | 67% | 49 | 54 | 4 |

**Major Stressors**
- Roads
- Water diversions
- Logging
- Invasive plants
- Excessive grazing
- Channelization and diking
- Climate Change

**Habitat needs for SGCN associated with this system**

| | |
|---|---|
| **Off-channel features** | Many closely associated SGCN require or are closely linked with important off-channel habitats such as springs and seeps (Cascade Torrent Salamander and a number of SGCN invertebrates) as well as stream-associated swamps and wetlands (Oregon Spotted Frog and Columbian White-tailed Deer). |
| **High water quality** | A number of closely associated SGCN, particularly invertebrates and most SGCN fishes, require waters that are cold, clear, and generally free of silt. These water quality characteristics typically are maintained by functions provided by higher quality riparian habitat. |
| **High ecological integrity** | A number of SGCN prefer older and mature riparian forest conditions with high canopy cover and complex structural characteristics. Closely associated SGCN that require these kinds of conditions include Rocky Mountain Tailed Frog, Cascade Torrent Salamander, Dunn's Salamander, and Puget Oregonian. Wood contributed to streams by these riparian forests is extremely important for forming and maintaining instream habitat conditions needed for spawning and rearing by all SGCN anadromous and freshwater salmonids. Riparian wood and plant inputs to streams provide important habitat conditions for SGCN freshwater non-salmonid fishes. |

**Actions needed to maintain habitat quality for SGCN**
- Grazing, agriculture, and farm management (e.g., fencing livestock)
- Forest management (e., g., forest – riparian buffers)
- Riparian habitat integrity protection and maintenance.
- Habitat restoration (e.g., control invasive plants, restore connectivity, floodplain restoration)

**Research and Data Needs**
- Research to inform riparian conservation planning in arid landscapes.
- Studies on cumulative effects of land use activities within and across watersheds.
- Noticeable gaps in research in the Pacific Northwest need to be filled to address the influences of land uses beyond forestry (e.g., agriculture, urbanization) to help guide riparian management and conservation.

**Ecological systems discussed in greater detail in this chapter include:**

A. Columbia Basin Foothill Riparian Woodland and Shrubland
B. North Pacific Hardwood-Conifer Swamp
C. North Pacific Lowland Riparian Forest and Shrubland
D. Northern Rocky Mountain Lower Montane Riparian Woodland and Shrubland

**Specific Ecological System References**. **(complete list at end of chapter)**

Knutson, K. L., and V. L. Naef. 1997. Management recommendations for Washington's priority habitats: riparian. Washington Department of Fish and Wildlife, Olympia, Washington.

## Columbia Basin Foothill Riparian Woodland and Shrubland

**Conservation Status and Concern**

The Columbia Basin Foothill Riparian Woodland and Shrubland Ecological System has been significantly degraded by historical grazing practices that were poorly managed. This system has also decreased in extent due to agricultural development, roads, dams and other flood-control activities. Twenty-five terrestrial SGCN are associated with this system, of which nine are closely associated species. Although a complete analysis has not been done for all SGCN anadromous and freshwater fishes, several appear closely associated with this system, e.g., Middle Columbia Steelhead DPS, Snake River Basin Steelhead DPS, and Snake River Spring/Summer Chinook Salmon ESU.

**Description and Distribution**

In the Columbia Plateau Ecoregion, this riparian system occurs along the middle and upper Columbia River and its tributaries. It also is widespread in the lower foothills of the East Cascade, Blue Mountain, and Okanogan Ecoregions. This system is found in low-elevation canyons and draws, on floodplains, in steep-sided canyons, and narrow V-shaped valleys with rocky substrates. Underlying gravels may keep the water table just below the ground surface and are favored substrates for black cottonwood (*Populus balsamifera*). Other trees commonly found in this riparian system are white alder (*Alnus rhombifolia)*, quaking aspen (*Populus tremuloides*), water birch (*Betula occidentalis*), and ponderosa pine (*Pinus ponderosa*).

| PHS | NHP Rank | Status and trend | SGCN closely and generally associated with this ecological system |
|---|---|---|---|
| Yes Riparian | S2 | Imperiled/ declining.<br><br>Declines of 50-70% in last 50 years and from historical condition. | **MAMMALS:** Hoary Bat, Silver-haired Bat, Spotted Bat, Townsend's Big-eared Bat |
| | | | **BIRDS:** Bald Eagle, Burrowing Owl, Ferruginous Hawk, Golden Eagle, Lewis' Woodpecker, Loggerhead Shrike, Pygmy Nuthatch |
| | | | **REPTILES/AMPHIBIANS:** Columbia Spotted Frog, Northern Leopard Frog*, Rocky Mountain Tailed Frog*, Western Toad, Ringneck Snake*, Sharptail Snake* |
| | | | **FISH:** to be determined- research needed |
| | | | **INVERTEBRATES:** Columbia Oregonian*, Dry Land Forestsnail, White-belted Ringtail*, Columbia Clubtail*, Mad River Mountainsnail*, Mann's Mollusk-eating Ground Beetle*, Mission Creek Oregonian, Morrison's Bumblebee |

* SGCN is closely associated with this ecological system

**Stressors and Actions Needed**

| STRESSOR | DESCRIPTION | ACTION CATEGORY | ACTION DESCRIPTION |
|---|---|---|---|
| Overharvesting of biological resources | Intentional beaver removal has led to loss and degradation of riparian habitat. | • Native species restoration | Restore beaver to its historical range |

| STRESSOR | DESCRIPTION | ACTION CATEGORY | ACTION DESCRIPTION |
|---|---|---|---|
| Climate change and severe weather | Impacting hydrology by altering seasonal inputs of water from rainfall and snowmelt. | • Research, survey or monitoring – habitat<br>• Partner/ stakeholder engagement | Research to identify climate change effects and to identify most vulnerable riparian areas. |
| Agriculture and aquaculture side effects | Grazing practices have impacted structure, composition, and function. | • Grazing/farm management | Encourage fencing livestock away from sensitive riparian zones. |
| Dams and diversions | Greatly altering the frequency and intensity of bottomland flooding. | • Dam and barrier removal<br>• Water management<br>• Water rights acquisition | Remove water retention structures and encourage water conservation in agriculture to return bottomland flooding closer to historical levels. |
| Invasive and other problematic species | Invasive plants like reed canarygrass (*Phalaris arundinacea*) have degraded many occurrences of this system. | • Invasive species control | Encourage fencing livestock away from sensitive riparian zones, non-native eradication, and restoration of riparian tree by planting. |

Historical and contemporary land use practices have impacted hydrologic, geomorphic, and biotic structure and function of this riparian system throughout eastern Washington. A comparison of the historical and current extent shows that about 90 percent of the Columbia Basin Foothill Riparian Woodland and Shrubland Ecological System in Washington has either been lost or severely degraded. Much of this is the result of widespread land clearing for crops. Land use activities both within riparian areas as well as in adjacent uplands have fragmented many riparian reaches, which has reduced its connectivity with uplands.

Improperly managed grazing is another major influence that has altered the structure, composition, and function of this system. In general, the presence of livestock in arid riparian systems leads to less woody cover and an increase of undesirable plants. The degradation of this system also inhibits its influence on in-stream properties, such as maintaining water quality for the benefit of aquatic organisms. Although grazing and agriculture are the major stressor, this ecosystem has also been lost or degraded to the construction of roads, dams and other flood-control structures. While the widespread removal of beaver has reduced riparian habitat function, beaver recolonization in the interior Columbia River Basin has led to the rapid expansion of riparian habitat along incised streams. Climate change is also a concern because of this system's reliance on seasonal rainfall. Thus, increased drought frequency and duration are a concern.

**Specific Ecological System References. (complete list at end of chapter)**

Kauffman, J. B., A. S. Thorpe, and E. N. J. Brookshire. 2004. Livestock exclusion and belowground ecosystem responses in riparian meadows of Eastern Oregon. Ecological Applications 14: 1671-1679.

Pollock, M. M., T. J. Beechie, and C. E. Jordan. 2007. Geomorphic changes upstream of beaver dams in Bridge Creek, an incised stream channel in the interior Columbia River basin, eastern Oregon. Earth Surface Processes and Landforms 32: 1174-1185.

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## North Pacific Hardwood-Conifer Swamp

**Conservation Status and Concern**

Widespread logging has altered the structure and composition of most of these forested wetlands. To a lesser degree, other land uses have also impacted this system. Only a fraction of what remains has characteristics consistent with high ecological integrity. Eleven terrestrial SGCN are associated with this system, for which only the Oregon Spotted Frog is a closely associated species.

**Description and Distribution**

Most occurrences of North Pacific hardwood-conifer swamps in Washington are concentrated in the Pacific Northwest Coast Ecoregion, though patches are found sporadically in the West and North Cascades Ecoregions as well as in Puget Trough. The sizes of patches are mostly small and sporadically distributed in glacial depressions, river valleys, at the edges of lakes and marshes, and on slopes where there are seeps. Examples of this system mainly occur on flat to gently sloping lowlands below 1,500 feet elevation, though they are found in higher elevation forests when shallow soils occur over bedrock. This system is dominated by any one or a number of coniferous or hardwood species. Overstory canopy can be dense to relatively open (i.e. less than 50 percent). Shrub cover can also vary from dense to less than 50 percent. Soils are poorly drained while surface waters either move slowly or occur as stagnant pools. Groundwater or streams which do not experience significant overbank flooding are major contributors of water.

| PHS | NHP Rank | Status and trend | SGCN closely and generally associated with this ecological system |
|---|---|---|---|
| Yes (Riparian; Freshwater Wetlands - Fresh Deepwater) | S2 | Imperiled/ declining.<br><br>Declines of 30-50 % within last 50 years.<br><br>Declines of 70-80% from historic. | **MAMMALS:** Fisher, Hoary Bat, Keen's Myotis, Silver-haired Bat, Townsend's Big-eared Bat, Western Spotted Skunk<br>**BIRDS:** Bald Eagle, Barrow's Goldeneye, Harlequin Duck, Marbled Murrelet, Western Screech Owl<br>**REPTILES/AMPHIBIANS:** Oregon Spotted Frog*, Western Toad<br>**FISH:** to be determined- research needed |

* SGCN is closely associated with this ecological system

**Stressors and Actions Needed**

Forestry has greatly influenced the structure, composition, and function of hardwood-conifer swamps in Washington. Most stands previously comprised of older and mature forest are now younger second-growth stands. Logging has led to establishment of younger red alder (*Alnus rubra*) dominated forest where stands once consisted of various hardwood and conifer species capable of growth in saturated or seasonally flooded soils. Similar to the effects on tree composition, logging can change the composition of understory shrubs. With logging, diverse understories have given way to a much less varied shrub-layer, often dominated by salmonberry (*Rubus spectabilis*;). As a secondary effect of logging, hardwood-conifer swamps have been degraded by the loss of large downed wood and snags. Logging has also negatively impacted forested swamps by altering water quality (e.g., increased nutrients and sediments), hydrology, water temperatures, as well as microclimate. This in turn has harmed aquatic and semiaquatic species, especially those that require clean cool water.

Beyond forestry, other land use activities have impacted the ecological integrity of this system. Agricultural development and roads have decreased the extent of this system. Because of the hydrological connections to adjacent systems, nearby land use activities can alter the ecological integrity of hardwood-conifer swamp systems. Consequently, watershed scale conservation planning as well as the use of buffers and other on-site conservation actions are important to maintaining system integrity. Exotic species, such as reed canarygrass, has also threatened the ecological integrity of hardwood-conifer swamps in Washington.

| STRESSOR | DESCRIPTION | ACTION CATEGORY | ACTION DESCRIPTION |
|---|---|---|---|
| Forestry impacts | Forestry has led to widespread alteration of forest composition and structure. Salmonberry responds similarly to alder and tends to dominate the understory after logging. | • Land use planning<br>• Vegetation management | Strengthen land use regulations (e.g., Forest Practices Act) as well as incentives to ensure adequate riparian buffers.<br><br>Control invasive plants and reestablish native species to restore ecological function. |
| Alteration of hydrology | Degraded water quality and altered hydrology resulting from land use negatively influence aquatic and semi-aquatic species. | • Land use planning | Strengthen land use regulations (e.g., Forest Practices Act) as well as incentives to ensure adequate riparian buffers. |
| Invasive and other problematic species | Invasive species such as reed canary grass and Himalayan blackberry can take over, especially at lower elevations. | • Invasive species control | Control invasive plants and reestablish native species to restore ecological function. |

**Specific Ecological System References**. **(complete list at end of chapter)**

Chappell, C. B., and J. Kagan. 2001. Westside riparian-wetlands. Pages 94-96 *in* D. H. Johnson, and T. A. O'Neil, editors. Wildlife-habitat relationships in Oregon and Washington. Oregon State University Press, Corvallis, OR.

## North Pacific Lowland Riparian Forest and Shrubland

### Conservation Status and Concern

By greatly influencing bottomland flooding, flood-control has altered the structure and composition of this lowland ecological system. Other land uses as well as ongoing threats from invasive species have also aided in the loss and degradation of this system. Thirty terrestrial SGCN are associated with this system, of which seven are closely associated species. Although a complete analysis has not been done for all SGCN anadromous and freshwater fishes, several appear closely associated with this system, e.g., Puget Sound

Chinook Salmon ESU, Lower Columbia Chinook Salmon ESU, Puget Sound Steelhead DPS, Lower Columbia Steelhead DPS, Lower Columbia Coho ESU, Hood Canal Summer Chum Salmon ESU, and Columbia River Chum Salmon ESU.

**Description and Distribution**

North Pacific Lowland Riparian Forest and Shrublands is a linear system that occurs on low-elevation, alluvial floodplains that are confined by valleys and inlets or lower terraces of rivers and streams. This ecological system is widely distributed across lowland western Washington in the Puget Trough, Pacific Northwest Coast, and West Cascade Ecoregions. Scattered occurrences also occur in the North and East Cascades and the Columbia Plateau Ecoregions. Riverine flooding and the succession that occurs after large flood events are the major drivers of this system. Consequently, this system does not develop under stagnant hydrological regimes. North Pacific Lowland Riparian Forest and Shrubland is primarily dominated by broadleaf species such as bigleaf maple (*Acer macrophyllum*), black cottonwood, and red alder, though in the absence of major disturbances conifers tends to increase.

| PHS | NHP Rank | Status and trend | SGCN closely and generally associated with this ecological system |
|---|---|---|---|
| Yes Riparian | S2 | Imperiled/ declining.<br><br>Declines of 30-50% within last 50 years and from historical condition. | **MAMMALS :** Columbian White-tailed Deer*, Fisher, Gray Wolf, Hoary Bat, Keen's Myotis, Pacific Marten, Silver-haired Bat, Townsend's Big-eared Bat, Western Gray Squirrel, Western Spotted Skunk |
| | | | **BIRDS:** Bald Eagle, Peregrine Falcon, Slender-billed White-breasted Nuthatch, Western Bluebird |
| | | | **REPTILES/AMPHIBIANS:** Cascade Torrent Salamander*, Cope’s Giant Salamander, Dunn's Salamander*, Larch Mountain Salamander, Olympic Torrent Salamander, Oregon Spotted Frog*, Van Dyke's Salamander, Western Toad |
| | | | **FISH:** to be determined- research needed |
| | | | **INVERTEBRATES:** California Floater, Puget Oregonian*, Barren Juga, Brown Juga*, Three-band Juga*, Dalles Sideband, Hoko Vertigo, Dalles Hesperian |

* SGCN is closely associated with this ecological system

**Stressors and Actions Needed**

Historical and contemporary land use practices have significantly altered the hydrology and biotic structure and function of this riparian system. Roughly half of the historical extent of this system has been lost, while much of what remains is degraded. Land uses activities both within riparian areas as well as in adjacent uplands have fragmented the riparian zone along most reaches of stream where this system occurs. Forestry, conversion to croplands, and development are primary contributors to loss of North Pacific Lowland Riparian Forest and Shrublands in Washington. Reservoirs, water diversions, levees and other water control structures also have impacted hydrologic regimes important to maintaining this system. In particular, major flood control dams have greatly altered the frequency and intensity of bottomland flooding. This in turn has permanently inundated some areas while altering the vegetative structure and composition of others. The spread of exotic and invasive plants such as reed canarygrass and blackberry have also contributed to the system’s degradation. All these disturbances have compromised the habitat function of North Pacific Lowland Riparian Forest and Shrublands for terrestrial species and compromise the system's contributions to aquatic habitats and species (e.g., input of large wood to rivers and streams).

These forests and shrublands, adapted to high moisture levels and local flooding regimes driven by snowmelt and rainfall hydrology are likely to be affected by changes in hydrology and fluvial processes resulting from climate change (precipitation shifts, reduced snowpack, earlier snowmelt, drought and altered streamflow regimes).

| STRESSOR | DESCRIPTION | ACTION CATEGORY | ACTION DESCRIPTION |
|---|---|---|---|
| Dams, levees and Diversions | Greatly altering the frequency and intensity of bottomland flooding. | • Dam and barrier removal<br>• Water management<br>• Water rights acquisition | Remove water retention structures and possible purchase of water rights to return bottomland flooding closer to historical levels. |
| Forestry impacts | Logging riparian forests results in the loss of terrestrial habitat, while indirectly impacting in-stream habitat conditions. | • Environmental review<br>• Land acquisition<br>• Private lands agreements | Strengthen land use regulations (e.g., Forest Practices Act) as well as incentives to ensure adequate riparian management areas. Outreach to landowners to find mutual benefits. |
| Roads and development | Impacts hydrological regime (e.g., runoff) associated with increased impervious surfaces. Confinement of alluvial floodplains. | • Land use planning | Strengthen land use regulations (e.g., Growth Management Act) as well as incentives to ensure adequate riparian management areas. |
| Climate change and severe weather | Impacting hydrology by altering seasonal inputs of water from rainfall and snowmelt. | • Research, survey or monitoring – habitat<br>• Partner/stakeholder engagement | Research to identify climate change effects and to identify most vulnerable riparian areas. |

## Northern Rocky Mountain Lower Montane Riparian Woodland and Shrubland

**Conservation Status and Concern**

The integrity of this system has been compromised across much of its range by land use activities that modify annual flooding and alter vegetative structure and composition. Twenty-four terrestrial SGCN are associated with this system, of which five are closely associated. Although a complete analysis has not been done for all SGCN anadromous and freshwater fishes, several appear closely associated with this system, e.g., Snake River Spring/Summer Chinook Salmon ESU, and Snake River Basin Steelhead DPS.

**Description and Distribution**

The Northern Rocky Mountain Lower Montane Riparian Woodland and Shrubland Ecological System consists of deciduous, coniferous, and mixed conifer-deciduous woodlands. In Washington, this system occurs mainly on public lands along streams and in floodplains within the lower montane and foothill zones of the Canadian Rocky Mountain, Blue Mountain, and Okanogan Ecoregions. It also sporadically is found along the lower slopes in the East Cascade Ecoregion. This system is maintained by annual flooding and wet soils and can take the form of woodlands, shrublands, wet meadows, and marshes. Beaver (*Castor Canadensis*) activity is an important driver of hydrological change. Black cottonwood is the key indicator species, while several other species, including quaking aspen, paper birch (*Betula papyrifera*), and water birch, can also be mixed among the canopy. Shrubs, ferns, and forbs associated with mesic conditions are also common.

| PHS | NHP Rank | Status and trend | SGCN closely and generally associated with this ecological system |
|---|---|---|---|
| Yes (Riparian) | S2 | Imperiled/ declining. | **MAMMALS :** Gray Wolf, Grizzly Bear, Hoary Bat, Preble's Shrew*, Silver-haired Bat, Townsend's Big-eared Bat, Western Spotted Skunk |
| | | Decline of 10-39% within last 50 years. | **BIRDS:** Bald Eagle, Barrow's Goldeneye, Flammulated Owl, Golden Eagle, Harlequin Duck, Lewis' Woodpecker, Mountain Quail*, Peregrine Falcon |
| | | Declines of 30-50% from historical condition. | **REPTILES/AMPHIBIANS:** Columbia Spotted Frog, Northern Leopard Frog*, Rocky Mountain Tailed Frog*, Tiger Salamander, Western Toad |
| | | | **FISH:** to be determined- research needed |
| | | | **INVERTEBRATES:** Meadow Fritillary*, Morrison's Bumblebee, Mission Creek Oregonian, Idaho Vertigo |

* SGCN is closely associated with this ecological system

**Stressors and Actions Needed**

Almost all productive floodplain riparian zones in central and eastern Washington have been put into agriculture use. Because this system occurs at low to mid elevations, it is accessible to livestock and is highly attractive to congregating cattle. Pressure from livestock has caused both biotic and hydrologic changes to this system. These include severe changes to ecosystem composition, such as when prolonged grazing eliminates shrubs in favor of annuals such as Kentucky bluegrass. Other non-native and invasive species are brought about by grazing and by the pressures of other land uses. At stream edges, the combination of root loss and trampling from heavy grazing weakens and collapses banks. This can cause a stream to downcut, which can lower water tables and severely alter the hydrology of these riparian systems. That in turn can further change and degrade the composition and structure of the riparian vegetation.

Although not as pervasive as grazing, croplands encroachment and logging have also led to the loss and degradation of this ecological system. Changes in hydrological regime caused by dams and water diversions as well as from the removal of beaver have influenced the spatial extent of the system and have altered peak and based flows. These changes can have substantial effect on both riparian plants and aquatic biota.

Climate change influences riparian ecosystems due to the reliance of these systems on water. River hydrology, especially in the arid west, responds to climate change through timing changes of spring snow melt, altered flood magnitudes, and reduced summer and base flows. This can shift riparian plant communities by favoring drought-tolerant species over drought-intolerant cottonwoods that are closely associated with Northern Rocky Mountain Lower Montane Riparian Woodland and Shrublands.

Land use activities both within riparian areas as well as in adjacent uplands have fragmented many riparian reaches, which has reduced riparian-upland connectivity. Degraded riparian habitat is also less able to beneficially influence adjacent streams (e.g., uptake of nutrients and pesticides from agriculture). Consequently, watershed scale conservation planning as well as the use of buffers and other on-site conservation tools are important to maintaining connectivity and system integrity.

| STRESSOR | DESCRIPTION | ACTION CATEGORY | ACTION DESCRIPTION |
|---|---|---|---|
| Agriculture and aquaculture side effects | Grazing practices incompatible with habitat conservation has impacted habitat structure and function. | • Grazing/ farm management | Encourage fencing livestock away from sensitive riparian zones. |
| Invasive and other problematic species | Invasive species become problematic when substrates are disturbed by grazing practices incompatible with habitat conservation. | • Invasive species control | Encourage fencing livestock away from sensitive riparian zones and control invasive plants and reestablish native species to restore ecological function. |
| Climate change and severe weather | Alteration of seasonal and annual flooding regimes will likely have adverse effects | • Address existing stressors | Addressing existing stressors can help build resilience to climate change impacts. |

**Specific Ecological System References**. **(complete list at end of chapter)**

Hultine, K. R., S. E. Bush, and J. R. Ehleringer. 2010. Ecophysiology of riparian cottonwood and willow before, during, and after two years of soil water removal. Ecological Applications 20:347-361.

Kauffman, J. B., M. Mahrt, L. A. Mahrt, and W. D. Edge. 2001. Wildlife of riparian habitats. Pages 361-388 *in* D. H. Johnson, and T. A. O'Neil, editors. Wildlife-habitat relationships in Oregon and Washington. Oregon State University Press, Corvallis, Oregon.

Kovalchik, B. L., and R. R. Clausnitzer. 2004. Classification and management of aquatic, riparian, and wetland sites on the national forests of eastern Washington: series description. USDA Forest Service General Technical Report PNW-GTR-593. Portland, Oregon.

Perry, L. G., D. C. Andersen, L. V. Reynolds, S. M. Nelson, and P. B. Shafroth. 2012. Vulnerability of riparian ecosystems to elevated CO2 and climate change in arid and semiarid western North America. Global Change Biology 18: 821-842.

Poff, B. K., A. Karen, D. G. Neary, and V. Henderson. 2011. Threats to Riparian Ecosystems in Western North America: An Analysis of Existing Literature. Journal of the American Water Resources Association 47:1241-1254.

Wissmar, R. C. 2004. Riparian corridors of eastern Oregon and Washington: functions and sustainability along lowland-arid to mountain gradients. Aquatic Sciences 66: 373-387

## FRESHWATER AQUATIC VEGETATION, WET MEADOW, AND MARSH

**Overview**

The freshwater aquatic vegetation, wet meadow, and marsh vegetation formation includes 11 ecological systems comprised mainly of native herbaceous vegetation. Associated ecological systems occur at a broad range of elevations, climate conditions, and are widely distributed throughout Washington. They mostly occur in small patches, found primarily where there are hydric soils. Many of these systems are made up of diverse plant communities and are used by a wide range of Washington's SGGN. The wet meadow and marsh systems that occur in arid parts of the state are particularly important as refuge for native fauna during dry summer periods. Washington has lost an estimated 31 percent of its 1.35 million acres of wetlands. Although many wetlands that remain are of high ecological quality, others occur in a degraded state.

Climate changes such as drought, increasing temperatures, and changes in precipitation type, timing, and amount that alter hydrologic regimes and rates of evaporation and recharge may have significant impacts in wetland habitats. For example, these climate changes could lead to wetland drying, shifts in species assemblages (native and non-native), habitat conversion, and/or decreased quality and quantity of habitat available for aquatic biota. Changes in winter precipitation type and timing, as well as earlier runoff, could positively (e.g., create side channels or additional habitat) or negatively (e.g., reduced opportunities for water storage and recharge, increased erosion) impact these habitats.

| Distribution | Public Land | Private Land | SGCN with close association (#) | SGCN with general association (#) | Ecological systems of concern (#) |
|---|---|---|---|---|---|
| 559 $mi^2$ | 11% | 89% | 40 | 68 | 5 |

**Major Stressors**

- Dams and water management/use
- Invasive plants
- Pollution and degraded water quality
- Excess pressure from agriculture and grazing
- Loss of connectivity with uplands
- Climate Change

**Habitat needs for SGCN associated with this system**

| | |
|---|---|
| **Open habitat** | Several amphibians (Oregon Spotted Frog, Western Pond Turtle, and Northern Leopard Frog) closely associated with some Freshwater Wet Meadow and Marsh ecological systems require open habitats with understory vegetation of low stature so eggs and egg masses will be exposed to sufficient sunlight. |
| **High ecological integrity** | The same amphibians that need open habitat are negatively affected by predators such as warm water fishes or bullfrogs (*Lithobates catesbeiana*) and when wetlands are invaded by aggressive plants such as reed canarygrass or plants such as the native broadleaf cattail (*Typha latifolia*) that may become aggressive when alterations to hydrology, nutrient and sediment regime produce an environment conducive to forming monotypic stands. Olympic Mudminnow and Tui Chub are likely closely associated with this system and require its ecological integrity throughout their life cycles. |
| **High habitat connectivity** | A number of closely associated SGCN have low mobility. Because many of these same species also require different types of habitats in close proximity to one another, wetlands with few barriers to adjacent uplands are preferred. |

**Actions needed to maintain habitat quality for SGCN**

- Invasive plant and animal control.
- Habitat restoration and native plant restoration.
- Maintenance and/or restoration of a close approximation of system's natural hydrology.

**Research and Data Needs**

- Information on the effects of agricultural practices on wetland functions in the Pacific Northwest,especially in eastern Washington, is limited.
- Studies have examined whether projects using compensatory wetland mitigation met performance standards. However, few studies explore why performance standards are not meth.
- Research on cumulative impacts to wetlands is mainly addressed from the perspective of direct wetland losses, and less from the perspective of degraded wetlands.
- Research on the effectiveness of wetland regulations and wetland rating systems for conserving species and important wetland functions and processes.

**Ecological systems and other habitats discussed in greater detail in this chapter include:**

A. Temperate Pacific Freshwater Mudflat
B. North Pacific Intertidal Freshwater Wetland
C. North American Arid West Emergent Marsh
D. Willamette Valley Wet Prairie
E. Temperate Pacific Freshwater Emergent Marsh

**Specific Ecological System References**. **(complete list at end of chapter)**

Dahl, T. E. 1990. Wetland losses in the United States 1780's to 1980's. U. S. Fish and Wildlife Service, Washington, DC, USA.

## North American Arid West Emergent Marsh

**Conservation Status and Concern**
North American arid west emergent Marshes provide important habitat for many migratory water birds as well other species that require shallow waters. It is also a particularly valuable source of moist habitat for fauna during dry summer periods in arid landscapes. Although a widespread system, almost all occurrences are degraded ecologically from their historical condition. Twenty terrestrial SGCN are associated with this system, eight of which are closely associated species. A complete analysis of habitat association has not been done for SGCN anadromous and freshwater fishes.

**Description and Distribution**
North American Arid West Emergent Marshes are widespread below the lower tree-line throughout the Columbia Plateau, and along the lower portions of the Canadian Rocky Mountain, and Okanogan Ecoregions. Typically represented as small wetland patches surrounded by savanna, shrub-steppe, or meadow-steppe vegetation, occurrences are sporadically distributed, mostly within depressions (e.g., ponds), along lake fringes, and near slow-flowing rivers and streams. Water chemistry can be highly variable, even within the same wetland complex and soils have hydric characteristics. Marshes are frequently inundated to water depths of up to 6 feet. For most of the growing season water can be found at or above the surface, although soils can become exposed by late summer. Plants adapted to waterlogged substrates dominate these wetlands and common emergent and floating vegetation include species of sedge, bulrush, rushes, pondweed, and pond-lily.

| PHS | NHP Rank | Status and trend | SGCN closely and generally associated with this ecological system |
|---|---|---|---|
| Yes (Freshwater Wetlands - Fresh Deepwater) | S2 | Imperiled/ declining.<br><br>Declines of 30-50% within last 50 years and from historical condition. | **MAMMALS:** Hoary Bat, Kincaid Meadow Vole*, Silver-haired Bat, Spotted Bat, Townsend's Big-eared Bat |
| | | | **BIRDS:** American White Pelican, Bald Eagle, Barrow's Goldeneye, Cinnamon Teal*, Common Loon, Marbled Godwit, Peregrine Falcon*, Red-necked Grebe, Short-eared Owl, Upland Sandpiper* |
| | | | **REPTILES/AMPHIBIANS:** Columbia Spotted Frog, Northern Leopard Frog*, Tiger Salamander*, Woodhouse's Toad* |
| | | | **FISH**: to be determined- research needed |
| | | | **INVERTEBRATES:** Silver-bordered Fritillary* |

* SGCN is closely associated with this ecological system

**Stressors and Actions Needed**
A variety of land use activities and stressors have negatively impacted this system. They range from development, grazing and agriculture, roads, invasive species, as well as the availability and quality of water. Grazing, invasive species, especially reed canarygrass, and altered hydrology have degraded almost every occurrence of this system in the Columbia Basin. Grazing practices that are incompatible with habitat conservation is a likely reason for the decreased abundance of native sedges and grasses, and an increase of invasive plants. Land use disturbance in contributing watersheds can contribute excess nutrients to marshes, which can also aid in the spread of invasive plants. Land use activities both within marshes as well as in adjacent uplands have likely reduced connectivity between wetland and upland habitats. Because

Bullfrogs have successfully spread throughout the low elevations of Washington State and is common to the Columbia Basin Ecoregion, this species likely occurs in this marsh system. As the frequency of severe droughts and air temperatures increase as a result of climate change, this will likely put further stress on this ecological system (e.g., wetlands drying out).

| STRESSOR | DESCRIPTION | ACTION CATEGORY | ACTION DESCRIPTION |
|---|---|---|---|
| Agriculture and aquaculture side effects | Spread of invasive plant species, particularly through grazing practices that are incompatible with habitat conservation. | • Invasive species control<br>• Grazing/farm management<br>• Private lands agreements | Control invasive plants to maintain native species and restore ecological functions. Work with landowners to exclude livestock from marshes. |
| Alteration of hydrology | Hydrological alterations | • Water management<br>• Water rights acquisition<br>• Grazing/farm management<br>• Private lands agreements | Remove water retention structures and possible purchase of water rights to minimize loss of groundwater. |
| Climate Change and severe weather | Sensitive to increasing temperatures and changes in precipitation type, timing, and amount | • Research, survey or monitoring - habitat | Activities to restore ecological function. |
| Invasive and other problematic species | Spread of invasive plant species, particularly through grazing practices that are incompatible with habitat conservation. | • Invasive species control<br>• Grazing/farm management<br>• Private lands agreements | Control invasive plants to maintain native species and restore ecological functions. Work with landowners to exclude livestock from marshes. |

**Specific Ecological System References**. **(complete list at end of chapter)**

Hallock, L. A., and K. R. McAllister. 2009. American Bullfrog. Washington Herp Atlas. http://www1.dnr.wa.gov/nhp/refdesk/herp/

## North Pacific Intertidal Freshwater Wetland

**Conservation Status and Concern:**
Hydrological modifications, especially those which alter tidal exchange, have negatively affected the ecological processes and species associated with this system. This and other disturbances such as spread of invasive plants have contributed to significant declines in spatial extent and ecological integrity of North Pacific Intertidal Freshwater Wetlands in Washington. Nine terrestrial SGCN are associated with this system, of which the Columbian White-tailed Deer and Peregrine Falcon are closely associated. A complete analysis of habitat association has not been done for SGCN anadromous and freshwater fishes.

**Description and Distribution**
North Pacific Intertidal Freshwater Wetland is a small-patch, tidally influenced freshwater ecological system that forms as narrow strips as well as more extensive patches of habitat. It occurs primarily in the Puget Trough and Pacific Northwest Coast Ecoregions. More specifically occurrences are found in bays and inlets of Washington's southern outer coast, at outlets of large rivers that discharge into Puget Sound (e.g., Skagit River Delta), and along the Columbia River and its tributaries downstream of Bonneville Dam. Although little detailed vegetation data has been collected for this system, plants communities are complex and can include patches dominated by trees, shrubs or herbaceous species.

| PHS | NHP Rank | Status and trend | SGCN closely and generally associated with this ecological system |
|---|---|---|---|
| Yes (Freshwater Wetlands - Fresh Deepwater) | S1 | Critically imperiled/ declining.<br><br>Decline of 50-70% within last 50 years and from historical condition. | **MAMMALS :** Columbian White-tailed Deer*, Hoary Bat, Silver Haired Bat |
| | | | **BIRDS:** Peregrine Falcon*, Bald Eagle, Barrow's Goldeneye, Red Necked Grebe, Sandhill Crane (Greater) |
| | | | **FISH:** to be determined- research needed |

* SGCN is closely associated with this ecological system

**Stressors and Actions Needed**
An estimated 90 percent of Puget Sound freshwater tidal wetlands have been lost, while lesser but still significant losses are documented in the Columbia River System. Hydrological modifications, especially those that alter tidal exchange (e.g., jetties, dikes, and dams) have contributed to these losses. Direct alterations of hydrology (i.e., channeling, draining, damming) as well as indirect alterations (e.g., roads on adjacent slopes) have likely also changed the locations of these types of wetlands. Water control structures have degraded the ecological processes and species composition linked to this system by substantially altering the processes that maintain this system. Where there have been long term changes in flow, these wetlands have sometimes reestablished to reflect the new hydrology (e.g., broadleaf cattail can be an aggressive invader).

Although harvesting timber in wetlands is now regulated, many occurrences were historically logged. Logging and other activities within wetlands as well as in adjacent uplands have likely also reduced wetland connectivity with upland habitat. Most remaining occurrences of North Pacific Intertidal Freshwater Wetlands are degraded to some extent by invasive weeds, such as reed canarygrass, giant knotweed (*Polygonum sachalinense*), and purple loosestrife (*Lythrum salicaria*).

| STRESSOR | DESCRIPTION | ACTION CATEGORY | ACTION DESCRIPTION |
|---|---|---|---|
| Dams, levees and diversions | Hydrological alterations (especially those which alter tidal exchange) | • Dam and barrier removal<br>• Hazard removal<br>• Instream modification | Restore hydrological processes by removing or modifying in-stream and near shore barriers inhibiting historical hydrological regime |
| Fish and wildlife habitat loss or degradation | Reduced connectivity with uplands | • Dam and barrier removal<br>• Create new habitat or natural processes | Remove barriers inhibiting habitat connectivity to restore ecological function. |
| Invasive and other problematic species | Invasive plants | • Invasive species control | Control invasive plants and reestablish native species to restore ecological function. |

**Specific Ecological System References**. **(complete list at end of chapter)**

Fresh K., M. Dethier, C. Simenstad, M. Logsdon, H. Shipman, C. Tanner, T. Leschine, T. Mumford, G. Gelfenbaum, R. Shuman, and J. Newton. 2011. Implications of Observed Anthropogenic Changes to the Nearshore Ecosystems in Puget Sound. Prepared for the Puget Sound Nearshore Ecosystem Restoration Project. Technical Report 2011-03.

Marcoe, K., and S. Pilson. 2012. Land cover change in the Lower Columbia River Estuary, 1880 – 2011. Poster presented at The Columbia River Estuary Conference. May 15 to 17, 2012, Astoria, Oregon.

## Temperate Pacific Freshwater Emergent Marsh

**Conservation Status and Concern:**
Although Temperate Pacific Freshwater Emergent Marshes remain widespread on the landscape, much, if not most of it is in a degraded condition. The system has also likely experience significant decline in its extent in Washington. Twenty-one terrestrial SGCN are associated with this system, five of which are closely associated species. A complete analysis of habitat association has not been done for SGCN anadromous and freshwater fishes.

**Description and Distribution**
Dominated by herbaceous vegetation, this system occurs as small patches mainly in lowlands. In Washington, Temperate Pacific Freshwater Emergent Marshes are most abundant in the Puget Trough Ecoregion, though it occurs throughout the Pacific Northwest Coast and North Cascades Ecoregions and in sporadic locations across the foothills of the East and West Cascades. This freshwater system ranges from seasonally to permanently flooded wetlands found in depressions, along streams, and shorelines. A consistent freshwater source is essential to the function of this system. Therefore, waters generally remain at or above the surface, though water levels can radically fluctuate and by late summer bare soil can become exposed. Waters are nutrient rich, which favor aggressive species and low plant species diversity. Vegetation is frequently made up of graminoids (e.g., grasses, sedges, rushes), though forbs can be present. Trees, shrubs and non-vascular plants are typically absent or sparse.

| PHS | NHP Rank | Status and trend | SGCN closely and generally associated with this ecological system |
|---|---|---|---|
| Yes Freshwater Wetlands, Freshwater Deepwater | S2 | Imperiled/ declining<br><br>Decline of 10 to 30% within last 50 years and from historical condition. | **MAMMALS:** Columbian White-tailed Deer, Hoary Bat, Keen's Myotis, Shaw Island Vole, Silver-haired Bat, Townsend's Big-eared Bat |
| | | | **BIRDS:** Bald Eagle, Barrow's Goldeneye, Cinnamon Teal*, Dusky Canada Goose, Harlequin Duck, Peregrine Falcon*, Purple Martin, Sandhill Crane (greater), Short-eared Owl |
| | | | **REPTILES/AMPHIBIANS:** Columbia spotted frog, Oregon spotted frog*, Tiger Salamander*, Western Toad, Western Pond Turtle* |
| | | | **FISH:** to be determined- research needed |

* SGCN is closely associated with this ecological system

**Stressors and Actions Needed**
Although most wetlands now receive regulatory protections, historical filling and draining certainly led to the direct loss of these wetlands. In addition to direct losses, alterations to this system have occurred from activities like diking, urban development, and agricultural. Given that a high concentration of these wetlands are in populous regions of the state, urban development pressures have certainly taken a toll on this ecological system. Such influences include altered hydrology associated with runoff over impervious surfaces. It also includes the flush of nutrients and toxic contaminants into wetlands from roads and development.

Development has also fragmented these wetlands from other nearby wetlands as well as from adjacent uplands. Similar to other types of wetlands, many Temperate Pacific Freshwater Emergent Marshes are degraded by invasive plants. Broadleaf cattail is a native species that can become a particularly problematic invader when ecological conditions have been altered. With the spread of Bullfrogs throughout the lowlands of Washington, especially in the Puget Sound Region, this non-native predator is now common to marsh systems in this region. Conversely, the widespread trapping of beaver has diminished the positive role that this species used to play in creating and maintaining wetlands throughout the state.

| STRESSOR | DESCRIPTION | ACTION CATEGORY | ACTION DESCRIPTION |
|---|---|---|---|
| Invasive and other problematic species | Invasive plants | • Invasive species control | Control invasive plants and reestablish native species to restore ecological function. |
| Invasive and other problematic species | Bullfrog use of wetland. | • Invasive species control | Control bullfrogs, especially where they coexist with vulnerable SGCN. |
| Roads and development | Impacts hydrological regime (e.g., runoff) associated with increased impervious surfaces. Confinement of alluvial floodplains. | • Land use planning | Strengthen land use regulations (e.g., Growth Management Act) as well as incentives to help encourage compatible development, such as Low Impact Development techniques. |

**Specific Ecological System References**. **(complete list at end of chapter)**

Hallock, L. A., and K. R. McAllister. 2009. American Bullfrog. Washington Herp Atlas. http://www1.dnr.wa.gov/nhp/refdesk/herp/

MacKenzie, W. H., and J. R. Moran. 2004. Wetlands of British Columbia: a guide to identification. Research Branch, B.C. Ministry of Forestry, Victoria, British Columbia.

## Temperate Pacific Freshwater Mudflat

### Conservation Status and Concern

Temperate Pacific Freshwater Mudflat Ecological Systems provide important habitat, especially as a migratory stopover for shorebirds to rest and feed. This ecological system has decreased from its historical extent in Washington, primarily because of a significantly altered flooding regime. Five terrestrial SGCN are associated with this system, of which only the Cinnamon Teal are closely associated. A complete analysis of habitat association has not been done for SGCN anadromous and freshwater fishes.

### Description and Distribution

This small patch system ranges from sparsely vegetated to extensive sods of herbaceous vegetation. The system occurs in seasonally flooded shallow floodplain mudflats, especially along the estuarine waters of the lower Columbia River in the Pacific Northwest Coast Ecoregion. Plants supported by these mudflats typically are annuals of low stature.

| PHS | NHP Rank | Status and trend | SGCN closely and generally associated with this ecological system |
|---|---|---|---|
| Yes (Freshwater Wetlands - Fresh Deepwater) | S1 | Critically imperiled.<br><br>Decline of 50-70% in last 50 years and from historical condition. | **BIRDS:** Cinnamon Teal*, Bald Eagle, Canada Goose, Peregrine Falcon<br>**FISH**: to be determined- research needed<br>**INVERTEBRATES:** Columbia River Tiger Beetle |

* SGCN is closely associated with this ecological system

### Stressors and Actions Needed

Hydrological alterations in the upper Columbia River drainage (e.g., large mainstem river dams) have likely decreased the extent of this system due to reduced sediment loads carried downstream and because of changes in flooding regime. River bottom dredging has also likely removed the sediment source required to maintain mudflats, while non-native species has also impacted the system.

| STRESSOR | DESCRIPTION | ACTION CATEGORY | ACTION DESCRIPTION |
|---|---|---|---|
| Energy development and distribution | Hydropower alters frequency and intensity of bottomland flooding and sediment inputs. | • Water management | Negotiations with dam operators during relicensing to influence ecosystem. |
| Invasive and other problematic species | Excess nutrients lead to establishment of non-native or invasive plants. | • Invasive species control<br>• Planting/seeding | Removing invasive flora. |

| STRESSOR | DESCRIPTION | ACTION CATEGORY | ACTION DESCRIPTION |
|---|---|---|---|
| Fish and wildlife habitat loss or degradation | Dredging activities can result in removal of sediments needed for mudflat development and maintenance. | • Create new habitat or natural processes<br>• Living shorelines | Work with Corps of Engineers on mudflat restoration (e.g., creating new mudflats with dredging spoils). |

## Willamette Valley Wet Prairie

**Conservation Status and Concern**

Willamette Valley Wet Prairie Ecological System has been nearly extirpated in Washington. Sixteen terrestrial SGCN are associated with this system; seven species mainly comprised of butterflies are closely associated species. A complete analysis of habitat association has not been done for SGCN anadromous and freshwater fishes.

**Description and Distribution**

This system is mainly restricted to oak/prairie landscapes of South Puget Sound as well as parts of Lewis, Cowlitz, and Clark Counties (hereafter referred to as Willamette Valley). Wet prairie is dominated by a highly diverse community of grasses and sedges and to a lesser degree by forbs or shrubs. In fire-maintained prairie landscapes, wet prairies occur in areas with seasonally high water tables. Although likely extirpated, South Puget Sound wet prairie occurred in low-lying sites with open topography and few barriers to isolate them from historically frequent fires. In the permeable, glacial outwash substrates of the region, wet prairies were most likely limited to swales and along low-gradient riparian areas where aquafers were perched close to the surface. The wet prairies of South Puget Sound contrast with Willamette Valley wet prairies, in that the latter generally occurs on fairly impermeable, clay-rich soils. Although Willamette Valley wet prairie once covered a large area, it now is likely restricted to scattered small patches of habitat.

| PHS | NHP Rank | Status and trend | SGCN closely and generally associated with this ecological system |
|---|---|---|---|
| Yes Westside Prairie | S1 | Critically imperiled/ declining.<br><br>Declines of >90% in last 50 years and from historical condition. | **MAMMALS:** Brush Prairie Pocket Gopher, Silver-haired Bat, Townsend's Big-eared Bat, Western Pocket Gopher |
| | | | **BIRDS:** Bald Eagle, Cinnamon Teal, Oregon Vesper Sparrow, Short-eared Owl, Streaked Horned Lark, Western Bluebird* |
| | | | **FISH**: to be determined- research needed |
| | | | **INVERTEBRATES:** Taylor's Checkerspot*, Oregon Branded Skipper*, Mardon Skipper*, Sonora Skipper*, Puget Sound Fritillary*, Valley Silverspot* |

* SGCN is closely associated with this ecological system

**Stressors and Actions Needed**

In the wet prairie swales of the South Puget Sound, relatively high site productivity resulted in their rapid conversion to agricultural use, intense grazing pressure from livestock, and rapid invasion by dense, woody vegetation in the absence of regular fires. In addition, the hydrology of many sites has been altered by draining, agriculture, roads, recession of the ground water table (due to wells), and lack of fire. As a result, native prairie vegetation in wet prairie swale habitat has been extirpated in South Puget Sound and may be close to meeting the same fate in southwest Washington.

| STRESSOR | DESCRIPTION | ACTION CATEGORY | ACTION DESCRIPTION |
|---|---|---|---|
| Fish and wildlife habitat loss or degradation | Habitat is nearly extirpated from Washington | • Private lands agreements<br>• Conservation area designation<br>• Land acquisition<br>• Habitat restoration | Work through regulatory and non-regulatory channels (e.g., conservation easements) to protect known extant wet prairie locations. |
| Resource information collection needs | Insufficient knowledge of the location of remaining wet prairie habitat, especially on private lands, where access is limited. | • Research, survey or monitoring - habitat | Identify extent of remaining wet prairie by gaining access to sites with likelihood of locating habitat. |

**Specific Ecological System References**. **(complete list at end of chapter)**


Altman, B., M. Hayes, S. Janes, and R. Forbes. 2001. Wildlife of westside grassland and chaparral habitats. Pages 261-291 *in* D. H. Johnson and T. A. O'Neil, Managing Directors. Wildlife-habitat relationships in Oregon and Washington. Oregon State University Press, Corvallis, Oregon.

Caplow, F., and J. Miller. 2004. Southwestern Washington prairies: using GIS to find rare plant habitat in historic prairies. Washington Department of Natural Resources, Olympia, Washington.

Chappell, C. B., E. A. Alverson, and W. R. Erickson. 2004. Ecologic and geographic variation in species composition of prairies, herbaceous balds, and oak woodlands of the Willamette Valley-Puget Trough-Georgia Basin Ecoregion. Abstract: Ecological Society of America, August 1 - 6, 2004, Portland Convention Center, Oregon.

Easterly, R. T., D. L. Salstrom, and C. B. Chappell. 2005. Wet prairie swales of the South Puget Sound, Washington. Report prepared for The Nature Conservancy, South Sound Office, Olympia, Washington.

# GRASSLAND, MEADOW, AND SHRUBLAND

**Overview**

Grasslands, meadows, and shrublands include 12 ecological systems comprised of native upland vegetation throughout a broad elevational and climactic range in Washington. They vary from dry subalpine grasslands to prairies to western Washington balds and bluffs, to deciduous shrublands and subalpine meadows to dry canyon grasslands and prairies of eastern Washington. They do not include ecological systems associated with deserts, wetlands, alpine, disturbed, urban, coastal dune and tidal vegetation. A total of 31 SGCN are closely associated with grasslands, meadows and shrublands, and 61 SGCN are generally associated.

| Distribution | Public Land | Private Land | SGCN with close association (#) | SGCN with general association (#) | Ecological systems of concern (#) |
|---|---|---|---|---|---|
| 3,713 $mi^2$ | 46% | 54% | 31 | 61 | 3 |

**Major stressors**

Wildlife habitat loss and degradation, invasive plants and animals (including invading native species), Fire suppression and climate change.

**Habitat needs for SGCN associated with this system**

| | |
|---|---|
| **Deep soils** | Several species (Mazama Pocket Gopher, Olympic Marmot, Badger, Western Pond Turtle) require soils that are relatively deep and suitable for burrowing. These species also provide natural disturbance in grassland habitats. Deep soil habitats are more suitable for agriculture and are sensitive to accelerated succession due to fire suppression and climate change. |
| **High micro-climate diversity** | Many of the butterflies use habitat of high microclimate diversity with few invasive plants and high diversity of native plants. |
| **High ecological integrity** | Some of the birds (Streaked Horned Lark, Oregon Vesper Sparrow) and butterflies (Taylor's Checkerspot, Mardon Skipper, Oregon Branded Skipper, Sonora Skipper) require short-stature vegetation provided by native species, and are sensitive to invasive shrubs and grasses. Ecological integrity of this habitat's riparian areas is important for SGCN interior Columbia basin anadromous salmonids and freshwater fishes. |

**Actions needed to maintain habitat quality for SGCN**

- Fire management (establishment of natural fire regimes and prescribed fire),
- Grazing, agriculture, and farm management,
- Invasive species control,
- Habitat restoration, research, and native species restoration).

**Ecological systems discussed in greater detail in this chapter**

Of the 12 ecological systems found in this formation, the following three are discussed in greater detail.

A. Columbia Basin Foothill and Canyon Dry Grassland,
B. Columbia Basin Palouse Prairie,
C. Willamette Valley Upland Prairie and Savanna.

## Columbia Basin Foothill and Canyon Dry Grassland

**Conservation Status and Concern**

Columbia Basin Foothill and Canyon Dry Grasslands occur over 1,450 square miles in eastern Washington. Degradation in condition is the major cause of conservation need. Cheatgrass (*Bromus tectorum*) and other annual bromes are widespread on south aspects. Exotic weeds also commonly invade this system on the north aspects.

**Description and Distribution**

Columbia Basin Foothill and Canyon Dry Grassland Ecological Systems occur on steep open slopes, from 300 to 5000 feet elevation in the canyons and valleys of the Columbia Plateau Ecoregion, particularly along the Snake River canyon and large tributaries. It typically occurs at and well below lower treeline. It is floristically similar to the Columbia Basin Palouse Prairie but is distinguished by landform, soil, and process characteristics. Perennial bunchgrasses and forbs (usually over 25 percent cover) dominate these grasslands. Annual precipitation is low 5 to 10 inches that occurs mostly in the winter, primarily as rain. Fire frequency is presumed to be less than 20 years; the return interval may have been as low as 5 to10 years. Elk, deer and bighorn sheep are native large grazers in the canyon who used particularly in winter and spring.

There are four terrestrial SGCN that are considered closely associated with this ecological system. They are all birds; Columbian Sharp-tailed Grouse, Greater Sage-grouse, Ferruginous Hawk, and Golden Eagle. An additional 28 terrestrial species are generally associated with this system. Although a complete analysis has not been done for all SGCN anadromous and freshwater fishes, several appear closely associated with this system, e.g., Snake River Basin Steelhead DPS, and Snake River Spring/Summer Chinook Salmon ESU.

| PHS | NHP Rank | Status and trend | SGCN closely and generally associated with this ecological system |
|---|---|---|---|
| Eastside Steppe | S1-S2 | Imperiled/ declining<br><br>Decline of 30 – 50% in last 50 years<br><br>Decline of >90% from historical conditions. | **MAMMALS:** American Badger, White-tailed Jackrabbit, Washington Ground Squirrel, Townsend's Big-eared Bat, Spotted Bat, Silver-haired Bat, Merriam's Shrew, Hoary Bat. |
| | | | **BIRDS:** Bald Eagle, Mountain Quail, Loggerhead Shrike, Short-eared Owl, Peregrine Falcon, Greater Sage Grouse*, Sharp-tailed Grouse*, Ferruginous Hawk*, Burrowing Owl, and Golden Eagle*. |
| | | | **AMPHIBIANS:** Columbia Spotted Frog, Tiger Salamander, Western Toad |
| | | | **FISH**: to be determined- research needed |
| | | | **INVERTEBRATES:** Morrison's Bumblebee, Poplar Oregonian, Giant Palouse Earthworm, Hoder's Mountainsnail, Ranne's Mountainsnail, Limestone Point Mountainsnail. |

**SGCN closely associated with this ecosystem.*

**Stressors and Actions Needed**

Two important attributes not mentioned above are the relative cover of native bunchgrass and condition of the biological soil crust. The primary land uses that alter the natural processes of this system are associated with livestock practices, annual exotic species invasion, fire regime alteration, direct soil surface disturbance, and fragmentation. Excessive grazing stresses the system through soil disturbance, diminishing or eliminating the biological soil crust, altering the composition of perennial species, and increases the establishment of annual grasses, particularly cheatgrass and other exotic annual bromes. Increasing habitat quality is the primary action needed to restore ecological integrity.

| STRESSOR | DESCRIPTION | ACTION CATEGORY | ACTION DESCRIPTION |
|---|---|---|---|
| Altered disturbance regimes | Fire exclusion has resulted in shrub encroachment, loss of habitat diversity | • Fire management<br>• Vegetation management | Integrated Habitat Restoration using prescribed fire, weed control and seeding with natives |
| Invasive and other problematic species | Invasive forbs and shrubs are degrading native grassland | • Invasive species control | Mechanical and herbicide control of exotics |
| Agriculture and aquaculture side effects | Excessive grazing and accelerating weed invasions | • Grazing/farm management<br>• Invasive species control<br>• Planting/seeding<br>• Private lands agreements | Conservation easements, landowner agreements, and restoration. Integrated habitat restoration using prescribed fire, weed control and seeding with natives |

**Specific Ecological System References (complete list at end of chapter)**

Tisdale, E.W. 1986. Canyon grasslands and associated shrublands of west-central Idaho and adjacent areas. Bulletin 40. Forestry, Wildlife and Range Experiment Station, University of Idaho, Moscow.

(Landfire 2007

## Columbia Basin Palouse Prairie

**Conservation Status and Concern**

This once extensive grassland is now limited to small patches, as over 90 percent of the original prairie was converted to agricultural uses. The remaining patches remain subject to weed and native shrub invasion.

**Description and Distribution**

The Columbia Basin Palouse Prairie Ecological System was once an extensive grassland system within the Columbia Plateau Ecoregion in southeast Washington and adjacent Idaho and Oregon. It was characterized by dense bunchgrass cover on a dune-like topography composed of loess hills and plains over basalt informally called the Palouse loess. Remnant prairies are now typically associated with small, steep and rocky sites or small, isolated sites within an agricultural landscape. The associated climate of the Palouse Prairie is generally warm to hot, dry summers and cool, wet winters. Annual precipitation is high, (15 to 30 inches) and the soils were typically deep, well-developed, and old There are four terrestrial SGCN that are considered closely associated with this ecological system. They are all birds (see table below). An additional 12 terrestrial species are generally associated with this system, and include Tiger Salamander, Short-eared Owl, Peregrine Falcon, Burrowing Owl, Cinnamon Teal, Hoary Bat, Silver-haired Bat, Townsends Big-eared Bat, White-tailed Jackrabbit, American Badger, Washington Ground Squirrel, and Giant Palouse Earthworm. A complete analysis of habitat association has not been done for SGCN anadromous and freshwater fishes.

| PHS | NHP Rank | Status and trend | SGCN closely and generally associated with this ecological system |
|---|---|---|---|
| Eastside Steppe | S1 | Critically imperiled/ declining.<br><br>Decline of 10-30% within the last 50 years.<br><br>Decline of >90% from historical condition. | **MAMMALS:** Hoary Bat, Silver-haired Bat, Townsends Big-eared Bat, White-tailed Jackrabiit, American Badger, Washington Ground Squirrel<br>**BIRDS:** Greater Sage-grouse*, Sharp-tailed Grouse*, Ferruginous Hawk*, Golden Eagle*, Short-eared Owl, Peregrine Falcon, Burrowing Owl, Cinnamon Teal.<br>**AMPHIBIANS:** Tiger Salamander<br>**FISH**: to be determined- research needed<br>**INVERTEBRATES**: Giant Palouse Earthworm |

* SGCN is closely associated with this ecological system

**Key Stressors and Actions Needed**

The primary land uses that alter the natural processes of the Columbia Plateau Palouse Prairie system are associated with agricultural and livestock practices, exotic species, fire regime alteration, direct soil surface disturbance, and fragmentation. Fire further stresses livestock-altered vegetation by increasing exposure of bare ground and consequent increases in exotic annuals and decrease in perennial bunchgrass. Fire suppression leads to deciduous shrubs, such as snowberry (*Symphoricarpos* spp.), ninebark (*Physocarpus malvaceus*), oceanspray (*Holodiscus discolor*), and currant (*Ribes* spp.) and in some areas ponderosa pine and Douglas-fir (*Pseudotsuga menziesii*).

| STRESSOR | DESCRIPTION | ACTION CATEGORY | ACTION DESCRIPTION |
|---|---|---|---|
| Altered disturbance regimes | Fire exclusion has resulted in shrub encroachment, loss of habitat diversity | • Fire management<br>• Invasive species control | Integrated Habitat Restoration using prescribed fire, weed control and seeding with natives |
| Invasive and other problematic species | Invasive forbs and shrubs are degrading native grassland | • Fire management<br>• Invasive species control | Mechanical and herbicide control of exotics |

## Willamette Valley Upland Prairie and Savanna

**Conservation Status and Concern**

Due to historical losses in habitat, and ongoing threats from invasive species and development, conservation action is critical for conservation of this ecological system and associated SGCN. There are 15 terrestrial SGCN that are considered closely associated with this ecological system (see table below). There are an additional 8 terrestrial species that are considered generally associated with this ecological system. A complete analysis of habitat association has not been done for SGCN anadromous and freshwater fishes.

**Description and Distribution**

The Willamette Valley Upland Prairie and Savanna is a grassland and savanna system endemic to the Willamette Valley Ecoregion and Puget Lowlands. In Washington, it is most expansive in the south Puget Sound (e.g., Pierce and Thurston Counties) and is also found in the San Juan Islands and in southwestern Washington. Most sites experience extreme soil drought in the summer. In the South Puget Sound, this system occurs as large patches, usually associated with deep, gravelly/sandy glacial outwash that is excessively well drained within more forested landscapes. Landforms are usually flat, rolling, or gently sloping, and often part of extensive plains.

| PHS | NHP Rank | Status and trend | SGCN closely and generally associated with this ecological system |
|---|---|---|---|
| Yes Westside Prairie | S1 | Critically imperiled, declining.<br><br>Decline of 30% within the last 50 years.<br><br>Decline of > 90% from historical condition. | **MAMMALS:** Mazama Pocket Gopher*, Western Gray Squirrel, Townsends Big-eared Bat, Silver-haired Bat, Hoary Bat, and Brush Prairie Pocket Gopher. |
| | | | **BIRDS:** Streaked Horned Lark*, Oregon Vesper Sparrow*, Western Bluebird*, Short-eared Owl, and Bald Eagle. |
| | | | **REPTILES/Amphibians:** Western Pond Turtle* and Western Toad. |
| | | | **FISH:** to be determined- research needed |
| | | | **INVERTEBRATES:** Taylor's Checkerspot*, Mardon Skipper*, Puget Blue*, Valley Silverspot*, Puget Sound Fritillary*, Sonora Skipper*, Island Marble*, Oregon Branded Skipper*, Propertius Duskywing*, and Hoary Elfin*. |

* SGCN is closely associated with this ecological system

**Stressors and Actions Needed**

The exclusion of fire from most of this system over the last 100 plus - years has resulted in the loss of oak savanna from the landscape and the encroachment of Douglas-fir, except perhaps on the very driest sites. This encroachment leads to the conversion of prairies and savannas to forests. Fire exclusion has also resulted in increases in shrub cover and the conversion of some prairies to shrublands. Nonnative species generally increase after ground-disturbing activities. The dominant native grass, Roemer's Fescue (*Festuca roemeri*), and many herbaceous species are threatened by the uncontrolled spread of Scot's broom (*Cytisus scoparius*). Prescribed fire and other management tools have been used recently in some areas to control Scot's broom and Douglas-fir encroachment, and to attempt to mimic historical conditions.

| STRESSOR | DESCRIPTION | ACTION CATEGORY | ACTION DESCRIPTION |
|---|---|---|---|
| Altered disturbance regimes | Fire exclusion has resulted in tree and shrub encroachment, loss of habitat diversity | • Fire management<br>• Vegetation management | Integrated habitat restoration using prescribed fire, weed control and seeding with natives |
| Invasive and other problematic species | Invasive forbs and shrubs are degrading native prairie | • Fire management<br>• Invasive species control | Mechanical and herbicide control of exotics |
| Roads and development | Habitat has been fragmented and lost to housing and subdivisions | • Environmental review<br>• Land acquisition<br>• Land use planning<br>• Private lands agreements | Acquisition, conservation easements, landowner agreements, and restoration |

## HERBACEOUS AGRICULTURAL VEGETATION

**Overview**

Herbaceous Agricultural Vegetation includes both cultivated croplands and pastures and hay. Cultivated croplands can be defined as areas used for the production of annual crops, as well as perennial woody crops such as orchards and vineyards. It includes all lands that are actively tilled. Pastures are defined as areas of grasses, legumes, or grass-legume mixtures planted for livestock grazing or the production of seed or hay crops, typically as a perennial planting (for example, fields). Conservation Reserve Program fields provide perennial grasslands used by a suite of grassland birds and are an important part of the landscape for Greater Sage-grouse, a Species of Greatest Conservation Need.

Each of these types of habitat can, under certain conditions, support a relatively large number of Species of Greatest Conservation Need (see table below). This may be, in part, due to the high diversity of agricultural lands, including diversity in elevation, highly productive soils, locations in valley bottoms and/or near rivers and streams, and distribution throughout the state. The annual or frequent disturbance associated with agricultural lands makes them valuable seasonally to many wildlife species. Ephemeral or farmed wetlands can be valuable places for overwintering waterfowl, breeding sites for amphibians, and food for many species during certain times of the year. Other features of the agricultural environment, including water developments, buildings and farm structures, roadsides, field borders, fence rows, and windbreaks can provide valuable habitat for wildlife .

Four terrestrial SGCN are considered to have close association with herbaceous agricultural vegetation. These are the Oregon Spotted Frog, Woodhouse's Toad, Dusky Canada Goose, and Gray-tailed Vole. For these species, agricultural lands should be considered essential for their continued conservation. For other species with general association, agricultural lands may provide important habitats, by providing important food, for example, and may be as important as habitat found in ecological systems of the natural landscape. Agricultural lands border many rivers and streams, especially in the interior Columbia Basin, and thus are associated with many anadromous and freshwater SGCN fishes. Although a complete analysis has not been done for all SGCN anadromous and freshwater fishes, several appear closely associated with this system, e.g., Middle Columbia Steelhead DPS, Upper Columbia Steelhead DPS, Upper Columbia Spring Chinook salmon ESU, and likely Bull trout-Mid-Columbia Recovery Unit.

| Distribution | Public Land | Private Land | SGCN with close association (#) | SGCN with general association (#) | Ecological systems of concern (#) |
|---|---|---|---|---|---|
| 13,354 $mi^2$ | 7% | 93% | 11 | 52 | 0 |

**Major Stressors**

- Annual disturbance – timing is key to understanding impacts to wildlife. Changes in disturbance regimes and areas disturbed also may significantly impact wildlife.
- Agricultural chemicals, including pesticides and fertilizers – choice of chemical, timing of exposure, and number of chemicals applied and rate of application are key to understanding impacts to wildlife and fishes.
- Increased predation by various predators, including corvids, gulls, canids, raccoons, opossums, skunks and rodents.

**Habitat needs for SGCN associated with this system**

| | |
|---|---|
| **Reduce pesticide impacts** | Reduce pesticide impacts through chemical selection, timing, amount of chemical applied and adoption of integrated pest management strategies. |
| **Enhance fencerows, borders, windbreaks, and roadsides** | Selection of appropriate species for planting in these areas, timing of disturbances like mowing to reduce impacts, maintenance of uncultivated and undisturbed strips of vegetation, and protection of these habitats from disturbances such as excessive grazing, vehicle traffic, etc.. |
| **Maintain riparian buffer native vegetation** | Adequately functioning riparian habitat is needed for anadromous and freshwater SGCN fishes |

**Actions needed to maintain habitat quality for SGCN**

- Continue programs that help agricultural lands provide wildlife habitat, principally Natural Resources Conservation Service and Farm Services Agency programs like the Wetland Reserve Program, Conservation Reserve Program, Environmental Quality Incentives Program, and the Resource Conservation and Development Program.
- Identify important connectivity areas in developing landscapes to help jurisdictions plan future growth.
- Continued support for programs that help educate landowners on ways to manage agricultural lands to help benefit wildlife and fishes.

**Research and Data Needs**

Key needs for continued research include understanding how agricultural production affects wildlife at the landscape scale, investigating the optimum patch size and landscape context for farmland set-aside programs to benefit grassland and shrubsteppe wildlife, continued work on benefits of integrated pest management to wildlife, and specific habitat enhancements for Species of Greatest Conservation Need.

**Specific Ecological System References**. **(complete list at end of chapter)**


Edge, W. D. 2001. Wildlife of Agriculture, Pastures, and Mixed Environs. Pages 342-360 *in* D. H. Johnson, and T. A. O'Neil, editors. Wildlife-habitat relationships in Oregon and Washington. Oregon State University Press, Corvallis, OR.

Schroeder, M. A. and W. M. Vander Haegen. 2011. Response of greater sage-grouse to the Conservation Reserve Program in Washington State. Studies in Avian Biology 38:517-529.

Vander Haegen, W. M., M. A. Schroeder, W. Y. Chang, and S. M. Knapp. 2015. Avian abundance and reproductive success in the intermountain west: Local-scale response to the conservation reserve program. Wildlife Society Bulletin (In Press).


## INTRODUCED AND SEMI-NATURAL

**Overview**

Introduced and Semi-Natural Vegetation includes 5 systems that are considered human influenced or made, 1) introduced riparian and wetland vegetation, and introduced upland vegetation: 2) annual grasslands,3) perennial grasslands, 4) shrublands, and 5) treed. These are considered spontaneous, self-perpetuating, and not (immediately) the result of planting, cultivation, or human maintenance. Land occupied by introduced vegetation is generally permanently altered (converted) unless restoration efforts are undertaken. Natural vegetation types are usually no longer recognizable. Land cover is significantly altered/disturbed by introduced wetland, grassland, shrubland, and tree species. Examples of these include: reed canarygrass invasions in wetland systems, Scot's broom invasions into upland grassland systems, cheatgrass invasions into shrub-steppe systems, and Russian olive along riparian systems in Eastern Washington.

Wildlife use of these habitats include, for example, Burrowing Owl use of disturbed vegetation in deep soils along irrigation canals in eastern Washington, Washington Ground Squirrel use of old grazed fields invaded by bulbous bluegrass (*Poa bulbosa*), Streaked Horned Lark use of disturbed vegetation in western Washington airports, and American Badger use of cheatgrass dominated communities of eastern Washington. The only terrestrial SGCN species identified as closely associated with Introduced and Semi-natural Vegetation is the Island Marble, a butterfly that inhabits the San Juan Islands associated with several introduced species that have spread in disturbed habitats, including field mustard (*Brassica campestris*), tall tumble mustard (*Sisymbrium altissimum*), and tall peppergrass (*Lepidium virginicum*).

| Distribution | Public Land | Private Land | SGCN with close association (#) | SGCN with general association (#) | Ecological systems of concern (#) |
|---|---|---|---|---|---|
| 1,085 $mi^2$ | 20% | 80% | 2 | 38 | 0 |

**Major Stressors**

Human disturbance is the key stressors for these systems, including changes in disturbance patterns and conversion to agricultural production.

**Habitat needs for SGCN associated with this system**

| | |
|---|---|
| **Short-stature exotic grasses and forbs** | A number of SGCN that use Introduced and Semi-natural Vegetation are associated with short stature exotic grasses and forbs, essentially providing structural similarities to native habitats. These include Streaked Horned Lark, Burrowing Owl, Oregon Vesper Sparrow, and Sharp-tailed Grouse. Oregon spotted frogs only use reed canarygrass habitat to a significant degree when it is mowed annually. |
| **Large unfragmented blocks of habitat** | Many SGCN are area sensitive, meaning they have a minimum size threshold for habitat to be functional for uses such as for breeding. Bald Eagle, Peregrine Falcon, Oregon Vesper Sparrow, and Sharp-tailed Grouse are known to require larger contiguous patches of undeveloped land. |

**Actions needed to maintain habitat quality for SGCN**

- Habitat Management - a number of SGCN that use Introduced and Semi-natural Vegetation are associated with a particular condition that may be subject to change over time, or a disturbance regime. Streaked Horned Lark, for example, is associated with short-stature vegetation at various airports in south Puget Sound. Airport habitat is actively mowed during the growing season to maintain the short-stature vegetation. Other disturbances like herbicide application, irrigation canal maintenance, and road maintenance have the potential to disrupt, disturb, or eliminate these species.
- Habitat Restoration – restoring native species to these environments can greatly increase their value to wildlife. Adding sagebrush to areas dominated by introduced grasses and forbs can provide a significant benefit to Sage-grouse, for example.

## OPEN FRESHWATER SYSTEMS

**Overview**

Open freshwater systems take on a variety of forms, from streams and rivers, potholes and small beaver ponds, to large lakes and reservoirs. They are found in every corner of the state, in all climates, at almost all elevations, and are just as common in wilderness areas as they are in major urban centers. An interesting fact is that Washington has more streams than any state other than Alaska. It should be noted that freshwater wetlands and some other standing shallow waters are not classified as Open Water (see Freshwater and Wet Meadow and Marsh).

Open water stands out from all terrestrial and other freshwater systems in that they have significantly greater numbers of closely associated SGCN. That in part is because all freshwater and anadromous fish as well as other aquatic species rely on open water for at least part of their life history. However, a large number of terrestrial and semi-aquatic SGCN also have a close affinity to open waters. These include many amphibians, waterfowl, as well as species of bats that use open waters to forage on insects. Because open water systems support so many sensitive species, the influence that disturbances pose on SGCN is a serious one to the state's overall biodiversity. In fact, the consequences of numerous disturbances to open water systems are being felt right now. Those are reflected in the large number of aquatic species in Washington that are Federally Threatened and Endangered, such as the 16 Pacific salmon, steelhead and bull trout species units included as SGCN.

.

| Distribution | Public Land | Private Land | SGCN with close association (#) | SGCN with general association (#) | Ecological systems of concern (#) |
|---|---|---|---|---|---|
| 4,402 $mi^2$ | 87% | 13% | 67 | 22 | 0 |

**Major Stressors**

- Reduced glacial and snowpack runoff to replenish open water systems from climate change.
- More frequent and intense droughts lasting longer durations from climate change.
- Physical barriers to instream movement and migration.
- Altered water quality from (e.g., increased temperature, sediment, nutrients, and toxicants) from loss of riparian filtering, as well as urban and agricultural runoff.
- Physical alterations, like dredging, channelizing, damming, and confinement of migrating channels.
- Artificial modifications to hydrology from activities such as damming and irrigation.
- Loss of aquatic habitat complexity.
- Altered natural disturbance processes (e.g., seasonal flooding) and regimes.

**Habitat needs for SGCN associated with this system**

| | |
|---|---|
| **Good water quality** | Many aquatic and semi-aquatic SGCN require waters that are clean and cold for their survival and fitness. These include many anadromous salmonids, freshwater fishes and amphibians. |
| **Habitat complexity** | A large number of SGCN require various types of aquatic habitat and diverse habitat structure. This includes areas with clean spawning gravels, large instream wood, deep pools, off-channel habitats (e.g., oxbows) and locations where species can find cool water refuge during periods of high stream temperatures. |
| **Habitat connectivity** | Connectivity is especially important to migratory anadromous fish where their life histories require being able to reach their particular spawning grounds. Lateral connectivity is also important between a stream’s main stem and off-channel and floodplain habitats. |

**Actions needed to maintain habitat quality for SGCN**

- Removal of artificial barriers, especially ones that can open up new habitat for SGCN.
- Research to assess influences of climate change and to identify mitigation measures.
- Maintaining function associated with intact riparian habitat.
- Maintenance and enhancements of in-stream structure (e.g., large downed wood) and complexity.
- Improve water quality (e.g., maintain or decommission roads causing siltation and erosion).
- Reintroduction and protection of beaver and conservation of beaver ponds.

## RECENTLY DISTURBED OR MODIFIED

**Overview**

There are seven Recently Disturbed or Modified ecological systems in Washington. Three are represented by second-growth or recently deforested lands at various stages of regeneration. The others are characterized by recent fire disturbances. Either of these two groups can includes places where the disturbance is the result of something other than human intervention, such as a stand of windblown timber. But in most cases the disturbance is human-caused (e.g., a catastrophic wildfire caused by a built-up fuels from fire suppression). In general, these areas are considerably altered from their historical condition, especially when the disturbance is directly caused by humans. Consequently they have lower ecological integrity when compared to their undisturbed counterparts and their value to native species has usually been compromised.

Although these lands may be less valuable, it is important not to undervalue or ignore them. One reason for this is that they compromise a large area, 10 percent of the state's land area in total. Because of this they are prominent across Washington's landscape and thus need to be seen for their potential. This includes their potential for habitat restoration as well as their potential to provide other benefits (e.g., as connections between important habitat areas). Although their value to native species is compromised, many recently disturbed or modified areas provide habitat to SGCN. In fact, 68 SGCN are associated with these systems, many of which are habitat generalists, though some have a particular affinity to the disturbed nature of these systems. Five of these SGCN are closely associated with these modified systems.

| Distribution | Public Land | Private Land | SGCN with close association (#) | SGCN with general association (#) | Ecological systems of concern (#) |
|---|---|---|---|---|---|
| 6,649 $mi^2$ | 38% | 62% | 5 | 63 | 0 |

**Major Stressors**

- Altered natural disturbance regimes and processes.
- Loss of structural diversity and habitat complexity.
- Loss of older forests because of short harvest rotation cycles.
- Spread of invasive plants.
- Habitat fragmentation and loss of connectivity.

**Habitat needs for SGCN associated with this system**

| | |
|---|---|
| **Complex habitat structure** | Many SGCN associated with disturbed habitats prefer the presence of more complex habitat feature such as snags and downed wood, and multiple canopy layers. The SGCN that have an affinity of more complex conditions are Barrow's Goldeneye, Great Gray Owl, Lewis' Woodpecker, Northern Spotted Owl, Western Bluebird, Keen's Myotis, and Silver-haired Bat. |

| | |
|---|---|
| **Protect key habitats within area of disturbance** | Within disturbed areas some types of habitats deserve special attention because of their value to many SGCN. These include systems such wetlands and riparian areas. |
| **Climax condition** | Several species prefer more mature habitat conditions or habitats that have at least some characteristics of climax conditions, like large trees. The SGCN that have an affinity for these conditions are Cascade Torrent Salamander, Bald Eagle, Barrow's Goldeneye, Great Gray Owl, Northern Spotted Owl, Keen's Myotis, and Western Gray Squirrel. |
| **Open habitat** | Some SGCN prefer open habitat over those with closed understories. These are Loggerhead Shrike, Short-eared Owl, Streaked Horned Lark, White-headed Woodpecker, and American Badger. |

**Actions needed to maintain habitat quality for SGCN**

- Controlling the spread and removal of invasive plants.
- Controlled burns and forest thinning to reduce the possibility of large wildfire.
- Habitat restoration.
- Prioritization of disturbed and modified sites and landscapes for conservation and protection.

# SALT MARSH VEGETATION

**Overview**
Salt Marsh vegetation includes three ecological systems; Inter-Mountain Basins Playa and Alkaline Closed Depression, Greasewood Flat, Tidal Salt/ Brackish Marsh. The Alkaline Closed Depression Ecological Systems are sparsely to densely vegetated found on seasonally flooded sites over saline soils in closed depressions or terminal basins. The Greasewood Flat ecological system includes open to moderately dense shrublands dominated or codominated by Greasewood (*Sarcobatus vermiculatus*) and also with saline soils. Inter-Mountain Basins Playa and Alkaline Closed Depression and Inter-Mountain Basins Greasewood Flat ecological systems are found in central to southern eastern Washington. The Tidal/Brackish Marsh ecological system is associated with tidally influenced coastal wetlands of estuaries, lagoons, and bays, and behind sand spits. All three of these ecological systems are ecological systems of concern.

Climate changes that lead to changes in water levels may impact inter-mountain basins playa, alkaline closed depressions and greasewood flats. Changes in precipitation may lead to fluctuations in salinity levels, which could lead to shifts in vegetation composition. Increases in runoff that increase nutrient levels in basin playas and alkaline closed depressions could also threaten vegetation. Projected sea level rise represents a key climate stressor for tidal salt and brackish marshes, as it could lead to submergence of habitats and declines in vegetation unless they are able to migrate inwards through sediment accretion.

| Distribution | Public Land | Private Land | SGCN with close association (#) | SGCN with general association (#) | Ecological systems of concern (#) |
|---|---|---|---|---|---|
| 91 $mi^2$ | 61% | 39% | 3 | 25 | 3 |

**Major Stressors**
Habitat degradation and exotic plant invasions, Development (dredging, filling, channeling), hydrological alteration and climate change.

**Habitat needs for SGCN associated with this system**

| | |
|---|---|
| **High invertebrate diversity/abundance** | Invertebrates serve as food for many of these species, including Marbled Godwit, Harlequin Duck, Red-necked Grebe, Surf Scoter |

**Actions needed to maintain habitat quality for SGCN**
- Fire management (establishment of natural fire regimes and prescribed fire),
- Grazing, Agriculture, and farm management,
- Invasive species control,
- Habitat restoration, research, and native species restoration, including hydrological restoration**.**

**Ecological systems discussed in greater detail in this chapter**
Of the 12 ecological systems found in this formation, the following 3 are discussed in greater detail here. These are considered ecological systems of concern, either because of their imperiled conservation status, because of their importance to SGCN, or both.

A. Inter-Mountain basins Greasewood Flat
B. Inter-Mountain Basins Playa and Alkaline Closed Depression
C. Temperate Pacific Tidal Salt/Brackish Marsh

## Inter-Mountain Basins Greasewood Flat

**Conservation Status and Concern**
This is a geographically limited ecological system with small sites. The primary conservation concern is degradation of the system.

**Description and Distribution**
Greasewood flats are limited to the Columbia Basin, especially the northern and central portions of the basin. They often co-occur with playas and alkaline depressions. They are more common in Benton, Grant, Franklin, Klickitat, and Walla Walla Counties.

Soils are typically saline and bare ground is a common feature. The water table remains high enough to maintain vegetation, despite salt accumulations. Wetland vegetation may concentrate near seeps/springs or in drainages where standing water is perennial. Saline soils and dominance by greasewood distinguish this type from other ecological systems. The primary ecological process maintaining greasewood flat systems is an elevated groundwater table.

| PHS | NHP Rank | Status and trend | SGCN closely and generally associated with this ecological system |
|---|---|---|---|
| None | S1 | Critically imperiled/ declining.<br><br>Decline of 30-50% within the last 50 years and from historical conditions. | **MAMMALS :** American Badger, Black-tailed Jackrabbit, Hoary Bat, Pygmy Rabbit, Silver-haired Bat, Spotted Bat, Townsend's Big-eared Bat |
| | | | **BIRDS:** Golden eagle, Loggerhead Shrike, Peregrine Falcon, Short-eared Owl |

* *No species were identified with a close association*

**Stressors and Actions Needed**
The primary stressors are alteration of hydrology, livestock practices, annual exotic species invasion, fire regime alteration, and fragmentation. Activities resulting in hydrological alterations, sedimentation, nutrient inputs, and/or physical disturbance may negatively shift species composition and allow for non-native species establishment. Declining water tables create perennially dry soils, stop surface salt accumulation, and allow salts to leach deeper that create a drier, less saline soil resulting in a change in vegetation composition and pattern. The tall perennial Pepperwood (*Lepidium latifolium*), a nonnative invasive species decreases the abundance of shorter native grasses and forbs. The introduction of cheatgrass into these communities has altered fuel loads and fuel distribution. Fire alters the community composition because salt-desert shrubs are not adapted to periodic fire.

| STRESSOR | DESCRIPTION | ACTION CATEGORY | ACTION DESCRIPTION |
|---|---|---|---|
| Alteration of hydrology | Hydrological alterations, agriculture, roads, and development | • Land acquisition<br>• Private lands agreements | Identify and protect sites with good ecological integrity. |
| Invasive and other problematic species | Invasive species increase with excessive grazing, trampling | • Grazing/farm management<br>• Invasive species control | Mechanical and herbicide control of exotics, planning |

## Inter-Mountain Basins Playa and Alkaline Closed Depression

**Conservation Status and Concern**

A significant amount of this system has been lost due to alterations of hydrology. Degradation has occurred across its range and in most locations. There are two SGCN that are considered closely associated with this ecological system and 12 that are considered generally associated with this ecological system (see table below).

**Description and Distribution**

The Inter-Mountain Basins Playa and the Inter-Mountain Basins Alkali Closed Depression Ecological Systems occur throughout much of the cool arid and semi-arid regions of the Columbia Plateau and Great Basin. They almost always appear within a shrub steppe or semi-desert landscape. They are differentiated by 1) vegetation cover (playa is typically sparse to patchily vegetated, generally less than 10 percent plant cover while alkali closed depression is moderately to densely covered by herbaceous plants), 2) soil chemistry (playas are considered more saline than alkaline closed depressions), and 3) hydrological regime (playas are more intermittently flooded; closed depressions are more seasonally to semi-permanently flooded).

| PHS | NHP Rank | Status and trend | SGCN closely and generally associated with this ecological system |
|---|---|---|---|
| Yes Freshwater Wetlands | S1 | Critically Imperiled/ declining.<br><br>Declines of 30-50% within the last 50 years and from historical conditions. | **MAMMALS:** Hoary Bat, Kincaid's Meadow Vole, Silver-Haired Bat, Spotted Bat, Townsends Big-Eared Bat. |
| | | | **BIRDS:** American White Pelican, Bald Eagle, Barrows Goldeneye, Cinnamon Teal*, Golden Eagle, Loggerhead Shrike, Marbled Godwit, Peregrine Falcon*, Short-eared Owl. |

* SGCN is closely associated with this ecological system

**Key Stressors and Actions Needed**

Historical and current land use practices have impacted hydrologic, geomorphic, and biotic structure and function of playas on the Columbia Basin. Reservoirs, water diversions, ditches, roads, and human land uses in the contributing watershed can also have a substantial impact on the hydrological regime. Direct alteration of hydrology (i.e., channeling, draining, damming) or indirect alteration (i.e., roads or removing vegetation on adjacent slopes) results in changes in the amount and pattern of herbaceous wetland habitat. Excessive livestock grazing leads to a shift in plant species composition.

| STRESSOR | DESCRIPTION | ACTION CATEGORY | ACTION DESCRIPTION |
|---|---|---|---|
| Alteration of hydrology | Hydrological alterations associated with agriculture, roads, and development | • Land acquisition<br>• Private lands agreements<br>• Water management | Identify and protect sites with good ecological integrity. |

| | | | |
|---|---|---|---|
| Invasive and other problematic species | Invasive species increase with excessive grazing, trampling | • Grazing/farm management<br>• Invasive species control | Mechanical and herbicide control of exotics, planning |

## Temperate Pacific Tidal Salt and Brackish Marsh

**Conservation Status and Concern**

A significant amount of this system has been lost. Habitat degradation has occurred across its range and in most locations. There is one terrestrial SGCN that is considered closely associated with this ecological system, and 15 terrestrial species considered generally associated with this ecological system. A complete analysis of habitat association has not been done for SGCN fishes.

**Description and Distribution**

Temperate Pacific Tidal Salt and Brackish Marsh Ecological Systems are found along the Pacific Coast, from south-central Alaska to the central California coast. In Washington, it occurs in large bays on the outer coast and around the waters of Puget Sound. Occurrences are confined primarily to inter-tidal portions of estuaries, coastal lagoons and bays, and behind sand spits or other locations protected from wave action. Their associated specific environments are defined by ranges of salinity, tidal inundation regime, and soil texture. This system is characterized as being dominated by emergent vegetation whose composition is influence by tidal fluctuations and varying degree of salinity (saline to brackish). Marine salt water circulation through a marsh is most important factor in marsh plant species distribution.

Characteristic plant species include seashore salt grass (*Distichlis spicata*), sea milkwort (*Glaux maritima*), jaumea (*Jaumea carnosa*), pickleweed (*Salicornia* spp.), sea blight (*Suaeda* spp.), and arrow grass (*Triglochin* spp.).

| PHS | NHP Rank | Status and trend | SGCN closely and generally associated with this ecological system |
|---|---|---|---|
| Yes<br><br>Nearshore – coastal<br><br>Nearshore – Puget Sound | S2 | Imperiled/ declining<br><br>Declines of 50-70% within the last 50 years and from historical conditions. | **MAMMALS :** Shaw Island Vole |
| | | | **BIRDS:** Bald Eagle, Barrow's Goldeneye, Black Scoter, Brown Pelican, Common Loon, Dusky Canada Goose, Harlequin Duck, Marbled Godwit, Peregrine Falcon, Purple Martin, Red-necked Grebe, Surf Scoter, White-winged Scoter, and Western High Arctic Brant |
| | | | **FISH:** to be determined- research needed |
| | | | **INVERTEBRATES:** Island Marble* |

* SGCN is closely associated with this ecological system

**Stressors and Actions Needed**

A number of stressors related to development, transportation and agriculture contribute threats to this ecological system.

| STRESSOR | DESCRIPTION | ACTION CATEGORY | ACTION DESCRIPTION |
|---|---|---|---|
| Alteration of hydrology | Hydrological alterations, agriculture, roads, and development | • Planting/seeding<br>• Vegetation management<br>• Water management | Salt marsh restoration, including restoration of native species |
| Invasive and other problematic species | Invasive species such as spartina | • Invasive species control | Mechanical and herbicide control of exotics |

## SCRUB AND HERBACEOUS COASTAL VEGETATION

**Overview**

Scrub and herbaceous coastal vegetation includes two ecological systems, North Pacific Coastal Cliff and Bluff, and Coastal Sand Dune and Strand. The North Pacific Coastal Cliff and Bluff includes un-vegetated or sparsely vegetated rock cliffs and very steep bluffs along Washington's coastline and associated marine and estuarine inlets. Sand dunes are isolated and scattered in Puget Sound, and most abundant along the southern Washington coastline.

| Distribution | Public Land | Private Land | SGCN with close association (#) | SGCN with general association (#) | Ecological systems of concern (#) |
|---|---|---|---|---|---|
| 28 $mi^2$ | 49% | 51% | 12 | 4 | 1 |

**Major Stressors**

1. Invasive species
2. Habitat degradation
3. Recreation
4. Climate Change

Currently, the major threats to Scrub and Herbaceous Coastal Vegetation is the continued spread and subsequent stabilization of sand dunes by invasive species, off road vehicle use, road construction, intentional dune stabilization, and conversion to residential lots. The exotic European beachgrass (*Ammophila arenaria*) has been extensively planted for stabilization purposes and has also spread widely on its own for over 125 years and the eastern North American native American beachgrass (*A. breviligulata*) has been planted and spreading on the Long Beach peninsula. Once these plant species became established, the physical form and natural processes of dunes were altered, leading to rapid acceleration of successional processes, which then altered the native species composition.

Sea level rise, increased coastal erosion, and increased storminess and wave action represent significant climate stressors for this formation. Projected sea level rise could cause erosion and/or landward shift of dunes and cliffs. Similarly, greater wave and wind action from storms could cause increased disturbance and erosion of cliffs, dunes, and dune vegetation. Climate induced-changes or declines in dune vegetation that help stabilize and protect dunes could make dune habitat more vulnerable to disturbances from increased erosion, waves, and winds.

**Habitat needs for SGCN associated with coastal sand dune and strand**

| | |
|---|---|
| **High ecological integrity** | Some of the birds (Streaked Horned Lark, Snowy Plover) and invertebrates (Taylor's Checkerspot, Sand Verbena Moth, Oregon Silverspot, Acmon Blue) require either an open dune composition without exotic beachgrasses, or short-stature vegetation provided by native species, and are sensitive to invasive weeds including dunegrasses. |

**Actions needed to maintain habitat quality for SGCN**

- Habitat restoration, research, and native species restoration**.**
- Invasive species control,
- Manage public recreation, including off road vehicle use.

**Ecological systems discussed in greater detail:**
Of the 2 ecological systems found in this formation, North Pacific Coastal Sand Dune and Strand is discussed in greater detail here. It is considered an ecological system of concern because of its imperiled conservation status and because of its importance to SGCN.

## North Pacific Maritime Coastal Sand Dune and Strand

**Conservation Status and Concern**
This ecological system is located in active or stabilized dunes along the coast. Exotic species like American beachgrass have greatly reduced or eliminated active dune processes, helping to accelerate successional process, greatly increasing vegetative cover, and restricting habitat for species associated with this ecological system. There are eight Species of Greatest Conservation Need that closely associated with this ecological system.

**Description and Distribution**
Sand dunes are distributed along the Pacific coast from south-central Alaska to central Oregon. In Washington dunes are found locally in Puget Sound, coastlines along the Straits of Juan de Fuca, and the western Olympic Peninsula. The most extensive areas of sand dunes are in the southern portion of the Washington coast between the mouths of the Copalis and Columbia Rivers. Coastal dunes include beach strand (not the beach itself but sparsely or densely vegetated areas behind the beach), foredunes, sand spits, and active to stable backdunes and sandsheets. Coastal dunes often front portions of inlets and tidal marshes. Significant plant species include native grasses such as dunegrass (*Leymus mollis*) and red fescue (*Festuca rubra*).

| PHS | NHP Rank | Status and trend | SGCN closely and generally associated with this ecological system |
|---|---|---|---|
| Yes<br><br>Nearshore – coastal<br><br>Nearshore – Open Water<br><br>Nearshore – Puget Sound | S1 | Imperiled/ declining<br><br>Decline of 50-70% within the last 50 years.<br><br>Decline of 70-80% from historical conditions. | **MAMMALS:** Shaw Island Vole<br>**BIRDS:** Streaked Horned Lark*, Snowy Plover*, Bald Eagle, and Peregrine Falcon.<br>**INVERTEBRATES:** Sand Verbena Moth*, Oregon Silverspot Butterfly, Taylor's Checkerspot*, Acmon Blue*, Island Marble*, and Siuslaw Sand Tiger Beetle*. |

* SGCN is closely associated with this ecological system

**Stressors and Actions Needed**

| STRESSOR | DESCRIPTION | ACTION CATEGORY | ACTION DESCRIPTION |
|---|---|---|---|
| Fish and wildlife habitat loss or degradation | Dune stabilization has resulted in accelerated succession, invasion of exotic trees, shrubs and grasses, and reduction or loss of function of critical habitat | • Vegetation management | Integrated habitat restoration using weed control and seeding with natives |
| Invasive and other problematic species | Invasive forbs and shrubs are degrading native vegetation | • Invasive species control | Mechanical and herbicide control of exotics |
| Recreation | Off-road vehicle use has resulted in the loss of native communities | • Land acquisition<br>• Private lands agreements | Identification and protection of areas with high ecological integrity |

# SEMI-DESERT SCRUB AND GRASSLAND

**Overview**

Semi-Desert Scrub and Grasslands includes nine verified ecological systems in Washington. Comprised of native upland vegetation, these systems occur throughout most of eastern Washington. The underlying soils are variable across the spectrum, although some systems are strongly linked to a particular soil characteristic (e.g., deep soil systems). All Semi-Desert Scrub and Grassland systems in Washington have an understory layer typically made up of native bunchgrasses that are almost always accompanied by other perennial grasses and/or forbs. Although not all the systems have a shrub layer, most have some cover of shrubs. Dominant shrubs include big sagebrush (*Artemisia tridentata*), antelope bitterbrush (*Purshia tridentata*), rabbitbrush (*Chrysothamnus* spp.), and dwarf sagebrush (*Artemsia arbuscula*). At the soil surface, diverse communities of moss and lichen can also be found, especially if soils are relatively intact or undisturbed. A total of 22 SGCN are closely associated with Semi-Desert Scrub and Grassland systems, and 44 SGCN are generally associated.

| Distribution | Public Land | Private Land | SGCN with close association (#) | SGCN with general association (#) | Ecological systems of concern (#) |
|---|---|---|---|---|---|
| 7,729 $mi^2$ | 46% | 54% | 22 | 44 | 4 |

**Major Stressors**

- Agriculture conversion
- Wind power and residential development
- Soil disturbance
- Invasive annual plants.
- Fire and fire frequency
- Excessive grazing

Climate changes including shifts in precipitation, drought, and altered fire regimes may affect plant composition, density, and distribution in semi-desert scrub and grassland habitats. Precipitation likely influences plant composition, growth, and recruitment, and drought negatively affects seedling survival in sagebrush systems, reduces shrub cover, and elevates herbaceous diversity and cover. Increasing fire frequencies and/or intensities will likely negatively affect sagebrush and shrub habitats, and may favor grassland expansion. However, fire also favors cheatgrass and other non-native annual establishment, which can alter ecosystem function.

**Habitat needs for SGCN associated with this system**

| | |
|---|---|
| **Deep Soils** | Several species, American Badger, Pygmy Rabbit, Washington Ground Squirrel, and Burrowing Owl require relatively deep soils suitable for burrowing. The burrowing actions of some of these species also function to provide natural disturbance in grassland habitats. |
| **Minimal habitat fragmentation** | Greater Sage-grouse, Sage Thrasher, and Sagebrush Sparrow require large intact blocks of shrub-steppe habitat. |

| | |
|---|---|
| **High ecological integrity** | Many SGCN that use ecological systems associated with Semi-Desert Scrub and Grassland do best where native perennial plants such as bunchgrasses are dominant and where the fire return interval is low. Some SGCN also have highly specific preferences in terms of habitat structure. Ecological integrity of this habitat's riparian areas is important for SGCN interior Columbia basin anadromous salmonids and freshwater fishes. |

**Actions needed to maintain habitat quality for SGCN**

- Management to maintain infrequent intervals of fire,
- Grazing management,
- Invasive species control (cheatgrass in particular),
- Habitat and native species restoration.

**Research and Data Needs**

- Research to help improve techniques for restoring degraded habitat.
- Studies to help develop science-based compensatory mitigation ratios.

**Ecological systems and other habitats discussed in greater detail in this chapter include:**

A. Columbia Plateau Low Sagebrush Steppe
B. Inter-Mountain Basins Big Sagebrush Steppe
C. Inter-Mountain Basins Semi-Desert Shrub Steppe
D. Columbia Plateau Steppe and Grassland

## Columbia Plateau Low Sagebrush Steppe

**Conservation Status and Concern**

This ecological system is very rare, occupying less than one percent of Washington's land area. The ecological integrity of the system is in decline, primarily due to disturbances from intense grazing and invasive plants. Fifteen terrestrial SGCN are associated with this system and two of those are closely associated.

**Description and Distribution**

This large patch system occurs on isolated ridges at or above the lower treeline (approximately 3300 to 4500 feet) within the East Cascade, Blue Mountain, and Columbia Plateau Ecoregions. The system often lies adjacent to Douglas-fir and ponderosa pine forests. While the overstory canopy is dominated by dwarf sagebrush understory vegetation is made up of bunchgrasses and/or native forbs. Although bunchgrasses typically dominate, forbs can be dominant, especially at higher elevations. The space between vascular plants may support a crust of mosses and lichens, especially where soils are relatively undisturbed and intact. Substrates are shallow, fine-textured soils or poorly drained clays, and are almost always very stony.

| PHS | NHP Rank | Status and trend | SGCN closely and generally associated with this ecological system |
|---|---|---|---|
| Yes Shrub-steppe | S2 | Imperiled/ declining<br><br>>30% decline within the last 50 years.<br><br>Decline from historical conditions is unknown. | **MAMMALS:** American Badger, Black-tailed Jackrabbit, Hoary Bat, Merriam's Shrew, Silver-haired Bat, Spotted Bat, Townsend's Big-eared Bat, White-tailed Jackrabbit |
| | | | **BIRDS:** Golden Eagle, Greater Sage-grouse*, Loggerhead Shrike, Mountain Quail, Short-eared Owl |
| | | | **REPTILES/AMPHIBIANS:** Short-horned Lizard* |
| | | | **FISH:** to be determined- research needed |
| | | | **INVERTEBRATES:** Morrison's Bumblebee |

* SGCN is closely associated with this ecological system

**Stressors and Actions Needed**

Disturbance from grazing and from the spread of invasive plants seem to be the chief threats to this system. On some sites cheatgrass has replaced native perennials. This is especially true on sites that are intensely grazed. Intense grazing also reduces the cover of moss and lichens and increases patches of bare ground. Areas of bare ground are highly susceptible to cheatgrass invasion.

| STRESSOR | DESCRIPTION | ACTION CATEGORY | ACTION DESCRIPTION |
|---|---|---|---|
| Invasive and other problematic species | Invasive annual grasses (cheatgrass) and exotic weeds have degraded habitat. In other places the problem is an overabundant cover of native shrubs. | • Invasive species control | Mechanical and herbicide control of invasive species. |

| STRESSOR | DESCRIPTION | ACTION CATEGORY | ACTION DESCRIPTION |
|---|---|---|---|
| Fish and wildlife habitat loss or degradation | Habitat has been lost to agriculture, and development to a lesser degree. | • Environmental Review<br>• Land acquisition<br>• Land use planning<br>• Private lands agreements | Acquisitions, conservation easements, landowner agreements, and restoration. |

## Columbia Plateau Steppe and Grassland

**Conservation Status and Concern**

Historically this system was more expansive across eastern Washington. Much of that expanse has been converted, especially to croplands. What is left is mostly degraded by grazing, an altered fire regime, invasive plants, and various other disturbances. Thirty-two terrestrial SGCN are associated with this system and nine of those are closely associated.

**Description and Distribution**

This extensive grassland system is dominated by perennial bunchgrasses and forbs (greater than 25 percent cover) and sometimes a sparse canopy of shrubs (less than 10 percent cover). Soils are variable, ranging from relatively deep to stony volcanic-derived clays, to alluvial sands. A characteristic of the soils is that often they lack areas of exposed or bare soil. Instead they typically are carpeted by a crust of mosses and lichens, especially where soils are intact and relatively undisturbed. In contrast to closely related ecological systems, historical fire frequency is higher, which is a factor for its low cover of fire intolerant shrubs. In Washington this large patch system is widespread throughout the Columbia Plateau Ecoregion, though it also occurs in small segments of the Blue Mountain, Okanogan, and East Cascade Ecoregions.

| PHS | NHP Rank | Status and trend | SGCN closely and generally associated with this ecological system |
|---|---|---|---|
| Yes Eastside Steppe | S2 | Imperiled/ declining | **MAMMALS:** American Badger*, Black-tailed Jackrabbit, Hoary Bat, Merriam's Shrew, Silver-haired Bat, Spotted Bat, Townsend's Big-eared Bat, Townsend's Ground Squirrel, Washington Ground Squirrel, White-tailed Jackrabbit |
| | | | **BIRDS:** Burrowing Owl, Cinnamon Teal, Ferruginous Hawk*, Golden Eagle, Greater Sage Grouse*, Loggerhead Shrike, Mountain Quail, Sage Thrasher*, Sagebrush Sparrow, Sharp-tailed Grouse*, Short-eared Owl |
| | | | **REPTILES/AMPHIBIANS:** Columbia Spotted Frog, Northern Leopard Frog*, Tiger Salamander, Woodhouse's Toad*, Night Snake, Ringneck Snake*, Short-horned Lizard*, Side-blotched Lizard |
| | | | **FISH:** to be determined- research needed |
| | | | **INVERTEBRATES:** Morrison's Bumblebee, Hoder's Mountainsnail, Ranne's Mountainsnail |

* SGCN is closely associated with this ecological system

**Stressors and Actions Needed**

The ecological integrity of this system has been diminished by persistent grazing, cropland conversion, invasive plants, altered fire regime, soil disturbance, and habitat fragmentation. Most deep soils steppe and grasslands has been converted to croplands. Thus most of what remains is on shallow, rocky soils. Although cropland conversion rates are not nearly what they were at their peak, conversions to agriculture still take place, especially in the wine-producing southern Columbia Valley. Residential and wind farm development is another source of direct loss of this habitat. And much of what has not already been converted is degraded. Fire suppression throughout much of the range has degraded the system by increasing shrub cover. These shrubs have displaced bunchgrasses and forbs by outcompeting with them for space and light. Grazing practices incompatible with habitat conservation have also degraded a considerable amount of this habitat. Where grazing is heavy and persistent the system responds in various ways depending on the type of grazing and season. In general, overgrazing has spread invasive plants, decreased native perennial cover, compacted soils, eliminated soil crusts of mosses and lichens, and has increased shrub cover. Across much of this landscape grazing and other land uses have increased bare ground and have replaced native perennials with cheatgrass. Fire on livestock-altered vegetation has further promoted the spread of annuals.

| STRESSOR | DESCRIPTION | ACTION CATEGORY | ACTION DESCRIPTION |
|---|---|---|---|
| Altered disturbance regimes | An altered fire regime and ground disturbance has degraded the habitat and has led to a loss of habitat diversity. Fire has a particularly strong impact to indigenous shrub and bunchgrass communities. | • Fire management<br>• Vegetation management<br>• Grazing /farm management<br>• Invasive species control | Integrated habitat restoration using prescribed fire, weed control, and seeding with native vegetation. |
| Fish and wildlife habitat loss or degradation | Habitat has been lost to agriculture and the development of homes and wind farms. | • Environmental Review<br>• Land acquisition<br>• Land use planning<br>• Private lands agreements | Acquisitions, conservation easements, landowner agreements, and restoration. |
| Invasive and other problematic species | Invasive annual grasses (cheatgrass) and exotic weeds have degraded habitat. In other places the problem is an overabundant cover of native shrubs. | • Invasive species control | Mechanical and herbicide control of invasive species. |

## Inter-Mountain Basins Big Sagebrush Steppe

**Conservation Status and Concern**

Historically this system was more expansive across eastern Washington. Much of that expanse has been converted, especially to croplands. What is left is mostly degraded by grazing, an altered fire regime, invasive plants, and various other disturbances. Twenty-five terrestrial SGCN are associated with this system and nine of those are closely associated.

**Description and Distribution**

This large patch system occurs throughout a large portion of the Columbia Plateau and Okanogan Ecoregions, as well as the lower foothills of the East Cascade Ecoregion. When found in less disturbed conditions it takes the character of a grassland with a conspicuous, but discontinuous, layer of shrubs. The natural fire regime of this ecological system historically maintained this patchy distribution of shrubs. The characteristic shrubs, typically sagebrush (*Artemisia* spp.) and/or antelope bitterbrush, form an open to moderately dense shrub layer (5 to 40 percent cover). Ground cover typically is made up of moderate to dense layer (more than 25 percent cover) of perennial bunchgrasses, although native forbs are also common to the herbaceous layer of this system. Soils are typically deep and non-saline, and typically are encrusted on the surface by mosses and lichens that bind the soil surface (biological soil crust),especially when soils are undisturbed. This system differs from the similar Inter-Mountain Basins Montane Sagebrush Steppe in that it occurs at lower elevations, mainly below 3,000 feet.

| PHS | NHP Rank | Status and trend | SGCN closely and generally associated with this ecological system |
|---|---|---|---|
| Yes Shrub-steppe | S2 | Imperiled/ declining<br><br>Decline of 30-50% within the last 50 years and from historical conditions. | **MAMMALS:** American Badger*, Black-tailed Jackrabbit, Hoary Bat, Merriam's Shrew, Pygmy Rabbit*, Silver-haired Bat, Spotted Bat, Townsend's Big-eared Bat, Townsend's Ground Squirrel, Washington Ground Squirrel, White-tailed Jackrabbit |
| | | | **BIRDS:** Burrowing Owl*, Cinnamon Teal, Ferruginous Hawk*, Golden Eagle, Greater Sage-Grouse*, Loggerhead Shrike, Mountain Quail, Peregrine Falcon, Sage Thrasher*, Sagebrush Sparrow*, Sharp-tailed Grouse*, Short-eared Owl |
| | | | **REPTILES/AMPHIBIANS:** Northern Leopard Frog*, Tiger Salamander, Western Toad, Woodhouse's Toad*, Night Snake, Ringneck Snake*, Sagebrush Lizard*, Sharptail Snake*, Short-horned Lizard*, Side-Blotched Lizard, Striped Whipsnake* |
| | | | **FISH:** to be determined- research needed |
| | | | **INVERTEBRATES:** Morrison's Bumblebee, Columbia Oregonian, Poplar Oregonian, Hoder's Mountainsnail, Ranne's Mountainsnail, Limestone Point Mountainsnail |

* SGCN is closely associated with this ecological system

**Stressors and Actions Needed**

Because this system lies on deep, fertile soils, it has been targeted for its suitability as cropland. Consequently, much of this system has been converted to crops, especially in the Columbia Basin Reclamation area. Cropland conversions have made deep soil Big Sagebrush Steppe rare. Although rates of cropland conversion are not nearly what they were at their peak, agriculture conversions still occur like in the wine-producing southern Columbia Valley. Residential and wind farm development is another source of direct loss of this habitat. Grazing is another ongoing disturbance, especially when grazing practices are incompatible with habitat conservation. Where grazing is heavy and persistent the system responds in various ways depending on the type of grazing and season. In general, overgrazing spreads invasive plants, compacts soils, eliminates important soil crusts of mosses and lichens, and can lead to a dense shrub cover. Dense shrub cover can in turn compete with native bunchgrasses for very limited water, reducing their cover. Shrubs also increase following fire suppression. Frequent intense fires, on the other hand, can eliminate entire stands of sagebrush. Recovery to pre-fire shrub cover can then take decades, especially in low rainfall areas.. After wildfire, conditions become favorable for the spread of annuals, such as cheatgrass, which make sites more susceptible to subsequent wildfire. All these changes in shrub-steppe composition and structure ultimately reduce the habitat conditions required for many SGCN to persist.

| STRESSOR | DESCRIPTION | ACTION CATEGORY | ACTION DESCRIPTION |
|---|---|---|---|
| Altered disturbance regimes | Fire and ground disturbance has degraded the habitat and has led to a loss of habitat diversity. Fire has a particularly strong impact to indigenous shrub and bunchgrass communities. | • Fire management<br>• Vegetation management<br>• Grazing /farm management | Integrated habitat restoration using prescribed fire, weed control, and seeding with native vegetation. |
| Fish and wildlife habitat loss or degradation | Habitat has been lost to agriculture and the development of homes and wind farms. | • Environmental Review<br>• Land acquisition<br>• Land use planning<br>• Private lands agreements | Acquisitions, conservation easements, landowner agreements, and restoration. |
| Invasive and other problematic species | Invasive annual grasses (cheatgrass) and exotic weeds have degraded habitat. In other places the problem is an overabundant cover of native shrubs. | • Invasive species control | Mechanical and herbicide control of invasive species. |

## Inter-Mountain Basins Semi-Desert Shrub Steppe

**Conservation Status and Concern**

This is the rarest of all Semi-Desert Scrub and Grassland ecological systems in Washington, occupying roughly a tenth of one percent of Washington's land area. Being in the driest region of Washington, this shrub-steppe ecosystem is particularly vulnerable to the spread of invasive plants that often are facilitated by fire and grazing. Six terrestrial SGCN are associated with this system and the Ferruginous Hawk is the only close associate.

**Description and Distribution**

Inter-Mountain Basins Semi-Desert Shrub Steppe occurs in the hottest and driest parts of southeastern Washington's Columbia Plateau, where annual rainfall is less than 8 inches. Although some occurrences are on public lands, most is in private ownership. Patch sizes of this ecological system range from small to large. Though the canopy often consists of an open to moderately dense mix of shrubs and dwarf shrubs, some occurrences are dominated by a single species of shrub. Dominant shrubs include spiny hopsage (*Grayia spinosa*), winterfat (*Krascheninnikovia lanata*), and rubber rabbitbrush (*Ericameria nauseosa*). Native herbaceous cover in the understory typically exceeds 25 percent and principally is made up of bunchgrasses with few or no forbs. The natural fire regime is important to maintaining a patchy distribution of shrubs, which is a characteristic of this system. The result is that the general look tends to be more like a grassland than shrubland.

| PHS | NHP Rank | Status and trend | SGCN closely and generally associated with this ecological system |
|---|---|---|---|
| Yes Shrub-steppe | S1 | Imperiled/ declining<br><br>50-70% decline within the last 50 years and from historical conditions. | **BIRDS:** Ferruginous Hawk*, Golden Eagle, Loggerhead Shrike, Short-eared Owl, Cinnamon Teal<br>**FISH:** to be determined- research needed<br>**INVERTEBRATES:** Morrison's Bumble Bee |

* SGCN is closely associated with this ecological system

**Stressors and Actions Needed**

This system's ecological integrity has been altered by persistent grazing, invasive plants, wildfire, soil disturbances, and habitat fragmentation. Grazing practices incompatible with habitat conservation have stressed the system by disturbing the delicate soils and by exposing bare ground. It also disturbs the layer of moss and lichens that lock in scarce amounts of soil moisture. Grazing has brought about a shift in this system's plant composition by creating dense stands of big sagebrush and by shifting the dominant grasses from native perennials to annuals, particularly cheatgrass. Because cheatgrass produces abundant fine fuels, its spread increases fire risk. Because fire also enhances the spread of cheatgrass, the system has become highly vulnerable to a persistent cycle of wildfire and cheatgrass expansion.

Fire has also drastically altered shrub species composition given the indigenous shrubs generally are intolerant of frequent fires. Although not as big a problem as grazing, wildfire, or invasive plants, cropland expansion (especially where the soils are deeper) and development have fragmented some of this shrub-steppe.

| STRESSOR | DESCRIPTION | ACTION CATEGORY | ACTION DESCRIPTION |
|---|---|---|---|
| Altered disturbance regimes | Fire and ground disturbance has degraded the habitat and has led to a loss of habitat diversity. Fire has a particularly strong impact to indigenous shrubs. | • Fire management<br>• Vegetation management<br>• Grazing/farmmanagement | Integrated habitat restoration using prescribed fire, weed control, and seeding with native vegetation. |
| Fish and wildlife habitat loss or degradation | Habitat has been lost to agriculture, and development to a lesser degree. | • Environmental Review<br>• Land acquisition<br>• Land use planning<br>• Private lands agreements | Acquisitions, conservation easements, landowner agreements, and restoration. |
| Invasive and other problematic species | Invasive annual grasses (cheatgrass) and exotic weeds have degraded habitat and increase with fire. | • Invasive species control | Mechanical and herbicide control of invasive vegetation. |

# TEMPERATE FOREST

**Overview**
Temperate Forest includes 29 ecological systems comprised of native upland vegetation throughout a broad elevation range and wide distribution in Washington. Forests in this category vary from the dry forest types of the eastern Cascade Range to the rain forests along the Washington coast. Temperate Forests support numerous SCGN including the following species: 20 birds, 11 amphibians, 30 invertebrates, 24 mammals, 6 reptiles, and approximately 31 anadromous or freshwater fishes.

| Distribution | Public Land | Private Land | SGCN with close association (#) | SGCN with general association (#) | Ecological systems of concern (#) |
|---|---|---|---|---|---|
| 28,929 $mi^2$ | 70% | 30% | 66 | 55 | 8 |

**Major stressors**

1. Agricultural conversion in lower elevation areas
2. Conversion for development purposes
3. Intensive plantation forestry primarily in lower- and mid-elevation areas
4. Altered fire behavior in dry forest landscapes
5. Excessive grazing
6. Weed invasions
7. Climate change

**Habitat needs for SGCN associated with this vegetation formation**

| | |
|---|---|
| **Old-growth Forest - High Ecological Integrity** | Old growth forest comprised of trees of a wide range of age, height and diameter distributions of living and dead trees which results in complex structure important to numerous species. Examples: Northern Spotted Owl nesting, roosting, and foraging habitat; Bald Eagle nesting and roosting habitat. Golden Eagle nesting in large ponderosa pines, White-headed Woodpecker foraging and nesting in ponderosa pine forests. |
| **High microclimate diversity** | Many of the butterflies use habitat of high microclimate diversity with few invasive plants and high diversity of native plants. |
| **Snags and downed wood** | Vertical structure and structure on the forest floor provide area for foraging wildlife such as woodpeckers and habitat for flying squirrels, an important prey species for Northern Spotted owl. |

**Actions needed to maintain habitat quality for SGCN**

- Fire management (establishment of natural fire regimes)
- Establish longer forestry rotations
- Grazing management
- Invasive species control
- Habitat restoration, research, and native species restoration.
- Landowner agreements/incentives; acquisition/easements

**Role of Climate Change**
Increasing temperatures, decreased moisture availability, and altered fire regimes represent the most significant climate stressors to temperate forests. Altered fire regimes appear to be the greatest threat, particularly given fire suppression practices of the past century that have led to the invasion of shade-tolerant and fire-intolerant species and/or altered forest structure and composition (i.e., increased stand density, smaller diameter trees. Warmer temperatures and decreased moisture availability may increase insect outbreaks in some temperate forests. In general, North Pacific temperate forests likely exhibit less vulnerability to climate change than temperate forests of the East Cascades and Rocky Mountains.

**Research and Data Needs**
- Assess effectiveness of various restoration methods
- Assess ecological consequences of using silvicultural versus prescribed fire methods to restore and/or retain habitats (e.g. ponderosa pine forest and woodland).
- What is the range of ecological value (e.g. wildlife species occurrence) that might be expected to occur in these ecological systems depending on varying levels of anticipated or hypothesized protection or ecological restoration?
- Are there minimum patch sizes or levels of isolation that make patches usable or unusable for the SGCN that are closely associated?

**Ecological systems and other habitats discussed in greater detail in this chapter include:**
A. East Cascades Oak-Ponderosa Pine Forest and Woodland
B. North Pacific Dry Douglas-fir-(Madrone) Forest and Woodland
C. North Pacific Hypermaritime Sitka Spruce Forest
D. North Pacific Hypermaritime Western Red-cedar-Western Hemlock Forest
E. North Pacific Oak Woodland
F. Northern Rocky Mountain Ponderosa Pine Woodland and Savanna.
G. Northern Rocky Mountain Western Larch Savanna
H. Rocky Mountain Aspen Forest and Woodland

## East Cascades Oak-Ponderosa Pine Forest and Woodland

**Conservation Status and Concern**
Fire suppression combined with grazing creates conditions that support cloning of oak and invasion by conifers resulting in denser stands. Seven terrestrial SGCN are closely associated with this ecological system and nine are generally associated. A complete analysis of habitat association has not been done for SGCN anadromous and freshwater fishes.

### Description and Distribution
This narrowly restricted ecological system appears at or near lower treeline in foothills of the eastern Cascade Range. Most occurrences of this system are dominated by a mix of Oregon white oak (*Quercus garryana)* and ponderosa pine or Douglas-fir. Scattered ponderosa pine or Douglas-fir comprise the upper canopy over Oregon white oak trees. Clonal Oregon white oak can create dense patches across a grassy landscape or can dominate open woodlands or savannas. Shrub-steppe vegetation may be prominent in some stands and create a distinct tree / shrub / sparse grassland habitat, including bitterbrush, big

sagebrush and yellow rabbitbrush (*Chrysothamnus viscidiflorus*). The understory is generally dominated by herbaceous species, especially graminoids (grasses, sedges, and rushes). Mesic sites have an open- to-closed sodgrass understory dominated by pinegrass (*Calamagrostis rubescens*), Geyer's sedge (*Carex geyeri),* Ross' sedge (*Carex rossii*), or blue wildrye (*Elymus glaucus*). Drier savanna and woodland understories typically contain bunchgrass steppe species such as Idaho fescue (*Festuca idahoensis*) or bluebunch wheatgrass (*Pseudoroegneria spicata*). Common exotic grasses that often appear in high abundance are cheatgrass and bulbous bluegrass.

In the Columbia River Gorge, Oregon white oak can be found in dense patches often associated with grassland or shrubland balds within a closed Douglas-fir overstory forest landscape. The understory is often shrubby and composed of deerbrush (*Ceanothus integerrimus), oceanspray,* common snowberry (*Symphoricarpos albus*), and Pacific poison oak (*Toxicodendron diversilobum*). These woodlands occur at the lower treeline/ecotone between sagebrush (*Artemisia* spp.) or bitterbrush steppe or shrubland and ponderosa pine and/or *Douglas-fir* forests or woodlands. The matrix system occurs in the eastern Cascades in Washington and Oregon within 40 miles of the Columbia River Gorge. Elevations range from 1500 to 6300 feet. The Washington map was based on LANDFIRE data.

| PHS | NHP Rank | Status and trend | SGCN closely and generally associated with this ecological system |
|---|---|---|---|
| Yes<br>If Snags or Logs, or Old Growth/ Mature Forest Conditions are present | S1/S2 | Imperiled/ declining. | **MAMMALS:** American badger, Hoary bat, Silver-haired Bat, Townsend's Big-eared Bat, Western Gray Squirrel* |
| | | | **BIRDS:** Bald Eagle, Golden Eagle, Lewis' Woodpecker*, Pygmy Nuthatch*, White-headed Woodpecker |
| | | | **AMPHIBIANS:** Larch Mountain Salamander, Western Toad |
| | | | **REPTILES:** California Mountain Kingsnake*, Ringneck Snake*, Sharptail Snake*, Western Pond Turtle* |
| | | | **FISH:** to be determined- research needed |

* SGCN is closely associated with this ecological system

**Stressors and Actions Needed**

Fire suppression may support cloning of oak and invasion by conifers resulting in denser stands. This may be exacerbated by excessive grazing. Establishment of a natural fire regime is a key conservation action.

| STRESSOR | DESCRIPTION | ACTION CATEGORY | ACTION DESCRIPTION |
|---|---|---|---|
| Altered disturbance regimes | Fire exclusion has resulted in tree and shrub encroachment. | • Fire management<br>• Vegetation management<br>• Invasive species control | Integrated habitat restoration using prescribed fire, weed control and seeding with natives. |
| Roads and development | Habitat has been lost to housing and subdivisions. | • Environmental review<br>• Land acquisition<br>• Land use planning<br>• Private lands agreements | Acquisitions, conservation easements, landowner agreements, and restoration. |

| | | | |
|---|---|---|---|
| Invasive and other problematic species | Invasive trees, forbs and shrubs are degrading habitat. | • Invasive species control | Mechanical and herbicide control of invasive species. |

## North Pacific Dry Douglas-Fir-(Madrone) Forest and Woodland

**Conservation Status and Concern**
Clearcut or similar logging reduces canopy structural complexity and abundance of large woody debris. Fire suppression and climate change are significant threats to habitat for at least one SGCN species. There are 4 closely associated and 15 generally associated terrestrial SCGN that use this system. A complete analysis of habitat association has not been done for SGCN anadromous and freshwater fishes.

**Description and Distribution**
Large and small patch system most common in the Puget Trough - Willamette Valley but found throughout western Washington and much of western Oregon. The Washington map was based on the recent modification of Washington's GAP map for Zone 1 (i.e. west side and east slope of the Cascades). Found in dry soils within relatively dry to mesic climates in the western Cascades, it can occur up to about 4000 feet elevation. With fire exclusion, stands have probably increased in tree density and grassy understories have been replaced by deciduous shrubs. Moderate to heavy grazing or other significant ground disturbance leads to increases in non-native invasive species, many of which are now abundant in stands with grassy or formerly grassy understories. Exotic herbaceous invaders include colonial bentgrass (*Agrostis capillaris*), common velvetgrass (*Holcus lanatus*), Kentucky bluegrass (*Poa pratensis)*, tall oatgrass (*Arrhenatherum elatius*), ripgut brome (*Bromus rigidus*), orchardgrass (*Dactylis glomerata*), bristly dogstail grass (*Cynosurus echinatus*), tall fescue (*Schedonorus arundinaceus*), and common St. Johnswort (*Hypericum perforatum*).

| PHS | NHP Rank | Status and trend | SGCN closely and generally associated with this ecological system |
|---|---|---|---|
| Yes<br>If Snags or Logs, or Old Growth/ Mature Forest Conditions are present | S2 | Imperiled/ declining.<br><br>Declines of 30-50% within the last 50 years.<br><br>Declines of 70-80% from historical conditions. | **MAMMALS:** Hoary Bat, Keen's Myotis, Shaw Island Vole, Silver-haired Bat, Townsend's Big-eared Bat, Western Gray Squirrel, Western Spotted Skunk<br>**BIRDS:** Bald Eagle, Marbled Murrelet, Peregrine Falcon, Western Bluebird, Western Screech Owl<br>**AMPHIBIANS:** Western Toad<br>**FISH:** to be determined- research needed<br>**INVERTEBRATES:** Great Arctic*, Hoary Elfin*, Oregon Megomphidx, Pacific Vertigo, Puget Sound Fritillary*, Valley Silverspot* |

* SGCN is closely associated with this ecological system

**Stressors and Actions Needed**: Maintenance of a natural fire regime is a key indicator of health

| STRESSOR | DESCRIPTION | ACTION CATEGORY | ACTION DESCRIPTION |
|---|---|---|---|
| Altered disturbance regimes | Fire exclusion has resulted in tree and shrub encroachment | • Fire management<br>• Vegetation management | Integrated habitat restoration using prescribed fire, weed control and seeding with natives |
| Roads and development | Habitat has been lost to housing and subdivisions | • Environmental review<br>• Land acquisition<br>• Land use planning<br>• Private lands agreements | Acquisitions, conservation easements, landowner agreements, and restoration |
| Invasive and other problematic species | Invasive trees, forbs and shrubs are degrading habitat | • Invasive species control | Mechanical and herbicide control of invasive species |
| Forestry impacts | Clearcut or similar logging reduces canopy structural complexity and abundance of large woody debris. | • Environmental review<br>• Land acquisition<br>• Private lands agreements | Protect key sites through acquisition, easement, and planning. |

## North Pacific Hypermaritime Sitka Spruce Forest

**Conservation Status and Concern**

Historically, this system was more extensive, and has been reduced by conversion to commercial forest and shorter forest rotation. There are 2 closely associated and 19 generally associated terrestrial SCGN that use this ecological system. A complete analysis of habitat association has not been done for SGCN anadromous and freshwater fishes.

**Description and Distribution**

This system is characterized by forests found in the outermost coastal fringe where salt spray is prominent and on riparian terraces and valley bottoms near the coast where there is abundant fog. Large patch system are restricted to the hypermaritime climatic areas near the Pacific Coast, along a fog belt from Point Arena, California, north to the Kenai Peninsula, Alaska. It is found below 1000 feet elevation and within 15 miles of the outer coast, and does not include swamp areas. Mild, wet climate with abundant summer fog are characteristic and annual precipitation ranges from 26 to 217 inches, with the majority falling as rain, which can be heavy. The Washington map is based on recent modification of Washington's GAP map for Zone 1 (i.e. west side and east slope of the Cascades).

| PHS | NHP Rank | Status and trend | SGCN closely and generally associated with this ecological system |
|---|---|---|---|
| Yes If Snags or Logs, or Old Growth/ Mature Forest Conditions are present. | S2 | Imperiled/ declining.<br><br>Decline of 70-80% within last 50 years and from historical condition. | **MAMMALS:** Fisher, Hoary Bat, Keen's Myotis, Pacific Marten (coastal population)*, Silver-haired Bat, Townsend's Big-eared Bat, Western Spotted Skunk |
| | | | **BIRDS:** Bald Eagle, Golden Eagle, Harlequin Duck, Marbled Murrelet, Northern Spotted Owl, Peregrine Falcon, Western Bluebird, Western Screech Owl |
| | | | **AMPHIBIANS:** Cope's Giant Salamander, Dunn's Salamander*, Olympic Torrent Salamander, Van Dyke's Salamander, Western Toad |
| | | | **FISH:** to be determined- research needed |
| | | | **INVERTEBRATES:** Crowned Ttightcoil |

* SGCN is closely associated with this ecological system

**Stressors and Actions Needed**

Many historical occurrences of this system have become conifer plantations and logging of remaining intact stands remains a threat. Clearcut logging and plantation forestry have resulted in less diverse tree canopies, and have focused mainly on Douglas-fir, with reductions in coarse woody debris, a shortened stand initiation phase, and succession truncated well before late-seral characteristics are expressed. Non-native species are also a potential threat to the persistence and ecological integrity of this ecological system. Maintenance of a natural fire regime and longer stand rotations are key conservation actions.

| STRESSOR | DESCRIPTION | ACTION CATEGORY | ACTION DESCRIPTION |
|---|---|---|---|
| Roads and development | Habitat has been lost to housing and subdivisions. | • Environmental review<br>• Land acquisition | Acquisitions, conservation easements, landowner agreements, and restoration. |

| STRESSOR | DESCRIPTION | ACTION CATEGORY | ACTION DESCRIPTION |
|---|---|---|---|
| | | • Land use planning<br>• Private lands agreements | |
| Forestry impacts | Intensive forestry that emphasizes shorter rotations and different species. | • Vegetation management | Integrated Habitat Restoration with native species. |
| Invasive and other problematic species | Invasive trees, forbs and shrubs are degrading habitat. | • Invasive species control | Mechanical and herbicide control of invasive species. |

## North Pacific Hypermaritime Western Red-cedar Western Hemlock Forest

**Conservation Status and Concern**
Fire suppression and climate change are significant threats to habitat for this ecological system. There are 3 closely associated and 20 generally associated terrestrial SCGN with this ecological system. A complete analysis of habitat association has not been done for SGCN anadromous and freshwater fishes.

**Description and Distribution**
This is a coastal forest occurring in areas of low, gentle relief within 15 miles of the coast. Where these forests are best developed they occur in a mosaic with forested wetlands, bogs, and Sitka spruce forests (the latter in riparian areas and on steep, more productive soils). The matrix system occupies the outer coastal portions of British Columbia, southeastern Alaska, and Washington. Its center of distribution is the northern coast of British Columbia, as western redcedar (*Thuja plicata*) approaches its northernmost limit in the southern half of southeastern Alaska.

| PHS | NHP Rank | Status and trend | SGCN closely and generally associated with this ecological system |
|---|---|---|---|
| Yes<br>If Snags or Logs, or Old Growth/ Mature Forest Conditions are present | S2 | Imperiled/ declining.<br><br>Declines of 70-80% within last 50 years.<br><br>Declines of 50-70% from historical. | **MAMMALS:** Fisher, Hoary Bat, Keen's Myotis, Pacific Marten(coastal population), Silver-haired Bat, Townsend's Big-eared Bat, Western Spotted Skunk |
| | | | **BIRDS:** Bald Eagle, Golden Eagle, Harlequin Duck, Marbled Murrelet, Northern Spotted Owl, Peregrine Falcon, Western bluebird, Western Screech Owl |
| | | | **AMPHIBIANS:** Dunn's Salamander*, Cope's Giant Salamander, Olympic Torrent Salamander, Van Dyke's Salamander, Western Toad |
| | | | **FISH:** to be determined- research needed |
| | | | **INVERTEBRATES:** Bluegray Taildropper*, Johnson's hairstreak*, Puget Oregonian |

* SGCN is closely associated with this ecological system

**Stressors and Actions Needed**

These forests very rarely burn and are more influenced by gap disturbance processes and intense windstorms than by fire. Many historical occurrences of this system have become conifer plantations and logging of remaining intact stands remains a threat. Clearcut logging and plantation forestry have resulted in less diverse tree canopies, and have focused mainly on Douglas-fir, with reductions in coarse woody debris, a shortened stand initiation phase, and succession truncated well before late-seral characteristics are expressed. Non-native species are also a potential threat to the persistence and ecological integrity of this ecological system.

| STRESSOR | DESCRIPTION | ACTION CATEGORY | ACTION DESCRIPTION |
|---|---|---|---|
| Forestry impacts | Intensive forestry that emphasizes shorter rotations and different species. | Vegetation management | Integrated habitat restoration with native species. |
| Roads and development | Habitat has been lost to housing and subdivisions. | • Environmental review<br>• Land acquisition<br>• Land use planning<br>• Private lands agreements | Acquisitions, conservation easements, landowner agreements, and restoration. |

## North Pacific Oak Woodland

**Conservation Status and Concern**

Due to historical loss of habitat, and ongoing threats from invasive species and development, conservation action is critical for conservation of this ecological system and associated SGCN. There are three terrestrial SGCN species that are closely associated with this ecological system and 12 that are generally associated. A complete analysis of habitat association has not been done for SGCN anadromous and freshwater fishes.

**Description and Distribution**

This oak woodland is most prevalent on gravelly outwash plains in Thurston and Pierce counties but is found on dry sites that experienced frequent pre-settlement fires in other part of the Puget Trough including parts of Jefferson, Clallam, Island and San Juan Counties. This system occurs as either large or small patches. The sporadic distribution and often small patch size of component parts of this system often limits visibility of mapped occurrences, thus the map also displays the counties in which the system is known to occur. The presence of Oregon white oak either as single species patches or where mixed with conifers characterizes these woodlands. East of the Cascade Crest is a different system dominated by Oregon white oak (i.e., East Cascades Oak-Ponderosa Pine Forest and Woodland).

| PHS | NHP Rank | Status and trend | SGCN closely and generally associated with this ecological system |
|---|---|---|---|
| Yes<br>Oregon White Oak Woodlands | S1 | Critically imperiled/ declining.<br>Rate of decline unknown. | **MAMMALS:** Western Gray Squirrel* |

| PHS | NHP Rank | Status and trend | SGCN closely and generally associated with this ecological system |
|---|---|---|---|
| | | | **BIRDS:** Bald Eagle, Slender-billed White-breasted Nuthatch*, Western Bluebird, Western Screech Owl |
| | | | **AMPHIBIANS:** Oregon Spotted Frog, Western Toad |
| | | | **REPTILES:** Western Pond Turtle* |
| | | | **FISH:** to be determined- research needed |
| | | | **INVERTEBRATES:** Propertius' Duskywing*, Puget Sound Fritillary* |

* SGCN is closely associated with this ecological system

**Stressors and Actions Needed**

This ecological system is relatively limited in area and is currently declining in extent and condition. With the cessation of regular fires, many oak woodlands have been invaded by a greater density of trees that alters the structure and function of woodlands and interferes with successional dynamics such as recruitment. Some areas have been lost to urban or agriculture development. Ongoing threats include residential development, increase and spread of exotic species, and fire suppression effects. Selective logging of Douglas-fir in oak woodlands can prevent long-term loss of oak dominance. Moderate to heavy grazing can lead to an increase in non-native species, many of which are now abundant. Maintenance of a natural fire regime is a key conservation action.

| STRESSOR | DESCRIPTION | ACTION CATEGORY | ACTION DESCRIPTION |
|---|---|---|---|
| Altered disturbance regimes | Fire exclusion has resulted in tree and shrub encroachment | • Fire management<br>• Vegetation management<br>• Invasive species control | Integrated habitat restoration using prescribed fire, weed control and seeding with native species |
| Roads and development | Habitat has been lost to housing and subdivisions | • Environmental review<br>• Land acquisition<br>• Land use planning<br>• Private lands agreements | Acquisitions, conservation easements, landowner agreements, and restoration |
| Invasive and other problematic species | Invasive trees, forbs and shrubs are degrading habitat | • Invasive species control | Mechanical and herbicide control of invasive species |

## Northern Rocky Mountain Ponderosa Pine Woodland and Savanna

**Conservation Status and Concern**

Fire suppression and climate change are significant threats to this ecological system. Housing and development is increasingly moving into this habitat. There are 9 terrestrial SGCN that are closely associated with this ecological system and 20 that are generally associated. Although a complete analysis has not been done for all SGCN anadromous and freshwater fishes, several appear closely associated with this system, e.g., Upper Columbia Steelhead DPS, and Upper Columbia Spring Chinook Salmon ESU.

**Description and Distribution**

These woodlands and savannas are, or at least historically were, fire-maintained and occur at the lower treeline/ecotone between grasslands or shrublands at lower elevations and more mesic coniferous forests at higher elevations. This is the predominant ponderosa pine system of eastern Washington. This system occurs in the foothills of the northern Rocky Mountains in the Columbia Plateau region and west along the foothills of the Modoc Plateau and eastern Cascades into southern interior British Columbia.

| PHS | NHP Rank | Status and trend | SGCN closely and generally associated with this ecological system |
|---|---|---|---|
| Yes If Snags or Logs, or Old Growth/ Mature Forest Conditions are present | S2 | Imperiled/ declining. | **MAMMALS:** American Badger, American Pika, Gray Wolf, Hoary Bat, Silver-haired Bat, Spotted Bat, Townsend's Big-eared Bat, Western Gray Squirrel |
| | | | **BIRDS:** Bald Eagle, Flammulated Owl*, Golden Eagle, Harlequin Duck, Lewis' Woodpecker, Mountain Quail*, Northern Spotted Owl, Peregrine Falcon, Pygmy Nuthatch*, White-headed woodpecker* |
| | | | **AMPHIBIANS:** Columbia Spotted Frog, Tiger Salamander, Western Toad |
| | | | **REPTILES:** California Mountain Kingsnake*, Night Snake, Ringneck Snake*, Sharptail Snake*, Short-horned Lizard |
| | | | **FISH:** to be determined- research needed |
| | | | **INVERTEBRATES:** Chelan Mountainsnail*, Hoder's Mountainsnail, Mardon Skipper* |

* SGCN is closely associated with this ecological system

**Stressors and Actions Needed**

Pre-1900, this system was a mosaic of forest containing a substantial area of open and park like forest with few understory trees. Currently, much of this system has a younger tree cohort often including more shade-tolerant species, resulting in a more closed, multilayered canopy in patches that include older trees. Fire suppression has led to a buildup of fuels (e.g. higher density of trees, inter-connecting canopies of trees, multiple heights classes of trees) that in turn increase the likelihood of stand-replacing fires. Heavy grazing, in contrast to fire, removes the grass cover and tends to favor shrub and conifer species. Fire suppression combined with grazing creates conditions that support invasion by conifers. Large late-seral ponderosa pine and Douglas-fir are harvested in much of this habitat. Under most management regimes, typical tree size decreases and tree density increases in this habitat. Maintenance of a natural fire regime and longer stand rotation are key conservation actions.

| STRESSOR | DESCRIPTION | ACTION CATEGORY | ACTION DESCRIPTION |
|---|---|---|---|
| Altered disturbance regimes | Fire exclusion has resulted in tree and shrub encroachment | • Fire management<br>• Vegetation management | Integrated habitat restoration using prescribed fire, weed control and seeding with natives |

| STRESSOR | DESCRIPTION | ACTION CATEGORY | ACTION DESCRIPTION |
|---|---|---|---|
| Fish and wildlife habitat loss or degradation | Habitat has been lost to agriculture, and development. | • Environmental Review<br>• Land acquisition<br>• Land use planning<br>• Private lands agreements | Acquisitions, conservation easements, landowner agreements, and restoration. |
| Invasive and other problematic species | Invasive trees, forbs and shrubs are degrading habitat | • Invasive species control | Mechanical and herbicide control of invasive species |

## Northern Rocky Mountain Western Larch Savanna

**Conservation Status and Concern**

This is a fire-dependent system and was much more extensive in the past; it is now very patchy in distribution. Fire suppression has led to invasion of the more shade-tolerant tree species grand fir (*Abies grandis*), subalpine fir (*Abies lasiocarpa*), Engelmann spruce (*Picea engelmannii*), or hemlock species (*Tsuga* spp.) and loss of much of the single-story canopy woodlands. Fire suppression and climate change are significant threats. There are 12 terrestrial SCGN species that are generally associated with this ecological system. A complete analysis of habitat association has not been done for SGCN anadromous and freshwater fishes.

**Description and Distribution**

This large patch system is restricted to the interior montane zone of the Pacific Northwest in northern Idaho and adjacent Montana, Washington, Oregon, and southeastern British Columbia. The Washington map is based on recent modification of Washington's GAP map for Zone 1 (i.e. east slope of the Cascades) and LANDFIRE data. The sporadic distribution of this system limits visibility of mapped occurrences, thus the map also displays the counties in which the system is known to occur. There may be remnant stands in Yakima and Klickitat counties. Elevations range from 2230 to 7200 feet, and sites include drier, lower montane settings of toe slopes and ash deposits. Winter snowpack typically melts off in early spring at lower elevations.

| PHS | NHP Rank | Status and trend | SGCN closely and generally associated with this ecological system |
|---|---|---|---|
| Yes If Snags or Logs, or Old Growth /Mature Forest Conditions are present | S1 | Critically imperiled/ declining. | **MAMMALS:** American pica, Cascade red fox, Gray wolf, Grizzly Bear, Hoary Bat, Silver-haired Bat, Townsends Big-eared Bat, Wolverine |
| | | | **BIRDS:** Bald Eagle, Golden Eagle, Lewis' woodpecker |
| | | | **AMPHIBIANS:** Columbia Spotted Frog |
| | | | **REPTILES:** none |
| | | | **FISH:** to be determined- research needed |
| | | | **INVERTEBRATES:** none |

* SGCN is closely associated with this ecological system

**Stressors and Actions Needed**

This is a fire-dependent system and was much more extensive in the past; it is now very patchy in distribution. Fire suppression has led to invasion of the more shade-tolerant tree species such as grand fir, subalpine fir, Engelmann spruce, or hemlock species and loss of much of the single-story canopy woodlands. Maintenance of a natural fire regime is a key conservation action.

| STRESSOR | DESCRIPTION | ACTION CATEGORY | ACTION DESCRIPTION |
|---|---|---|---|
| Altered disturbance regimes | Fire exclusion has resulted in tree and shrub encroachment | • Fire management<br>• Vegetation management<br>• Invasive species control | Integrated habitat restoration using prescribed fire, weed control and seeding with natives |
| Roads and development | Habitat has been lost to housing and subdivisions | • Environmental review<br>• Land acquisition<br>• Land use planning<br>• Private lands agreements | Acquisitions, conservation easements, landowner agreements, and restoration |

## Rocky Mountain Aspen Forest and Woodland

**Conservation Status and Concern**

Conifers now dominate many seral aspen stands and extensive stands of young aspen are uncommon. Heavy livestock browsing can adversely impact aspen growth and regeneration. With fire suppression and alteration of fine fuels, fire rejuvenation of aspen habitat has been greatly reduced since about 1900. There are 10 generally associated terrestrial SCGN that use this ecological system. A complete analysis of habitat association has not been done for SGCN anadromous and freshwater fishes.

### Description and Distribution

Aspen forests and woodlands are a minor type found on the east side of the North Cascades and in the Okanogan. Although aspen can be associated with streams, ponds, or wetlands, this system consists of upland aspen stands found from low to moderate elevation. This widespread, large patch system is very common in the southern and central Rocky Mountains but occurs in the montane and subalpine zones throughout much of the western U.S. and north into Canada. The Washington map is based on recent modification of Washington's GAP map for Zone 1 (i.e. west side and east slope of the Cascades). The sporadic distribution of this system limits visibility of mapped occurrences, thus the map also displays the counties in which the system is known to occur. It often occurs on well-drained mountain slopes or canyon walls that have some moisture. Rockfalls, talus, or stony north slopes are often typical sites and the system may occur in steppe on moist microsites.

| PHS | NHP Rank | Status and trend | SGCN closely and generally associated with this ecological system |
|---|---|---|---|
| Yes. Snags and Logs and Aspen Stands | S2 | Imperiled/ declining.<br><br>Declines of 50-70% within the last 50 years. | **MAMMALS:** Gray Wolf, Grizzly Bear, Hoary Bat Silver-haired Bat, Townsend's Big-eared Bat |
| | | | **BIRDS:** Bald Eagle, Harlequin Duck, Lewis' woodpecker |
| | | | **AMPHIBIANS:** Columbia spotted frog , Western toad |
| | | | **FISH:** to be determined- research needed |
| | | | **INVERTEBRATES:** none |

* SGCN is closely associated with this ecological system

**Stressors and Actions Needed**

| STRESSOR | DESCRIPTION | ACTION CATEGORY | ACTION DESCRIPTION |
|---|---|---|---|
| Altered disturbance regimes | Fire exclusion has resulted in tree and shrub encroachment, loss of habitat diversity | • Fire management<br>• Vegetation management<br>• Invasive species control | Integrated habitat restoration using prescribed fire, weed control and seeding with natives |
| Roads and development | Habitat has been lost to housing and subdivisions | • Environmental review<br>• Land acquisition<br>• Land use planning<br>• Private lands agreements | Acquisitions, conservation easements, landowner agreements, and restoration |

# 4.4 PUTTING IT ALL TOGETHER: PRIORITY LANDSCAPES INITIATIVE

The Priority Landscapes Initiative is a new effort intended to identify statewide priorities and provide a framework for place-based collaborative work aimed at preserving landscape conservation values throughout Washington State.

This initiative is one avenue by which the agency intends to link the conservation priorities identified for our Species of Greatest Conservation Need (SGCN), with those for our most important habitats and Ecological Systems of Concern and identify landscape level actions to benefits them. Products of the initiative will include the identification of specific geographies where landscape level conservation actions will have broad benefit across ecological systems and SGCN.

Between 2015 and 2017, WDFW intends to identify landscape level priorities statewide, and also to select two to four areas to be the near-term focus of efforts to promote collaborative conservation aimed at improving habitat conditions for wildlife.

### Criteria for Priority Landscapes

The selection criteria is generally a combination of agency priorities for conservation (in part identified through the State Wildlife Action Plan), and an assessment of the readiness of local communities and constituents to engage in a place-based collaborative conservation. Specific criteria will likely include:

- Conservation benefit to SGCN/ecological systems of concern
- Priority for species recovery plans and/or a habitat connectivity priority
- Conservation partner priorities (including land trusts, conservation NGOs, federal and state partners, farming and forestry associations, tribes, etc.)
- Momentum, and political support and funding availability

Preliminary results indicate potential Priority Landscapes in marine/nearshore systems, urban/wild interface and in agriculture and forested landscapes. Our focus in the next phase of action is to develop a list of gaps (conservation needs that are still unmet in these landscapes) to focus on in the next 10 years.

## 4.5 REFERENCE INFORMATION

### Definition of Terms

**PHS (Priority Habitats and Species Program)**
A species or habitat listed under the PHS program is considered to be a priority for conservation and management and requires protective measures for survival due to population status and/or tribal, recreational or commercial importance. Management recommendations have been developed for PHS habitats, and can assist landowners, managers and others in conducting land use activities in a manner that incorporates the needs of fish and wildlife. A complete list of PHS Habitats is available here.

**Public Ownership**
Public Ownership – Property owned by government entities including cities or municipal governments, counties, state agencies, federal agencies, and tribes.

**Private Ownership**
Private Land Ownership – Land owned by individuals or non-government organizations.
Natural Heritage Program (more, ranking guide)

**NHP Rank (Natural Heritage Program Rank)**
The Washington Natural Heritage Program assigned conservation status ranks to Washington's Ecological Systems using NatureServe's Conservation Status Rank calculator. The Conservation Status Rank is a measure of an ecological system's elimination risk. The rank is calculated using a measure of eight core factors relevant to risk assessment of elimination. The factors are organized into three categories: rarity, threats, and trends. Factors are scaled and weighted and subsequently scored according to their impact on risk. Scores are combined by category resulting in an overall calculated rank, which is reviewed by the user, and a final conservation status rank is assigned. The Conservation Status Rank calculator automates the process of assigning conservation status ranks across the network thereby improving standardization of rank assignments. WDFW identified systems with S1, S1S2, and S2 as ecological systems of concern.

## General references

- Supporting documents for the EIAs can be found at: http://www1.dnr.wa.gov/nhp/refdesk/communities/eia.html

- Documentation about Ecological Systems can be found at: http://www1.dnr.wa.gov/nhp/refdesk/communities/ecol_systems.html

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## Crosswalk between Formations, Ecological Systems and PHS[1] Categories

**Table 4-6: National Vegetation Classification/PHS Crosswalk**

| Formation | Ecological System | ESOC[2] | Associated PHS Habitat | Conditional Riparian Habitat |
|---|---|---|---|---|
| Alpine Cliff, Scree & Rock Vegetation | North Pacific Alpine and Subalpine Bedrock and Scree | no | see "Conditional Riparian Habitat" column | Talus |
| | Rocky Mountain Alpine Bedrock and Scree | no | see "Conditional Riparian Habitat" column | Talus |
| | North Pacific Dry and Mesic Alpine Dwarf-Shrubland, Fell-field and Meadow | no | none | N/A |
| | Rocky Mountain Alpine Fell-Field | no | none | N/A |
| | Rocky Mountain Alpine Tundra/Fell-field/Dwarf-shrub Map Unit | no | none | N/A |
| Barren | North American Alpine Ice Field | no | none | N/A |
| | Unconsolidated Shore | no | none (Riparian?) | N/A |
| Bog & Fen | North Pacific Bog and Fen | yes | Freshwater Wetlands and Fresh Deepwater | N/A |
| | Rocky Mountain Subalpine-Montane Fen | no | Freshwater Wetlands and Fresh Deepwater | N/A |
| Cliff, Scree & Rock Vegetation | North Pacific Montane Massive Bedrock, Cliff and Talus | no | Talus | N/A |
| | Rocky Mountain Cliff, Canyon and Massive Bedrock | no | see "Conditional Riparian Habitat" column | Cliffs |
| Current and Historic Mining Activity | Quarries, Mines, Gravel Pits and Oil Wells | no | none | N/A |

[1] Priority Habitats and Species
[2] Ecological System of Concern

| Formation | Ecological System | ESOC[2] | Associated PHS Habitat | Conditional Riparian Habitat |
|---|---|---|---|---|
| Developed & Urban | Developed, High Intensity | no | none | N/A |
| | Developed, Low Intensity | no | none | N/A |
| | Developed, Medium Intensity | no | none | N/A |
| | Developed, Open Space | no | none | N/A |
| Flooded and Swamp Forest | Columbia Basin Foothill Riparian Woodland and Shrubland | yes | Riparian | N/A |
| | Great Basin Foothill and Lower Montane Riparian Woodland and Shrubland | no | Riparian | N/A |
| | Inter-Mountain Basins Montane Riparian Systems | no | Riparian | N/A |
| | North Pacific Hardwood-Conifer Swamp | yes | Freshwater Wetlands and Fresh Deepwater | N/A |
| | North Pacific Lowland Riparian Forest and Shrubland | yes | Riparian | N/A |
| | North Pacific Montane Riparian Woodland and Shrubland | no | Riparian | N/A |
| | North Pacific Shrub Swamp | no | Freshwater Wetlands and Fresh Deepwater | N/A |
| | Northern Rocky Mountain Conifer Swamp | no | Freshwater Wetlands and Fresh Deepwater | N/A |
| | Northern Rocky Mountain Lower Montane Riparian Woodland and Shrubland | yes | Riparian | N/A |
| | Rocky Mountain Lower Montane Riparian Woodland and Shrubland | no | Riparian | N/A |
| | Rocky Mountain Subalpine-Montane Riparian Woodland | no | Riparian | N/A |

| Formation | Ecological System | ESOC[2] | Associated PHS Habitat | Conditional Riparian Habitat |
|---|---|---|---|---|
| Freshwater Aquatic Vegetation | Temperate Pacific Freshwater Aquatic Bed | no | Freshwater Wetlands and Fresh Deepwater | N/A |
| Freshwater Wet Meadow & Marsh | Columbia Plateau Vernal Pool | no | Freshwater Wetlands and Fresh Deepwater | N/A |
| | North American Arid West Emergent Marsh | yes | Freshwater Wetlands and Fresh Deepwater | N/A |
| | North Pacific Avalanche Chute Shrubland | no | none | N/A |
| | North Pacific Intertidal Freshwater Wetland | yes | Freshwater Wetlands and Fresh Deepwater | N/A |
| | Rocky Mountain Alpine-Montane Wet Meadow | no | Freshwater Wetlands and Fresh Deepwater? | N/A |
| | Rocky Mountain Subalpine-Montane Riparian Shrubland | no | Riparian | N/A |
| | Temperate Pacific Freshwater Emergent Marsh | yes | Freshwater Wetlands and Fresh Deepwater | N/A |
| | Temperate Pacific Freshwater Mudflat | yes | Freshwater Wetlands and Fresh Deepwater | N/A |
| | Temperate Pacific Montane Wet Meadow | no | Freshwater Wetlands and Fresh Deepwater | N/A |
| | Willamette Valley Wet Prairie | yes | Westside Prairie | N/A |
| Grassland, Meadow & Shrubland | Columbia Basin Foothill and Canyon Dry Grassland | yes | none (Eastside Steppe?) | N/A |
| | Columbia Basin Palouse Prairie | yes | Eastside Steppe | N/A |
| | North Pacific Alpine and Subalpine Dry Grassland | no | none | N/A |
| | North Pacific Herbaceous Bald and Bluff | no | Herbaceous Bald | N/A |

| Formation | Ecological System | ESOC[2] | Associated PHS Habitat | Conditional Riparian Habitat |
|---|---|---|---|---|
| | North Pacific Hypermaritime Shrub and Herbaceous Headland | no | Nearshore - Open Coast | N/A |
| | North Pacific Montane Shrubland | no | none | N/A |
| | Northern Rocky Mountain Lower Montane, Foothill and Valley Grassland | no | none (Eastside Steppe?) | N/A |
| | Northern Rocky Mountain Montane-Foothill Deciduous Shrubland | no | none | N/A |
| | Northern Rocky Mountain Subalpine Deciduous Shrubland | no | none | N/A |
| | Northern Rocky Mountain Subalpine-Upper Montane Grassland | no | none (Eastside Steppe?) | N/A |
| | Rocky Mountain Subalpine-Montane Mesic Meadow | no | none | N/A |
| | Willamette Valley Upland Prairie and Savanna | yes | Westside Prairie | N/A |
| Herbaceous Agricultural Vegetation | Cultivated Cropland | no | none | N/A |
| | Pasture/Hay | no | none | N/A |
| Introduced & Semi Natural Vegetation | Introduced Riparian and Wetland Vegetation | no | Riparian; Freshwater Wetlands and Fresh Deepwater | N/A |
| | Introduced Upland Vegetation - Annual Grassland | no | none | N/A |
| | Introduced Upland Vegetation - Perennial Grassland and Forbland | no | none | N/A |
| | Introduced Upland Vegetation - Shrub | no | none | N/A |
| Marine & Estuarine Saltwater Aquatic | North Pacific Maritime Eelgrass Bed | no | Nearshore - Open Coast; Nearshore - Coastal; Nearshore - Puget Sound | N/A |

| Formation | Ecological System | ESOC[2] | Associated PHS Habitat | Conditional Riparian Habitat |
|---|---|---|---|---|
| Vegetation | Temperate Pacific Intertidal Mudflat | no | Nearshore - Open Coast; Nearshore - Coastal; Nearshore - Puget Sound | N/A |
| Open Water | Open Water (Fresh) | no | see "Conditional Riparian Habitat" column | Freshwater Wetlands and Fresh Deepwater; |
| Recently Disturbed or Modified | Disturbed, Non-specific | no | none | N/A |
| | Harvested Forest - Grass/Forb Regeneration | no | none | N/A |
| | Harvested Forest - Northwestern Conifer Regeneration | no | none | N/A |
| | Harvested Forest-Shrub Regeneration | no | none | N/A |
| | Recently burned forest | no | see "Conditional Riparian Habitat" column | Snags and logs |
| | Recently burned grassland | no | none | N/A |
| | Recently burned shrubland | no | none | N/A |
| Salt Marsh | Inter-Mountain Basins Alkaline Closed Depression | yes | Freshwater Wetlands and Fresh Deepwater | N/A |
| | Inter-Mountain Basins Greasewood Flat | yes | none | N/A |
| | Inter-Mountain Basins Playa | no | none | N/A |
| | Temperate Pacific Tidal Salt and Brackish Marsh | yes | Nearshore - Coastal; Nearshore - Puget Sound | N/A |
| Scrub & Herb Coastal Vegetation | North Pacific Coastal Cliff and Bluff | no | Nearshore - Open Coast; see "Conditional Riparian Habitat" column | Cliffs |

| Formation | Ecological System | ESOC[2] | Associated PHS Habitat | Conditional Riparian Habitat |
|---|---|---|---|---|
| | North Pacific Maritime Coastal Sand Dune and Strand | yes | Nearshore - Coastal; Nearshore - Puget Sound | N/A |
| Semi-Desert Cliff, Scree & Rock Vegetation | Columbia Plateau Ash and Tuff Badland | no | none | N/A |
| | Inter-Mountain Basins Active and Stabilized Dune | yes | Inland Dunes | N/A |
| | Inter-Mountain Basins Cliff and Canyon | no | see "Conditional Riparian Habitat" column | Cliffs; Talus |
| Semi-Desert Scrub & Grassland | Columbia Plateau Low Sagebrush Steppe | yes | Shrub-steppe | N/A |
| | Columbia Plateau Scabland Shrubland | no | none (Shrub-steppe?) | N/A |
| | Columbia Plateau Steppe and Grassland | yes | Eastside Steppe | N/A |
| | Inter-Mountain Basins Big Sagebrush Shrubland | no | none (Shrub-steppe?) | N/A |
| | Inter-Mountain Basins Big Sagebrush Steppe | yes | Shrub-steppe | N/A |
| | Inter-Mountain Basins Mixed Salt Desert Scrub | no | none (Shrub-steppe?) | N/A |
| | Inter-Mountain Basins Montane Sagebrush Steppe | no | Shrub-steppe | N/A |
| | Inter-Mountain Basins Semi-Desert Grassland | no | none (Eastside Steppe?) | N/A |
| | Inter-Mountain Basins Semi-Desert Shrub Steppe | yes | Shrub-steppe | N/A |
| Temperate Forest | Columbia Plateau Western Juniper Woodland and Savanna | no | see "Conditional Riparian Habitat" column | Juniper Savannah |
| | East Cascades Mesic Montane Mixed-Conifer Forest and Woodland | no | see "Conditional Riparian Habitat" column | Old Growth - Mature Forest; Snags and Logs |
| | East Cascades Oak-Ponderosa Pine Forest and Woodland | yes | see "Conditional Riparian Habitat" column | Old Growth - Mature Forest; Snags and Logs; |

| Formation | Ecological System | ESOC[2] | Associated PHS Habitat | Conditional Riparian Habitat |
|---|---|---|---|---|
| | Inter-Mountain Basins Aspen-Mixed Conifer Forest and Woodland | no | Aspen Stands | N/A |
| | Inter-Mountain Basins Curl-leaf Mountain Mahogany Woodland and Shrubland | no | none | N/A |
| | Middle Rocky Mountain Montane Douglas-fir Forest and Woodland | no | see "Conditional Riparian Habitat" column | Old Growth - Mature Forest; Snags and Logs |
| | North Pacific Broadleaf Landslide Forest and Shrubland | no | none | N/A |
| | North Pacific Dry Douglas-fir-(Madrone) Forest and Woodland | yes | see "Conditional Riparian Habitat" column | Old Growth - Mature Forest; Snags and Logs |
| | North Pacific Dry-Mesic Silver Fir-Western Hemlock-Douglas-fir Forest | no | see "Conditional Riparian Habitat" column | Old Growth - Mature Forest; Snags and Logs |
| | North Pacific Hypermaritime Sitka Spruce Forest | yes | see "Conditional Riparian Habitat" column | Old Growth - Mature Forest; Snags and Logs |
| | North Pacific Hypermaritime Western Red-cedar-Western Hemlock Forest | yes | see "Conditional Riparian Habitat" column | Old Growth - Mature Forest; Snags and Logs |
| | North Pacific Lowland Mixed Hardwood-Conifer Forest and Woodland | no | see "Conditional Riparian Habitat" column | Old Growth - Mature Forest; Snags and Logs |
| | North Pacific Maritime Dry-Mesic Douglas-fir-Western Hemlock Forest | no | see "Conditional Riparian Habitat" column | Old Growth - Mature Forest; Snags and Logs |
| | North Pacific Maritime Mesic Subalpine Parkland | no | see "Conditional Riparian Habitat" column | Old Growth - Mature Forest; Snags and Logs |
| | North Pacific Maritime Mesic-Wet Douglas-fir-Western Hemlock Forest | no | see "Conditional Riparian Habitat" column | Old Growth - Mature Forest; Snags and Logs |
| | North Pacific Mesic Western Hemlock-Silver Fir Forest | no | see "Conditional Riparian Habitat" column | Old Growth - Mature Forest; Snags and Logs |
| | North Pacific Mountain Hemlock Forest | no | see "Conditional Riparian Habitat" column | Old Growth - Mature Forest; Snags and Logs |
| | North Pacific Oak Woodland | yes | Oregon White Oak Woodlands; see "Conditional Riparian Habitat" column | Old Growth - Mature Forest; Snags and Logs |

| Formation | Ecological System | ESOC[2] | Associated PHS Habitat | Conditional Riparian Habitat |
|---|---|---|---|---|
| Temperate Forest | North Pacific Wooded Volcanic Flowage | no | none | N/A |
| | Northern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest | no | see "Conditional Riparian Habitat" column | Old Growth - Mature Forest; Snags and Logs |
| | Northern Rocky Mountain Mesic Montane Mixed Conifer Forest | no | see "Conditional Riparian Habitat" column | Old Growth - Mature Forest; Snags and Logs |
| | Northern Rocky Mountain Ponderosa Pine Woodland and Savanna | yes | none | N/A |
| | Northern Rocky Mountain Subalpine Woodland and Parkland | no | none | N/A |
| | Northern Rocky Mountain Western Larch Savanna | yes | none | N/A |
| | Rocky Mountain Aspen Forest and Woodland | yes | Aspen Stands | N/A |
| | Rocky Mountain Lodgepole Pine Forest | no | see "Conditional Riparian Habitat" column | Old Growth - Mature Forest; Snags and Logs |
| | Rocky Mountain Poor-Site Lodgepole Pine Forest | no | see "Conditional Riparian Habitat" column | Old Growth - Mature Forest; Snags and Logs |
| | Rocky Mountain Subalpine Dry-Mesic Spruce-Fir Forest and Woodland | no | see "Conditional Riparian Habitat" column | Old Growth - Mature Forest; Snags and Logs |
| | Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland | no | see "Conditional Riparian Habitat" column | Old Growth - Mature Forest; Snags and Logs |

# Chapter 5

# Climate Change Vulnerability of Species and Habitats in Washington

## Table of Contents

## LIST OF FIGURES


## LIST OF TABLES

# Chapter 5
# Climate Change Vulnerability of Species and Habitats in Washington

## 1.0 Introduction and Overview

This chapter describes the approach and methodology used to integrate the risks of climate change into the State Wildlife Action Plan (SWAP) Update, and also presents a summary of key findings. Additional detail is available in Appendix C. The Washington Department of Fish and Wildlife (WDFW) has been working for several years to better understand how the risks posed by climate change will affect the fish and wildlife resources of our state. Working in partnership with other organizations, the agency has conducted studies and contributed to research aimed at assessing the nature and degree of the climate change threat to our conservation efforts. More recently, climate change efforts at the agency have focused on understanding how policies and procedures might be modified to create greater resilience or facilitate adaptive response to the impacts of climate change.

Figure 1: Explanation of terms

**Defining Terms**

***Sensitivity***: A measure of whether and how a resource is likely to be affected by a given change in climatic factors (Glick et al. 2011).

***Exposure***: A measure of how much of a change in climate or climate-driven factors a resource is likely to experience (Glick et al. 2011).

***Vulnerability***: The degree to which a habitat or species is susceptible to, and unable to cope with adverse impacts of climate change (Schneider et al. 2007).

***Confidence:*** For the purposes of this study, confidence reflects the sureness assessors had in a given sensitivity or exposure ranking.

The effort to integrate climate change into the SWAP Update represents a step in this direction. One goal of the project was to evaluate the relative importance of climate change not as a stand-alone threat, but in the context of existing stressors. From a management perspective, this increases our ability to determine which stressors or actions will leverage the greatest long term conservation benefit for the species or habitat under consideration. Future work will include additional analysis of the conservation needs for those species determined to be at highest risk. Developing our understanding regarding how and when climate may exacerbate existing stressors can inform priorities, research needs and other conservation actions.

## 2.0 Approach and Methodology

We began by assessing the relative vulnerability of all of the Species and Habitats of Greatest Conservation Need, using existing resources and tools, and a consistent methodology. See Figure 1 for an explanation of terms used in this section.

### Vulnerability Assessment Methodology

To determine the vulnerability to climate change, we evaluated sensitivity and exposure for each species or habitat, assessed confidence for each sensitivity and exposure evaluation, and scored overall vulnerability and confidence for a species or habitat. Note that the SWAP uses ecological systems to describe habitat types, and ecological systems of concern indicate those systems most imperiled. The terms habitats and ecological systems are used interchangeably in this chapter. Please see the introduction of Chapter 4 for more description about these terms.

Each evaluation of sensitivity includes assigned rankings as well as short summaries describing key information from the scientific literature. The aim of the summaries that accompany rankings is to make the rationales and assumptions underlying the rankings and confidences assigned transparent. Each evaluation of exposure includes assigned rankings as well as a bulleted list of the key climate exposure factors for a given species or habitat. This list of exposure factors, along with the spatial location of a resource, was used to guide the literature review for future climate projections in order to assign rankings.

Based on the literature review, one of five rankings (High-5, Moderate-High-4, Moderate-3, Low-Moderate-2, or Low-1) was assigned each to sensitivity and exposure for a given species or habitat. Assigned rankings for sensitivity and exposure were then averaged to generate an overall vulnerability score for that particular species or habitat:

**Vulnerability = (Climate Exposure Rank + Sensitivity Rank) ÷ by two.**

Sensitivity and exposure evaluations were also assigned one of three confidence rankings (High-3, Moderate-2, or Low-1); confidence reflects the sureness assessors had in a given sensitivity or exposure ranking and was based on the extent and quality of reference material. Confidence rankings for sensitivity and exposure were also averaged (mean) to generate an overall confidence score.

***Species Sensitivity***

Species sensitivity to climatic factors may be direct (e.g., physiological) or indirect (e.g., ecological relationships). Sensitivity to climatic factors includes consideration of direct climate (i.e., temperature, precipitation) or climate-driven changes (e.g., pH, oxygen) or disturbance regimes (e.g., fire, flooding, extreme events). Physiological sensitivity refers to a species' physiological ability to tolerate changes that are higher or lower than the range of variability that they currently experience. Species that are able to tolerate a wide range of climatic factors may be considered less sensitive (Glick et al. 2011). The sensitivity of a species also depends on the sensitivity of its ecological relationships (e.g., habitat needs, diseases, predator-prey dynamics, foraging, pollination, competition). More generalist species (e.g., few to no dependencies on specific habitats, prey or forage species, etc.) are likely less sensitive to climate change effects, whereas specialist species that are dependent on specific habitats or prey or forage are likely more sensitive, particularly if those relationships are likely to be affected by climate change. For example, climate-driven changes in Clark's Nutcracker distribution or behavior could have a significant impact on whitebark pine regeneration, as this species is dependent on the Clark's Nutcracker for seed dispersal (Tomback 2007; Lorenz et al. 2008). Ecological relationships significantly affected by small changes in climatic factors likely confer a higher sensitivity to a species.

Evaluations of sensitivity for species considered the following factors:

- Physiology (e.g., limits to heat tolerance)
- Phenology dependencies (the timing of ecological events e.g., the availability of prey or forage species relative to migration timing)
- Other ecological relationships (e.g., competition, predator-prey dynamics)

Species sensitivity rankings were assigned as follows:

- **Low**: Unlikely to be affected by a given change in climatic factors. The species exhibits little to no physiological or phenological sensitivity to climatic factors. The species is more of a generalist with few to no dependencies (e.g., on specific habitat types, prey or forage species). For those dependencies that do exist, they are unlikely to be sensitive to climate change.

- **Low-Moderate:** May be somewhat affected by a given change in climatic factors but to a low degree. The species may exhibit some slight sensitivity to climatic factors in terms of physiology, phenology, and/or ecological relationships (e.g., habitat needs, forage or prey).
- **Moderate:** Likely to be noticeably but not significantly affected by a given change in climatic factors. The species exhibits a fair amount of sensitivity to climatic factors in terms of physiology, phenology, and/or ecological relationships.
- **Moderate-High:** Likely to be significantly affected by a given change in climatic factors. The species exhibits more significant sensitivity to climatic factors in terms of physiology, phenology, and/or ecological relationships.
- **High:** Likely to be substantially affected by a given change in climatic factors, with major implications for species long-term persistence. The species exhibits substantial physiological sensitivity to climatic factors **AND/OR** the species is more of a specialist with critical dependencies (e.g., on specific habitat types, prey or forage species) that are likely to be significantly affected by climate change.

***Habitat Sensitivity***

Habitat sensitivity to climatic factors includes consideration of whether the habitat occurs in a relatively narrow climatic zone, and/or whether it experiences large changes in structure or composition in response to relatively small changes in climatic factors. Sensitivity to climatic factors includes consideration of direct climate (i.e., temperature, precipitation) or climate-driven changes (e.g., pH, snowpack) or disturbance regimes (e.g., fire, flooding, insect and disease outbreaks, wind). More sensitive habitats are likely those that occur within a narrow climatic zone and/or experience large changes in composition or structure in response to small changes in climatic factors (Lawler 2010). Similarly, habitats may be at greater risk of decline, or elimination even, in response to small alterations in disturbance regimes (Lawler 2010). For example, altered fire regimes in grassland habitats may increase invasion rates and abundance of non-native annual grasses and weed species that out-compete native grasses.

Habitat sensitivity rankings were assigned as follows:

- **Low**: Unlikely to be affected by a given change in climatic factors. The habitat exhibits little to no change in structure or composition in response to changes in climatic factors or disturbance regimes, and/or does not occur in a relatively narrow climatic zone.
- **Low-Moderate:** May be somewhat affected by a given change in climatic factors but to a low degree. The habitat may exhibit some slight sensitivity to climatic factors in terms of changes in structure or composition.
- **Moderate:** Likely to be noticeably but not significantly affected by a given change in climatic factors. The habitat exhibits a fair amount of sensitivity to climatic factors in terms of changes in structure or composition, and/or may inhabit a somewhat narrow climatic zone, increasing its potential susceptibility to climate changes.
- **Moderate-High:** Likely to be significantly affected by a given change in climatic factors. The habitat exhibits more significant sensitivity to climatic factors in terms of changes in structure or composition, and/or occurs in a narrow climatic zone likely to be significantly affected by climate change.
- **High:** Likely to be substantially affected by a given change in climatic factors, with major implications for long-term persistence. The habitat exhibits substantial change in structure or composition in response to changes in climatic factors or disturbance regimes, and/or occurs in a narrow climatic zone likely to be eliminated or experience substantial declines due to climate change.

***Assessing Exposure - Species and Habitat***

An exposure evaluation for habitats or species includes considering exposure to climate changes (e.g., temperature and precipitation) as well as climate-driven changes and disturbance regimes (e.g., water chemistry, altered fire regimes, altered flow regimes). In particular, to what degree is the habitat or species likely to be exposed to and affected by a given change? As part of this evaluation, it is important to consider both the magnitude and rate of projected future change. In general, exposure for a given species or habitat was evaluated using downscaled climate projections (tables, narratives, figures) from the following resources (see full citations at the end of this chapter):

- Appendix C: A summary and overview of climate impacts affecting natural systems in Washington – prepared to support the SWAP Update
- Washington State Integrated Climate Change Response Strategy, 2012
  - Projected future changes in marine and coastal ecosystems, forests, freshwater/aquatic ecosystems, and aridlands.
- Washington Climate Change Impacts Assessment (Climate Impacts Group, 2009)
  - Temperature, precipitation, April 1 snow-water equivalent, shifts from snow to rain, extreme precipitation, flood risk, heat waves.
- Wade et al. 2013
  - Water temperature, high and low flows.
- Tillman and Siemann 2011
  - Projected future changes in marine ecosystems.
- Littell et al, 2010
  - Fire and insect outbreaks.
- Michalak et al. 2014
  - Vegetation projections, temperature, precipitation, and invasive species spread for the Columbia Plateau ecoregion.

Exposure rankings were assigned as follows:

- **Low**: Unlikely to be exposed to and affected by a given change in climatic factors.
- **Low-Moderate:** May be somewhat exposed to and affected by a given change in climatic factors but to a low degree.
- **Moderate:** Likely to be noticeably but not significantly exposed to and affected by a given change in climatic factors.
- **Moderate-High:** Likely to be significantly exposed to and affected by a given change in climatic factors.
- **High:** Likely to be substantially exposed to and affected by a given change in climatic factors, with major implications for long-term persistence.

***Overall Vulnerability***

In this particular context, vulnerability was evaluated by considering the sensitivity and exposure of the habitat or species to climatic factors. Vulnerability rankings were assigned as follows:

- **Low**: A combination of low or low-moderate sensitivity and exposure to climate change. Score range: 1-1.8
- **Low-Moderate:** A combination of low to moderate sensitivity and exposure to climate change. Score range: 1.81-2.6
- **Moderate:** Moderate sensitivity and exposure to climate change or some combination of high and low sensitivity and exposure. Score range: 2.61-3.4
- **Moderate-High:** A combination of moderate to high sensitivity and exposure to climate change. Score range: 3.41-4.2

- **High:** A combination of moderate-high or high sensitivity and exposure to climate change. Score range: 4.21-5

***Assessing Confidence***

Confidence can be defined as "the subjective assessment that any ranking will prove correct" (Schneider et al. 2007). Sensitivity and exposure evaluations were assigned one of three confidence rankings (High-3, Moderate-2, or Low-1). These approximate confidence levels were based on Manomet Center for Conservation Sciences (2012), which collapsed the 5-category scale developed by Moss and Schneider (2000) for the IPCC Third Assessment Report into a 3-category scale to avoid implying a greater level of certainty precision. Confidence rankings for sensitivity and exposure were averaged (mean) to generate an overall confidence score.

Confidence rankings were assigned as follows:

- Low: Little to no information exists in the scientific literature and/or information is characterized by high uncertainty.
- Moderate: Some (e.g., 1-3 scientific or gray literature reports or papers) exist for the sensitivity or exposure factors identified although there may be some uncertainty and/or conflicting information.
- High: Multiple (>3) scientific or gray literature sources exist for each sensitivity or exposure factor identified with less uncertainty.

## 3.0 Summary of Climate Impacts in Washington State

Climate in the Pacific Northwest has been changing significantly over the past century as a result of natural climate variability and greenhouse gas emissions, resulting in warmer air temperatures and variable precipitation patterns. Air temperatures are projected to continue increasing over the next century, while precipitation will remain variable but largely exhibit summer declines. These changes are projected to lead to a future with significantly altered snowpack, streamflow patterns, water availability, wildfire risk, ocean pH, and sea levels, with various impacts on terrestrial, aquatic, and marine and coastal habitats and their associated species in Washington State.

The following section summarizes current understanding of the historical and observed climate changes in Washington State, as well as projected future changes. Please refer to Appendix C for a more comprehensive summary of climate impacts and what they mean for habitats and species of Washington.

### 3.1 Historical and Observed Changes

***Terrestrial Ecosystems***

- Average annual air temperatures in the Pacific Northwest have been increasing over the past century, including increases in all seasons and in both maximum and minimum air temperatures.
- No significant trend in precipitation over the past century has been observed.
- Snowpack declined significantly (average 25 percent) and snowmelt occurred 0 to 30 days earlier (depending on location) in the Cascade Mountains during the latter half of the 20$^{th}$ century.
- Over the past half-century, snow-dominated watersheds have experienced earlier snowmelt runoff and reduced snowmelt contributions.
- Soil moisture recharge has been occurring earlier in the Pacific Northwest over the past half century. Over the same time period, July 1 soil moisture trends have been variable, and warmer areas (e.g., the Washington coast) have experienced declines.
- Warmer temperatures have contributed to increasing wildfire frequency and extent in the Pacific Northwest since the 1970s.

### *Freshwater Ecosystems*

- Stream temperatures in the northwest United States experienced a net increase from 1980-2009 largely as a result of increasing air temperatures, with rates of summer warming of 0.40°F per decade.
- 20th century warming caused no change in flood risk for rain-dominant basins, reduced flood risk in snow-dominant basins (due to reduced snowpack), and highly variable but generally elevated flood risk in transient basins.
- All watersheds are experiencing reduced summer flows.

### *Marine and Coastal Ecosystems*

- Global sea surface temperatures have increased 1.1°F since 1950, but no significant ocean warming offshore of North America was observed between 1900 to 2008, except in localized areas (e.g., west of Vancouver Island).
- Global sea levels rose 1.8 (+/- .5) mm/year from 1961 to 2003, with rates accelerating to 3.1 (+/- 0.7) mm/year in the last decade of observation. In the Pacific Northwest, sea levels are largely increasing, although some areas are experiencing decreases.
- The coastal waters of Washington State have been experiencing seasonal hypoxic conditions since at least 1950, and feature the lowest recorded dissolved oxygen (DO) levels of the California Current System.
- Global ocean surface pH has declined 0.1 units since 1750, with rates of -0.02 units/year in the past two decades. Since 1800, outer coastal water acidity in Washington State has increased 10 to 40 percent, translating to a pH decline of -0.05 to -0.15.

## 3.2 Projected Future Changes

### *Terrestrial Ecosystems*

- Air temperatures are projected to continue increasing in all seasons through the end of this century at rates from 0.2 to 1.0°F per decade.
  - Summer temperatures are projected to warm more rapidly than winter temperatures' and the interior of Washington is projected to experience slightly greater warming than coastal areas.
  - The number, mean duration, and maximum duration of extreme heat events are expected to increase, particularly in south central Washington and lowlands in western Washington.
- Precipitation projections are highly variable, and may include either increases or decreases in annual precipitation over the next century.
  - By the end of the century, winters will likely be wetter and summers will likely be drier.
  - Precipitation intensity may also rise, particularly in the North Cascades and NE Washington.
- April 1st snowpack is projected to continue decreasing significantly throughout this century (-53 percent to -65 percent by 2080); snowpack losses likely to be greatest at lower elevations and more modest at higher elevations.
- Snowmelt is projected to occur increasingly earlier by 2050, potentially 3 to 4 weeks earlier than the 20th century average.
- Warmer temperatures will likely drive shifts from snow-dominant to transient or rain-dominant basins, with streamflow timing likely occurring earlier in snow-dominant and transient basins.
- Flood risk and erosion is projected to increase in transient basins while snowmelt and rain-dominant basins will see minimal or slight increases.
- July 1 soil moisture is largely projected to decline across Washington State (-15 to -18 percent by 2080).
- Increased lightning activity and projected temperature increases over the next century may contribute to increased fire frequency, severity, intensity, and total area burned in the Pacific Northwest.
  - Forested ecosystems in the Pacific Northwest are projected to experience a larger relative increase in area burned than non-forested vegetation.

***Freshwater Ecosystems***

- Spring and summer stream temperatures are projected to continue increasing across the state, including increases in the frequency and duration of unfavorable temperature events (periods with water temperatures greater than 70°F).
    - Increasing stream temperature trends will be particularly pronounced in the Yakima River, the Columba River (near Bonneville Dam), the Lower Snake River, and in western Washington, the Stillaguamish River, Lake Washington and Lake Union.

***Marine and Coastal Ecosystems***

- Northwest ocean temperatures are projected to increase 2.2°F by the 2040s.
- Rates of sea level rise are projected to continue increasing globally over the next century, and Washington State could experience increases of +4 to +56 inches by 2100 (relative to 2000).
    - Puget Sound is projected to keep pace with global sea level rise and experience the most sea level rise by the end of the century.
    - The northwest Olympic Peninsula, which is experiencing significant uplift (greater than2 mm/year), will see much lower increases and/or declines in sea level by 2100.
    - The central and southern coasts, which may be experiencing moderate uplift (0-2 mm/year), will likely experience sea level increases with magnitudes in between the other two regions during the same time period.
- Coastal hypoxia episodes may increase as a result of climate change due to warmer sea surface temperatures, which affect oxygen solubility, and intensified upwelling as a result of shifting wind patterns.
- Global ocean surface pH, as well as pH in the North Pacific, is projected to decline an additional -0.2 to -0.3 units by 2100, translating to a 100 to 150 percent increase in ocean acidity.

## 3.3 How will climate change affect habitats and species?

The implications for species and habitats will vary based on location and the specific vulnerabilities of the target resource, but in general will include the following:

- Shifts in habitat amount, extent, and quality.
- Shifts in species composition, distribution and biodiversity, as well as shifts in species interactions.
- Impaired biological, ecological, and biogeochemical processes.
- Declines in certain vegetation types and expansions in others as suitable habitat ranges shift.
- Shifts in phenology, affecting plant reproduction and/or productivity and animal life histories, survival, reproduction, and growth.
- Increases in forest disease susceptibility due to moisture stress.
- Altered aquatic organism behavior, health, growth, reproductive success, and survival.
- Increased sensitivity to pollutants and contaminants.
- Increased risk of invasive species spread and/or establishment.

## 4.0 Results: Vulnerability Rankings for Species of Greatest Conservation Need

The following section highlights those Species of Greatest Conservation Need evaluated as having moderate-high or high vulnerability to climate change. Table 5-1 below highlights those species with moderate-high or high vulnerability *and* high confidence[1] -- 12 mammals, 11 birds, 2 reptiles, 14 amphibians, 32 fishes, and 4 invertebrates.

Species that received moderate-high or high vulnerability rankings but low or moderate confidence evaluations are not listed in this table, as more research, data, and/or expert consultation is required to improve confidence. Table 5-1 should be considered a dynamic as opposed to a static list. As new information becomes available for the sensitivity or exposure of a given species, it can be incorporated into the table and used to reevaluate vulnerability.

Summaries of the results for all species are summarized below, by taxa. Each of the taxa summaries includes a figure that represents relative vulnerability in ways that may help to identify appropriate management options. For example, figure 5-2, below shows the 44 mammals placed according to their vulnerability and the confidence in that evaluation. Feasible adaptation approaches for these animals vary depending on location within the figure, as described below.

**Low Vulnerability**
Focus on reducing current stressors as these likely represent a greater threat to these species. For species with low confidence, managers could consider gathering and integrating additional data to refine vulnerability information and improve confidence.

**Moderate Vulnerability**
Focus on identifying possible interactions between climate and non-climate stressors, as non-climate stressors may have the potential to exacerbate climate impacts. Other options include reducing current stressors, enhancing knowledge to refine vulnerability information and improve confidence evaluation (e.g., for low or moderate confidence), or increasing or enhancing monitoring to include evaluation of climate stressors.

**High Vulnerability**
Focus on reducing climate stressors as these likely represent a significant threat to these habitats. Additionally, those habitats with low or moderate confidence could be prioritized for monitoring to determine if and when impacts occur. High vulnerability and high confidence habitats may also provide an opportunity to review and modify actions for reducing non-climate stressors so that they help to ameliorate the effects of climate change.

For more discussion on adaptation approaches, see section 6.0 – Management Considerations. For full descriptions of the vulnerability rankings for all 268 SGCN see Appendix C, which includes narrative descriptions of sensitivity and summaries of the key exposure factors.

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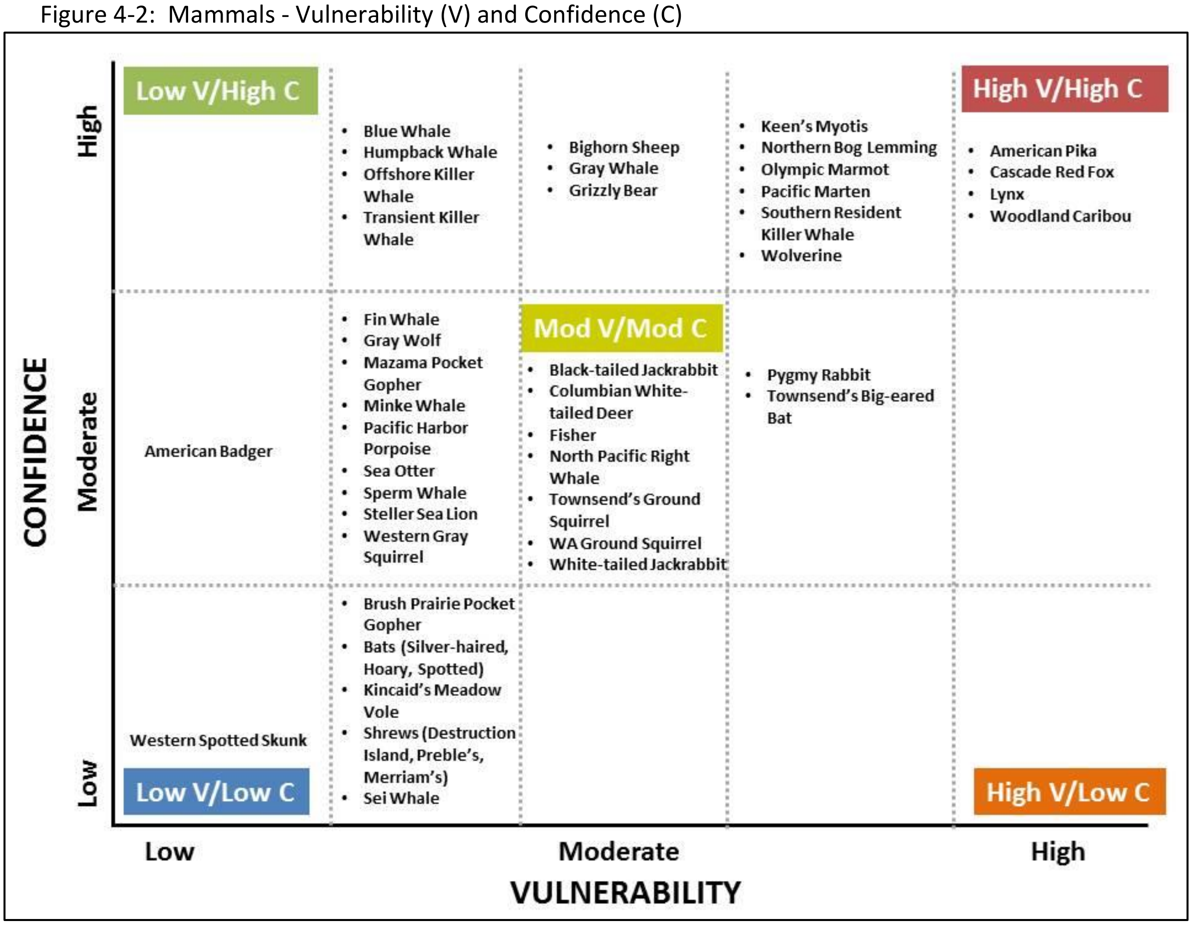
[1] Confidence reflects the average sureness assessors had in a vulnerability ranking.

## 4.1 Summary of key findings from each of the species taxa

### Mammals

- Species such as American Pika, Olympic Marmot, Wolverine, Lynx, Cascade Red Fox, and Pacific Marten occupying higher elevation habitats such as alpine and subalpine forests, meadows, and parklands have higher vulnerability, in particular, to warming temperatures and reduced snowpack
- Many marine mammals including Blue, Fin, Humpback, Sperm, Minke, and Sei Whales; Transient/Offshore Killer Whales, Harbor Porpoise, Sea Otters, and Sea Lions were evaluated as having low-moderate overall vulnerability.
    - Sensitivity for many of these marine mammals was primarily driven by prey availability, although many species (e.g., Sea Otters; Harbor Porpoise; Sei, Minke, Fin Whales) are able to switch prey species, lowering overall sensitivity.
- Species evaluated with moderate-high or high vulnerability but only moderate confidence included Pygmy Rabbit and Townsend's Big-eared Bat.
- Hoary, Spotted, and Silver-haired Bats occupy a range of habitats and/or exhibit a generalist diet, leading to a lower overall vulnerability ranking.
- A number of small mammal species had little to no information on climate sensitivity including the Brush Prairie Pocket Gopher, Destruction Island Shrew, Kincaid's Meadow Vole, Mazama Pocket Gopher, Preble's Shrew, and Western Spotted Skunk.

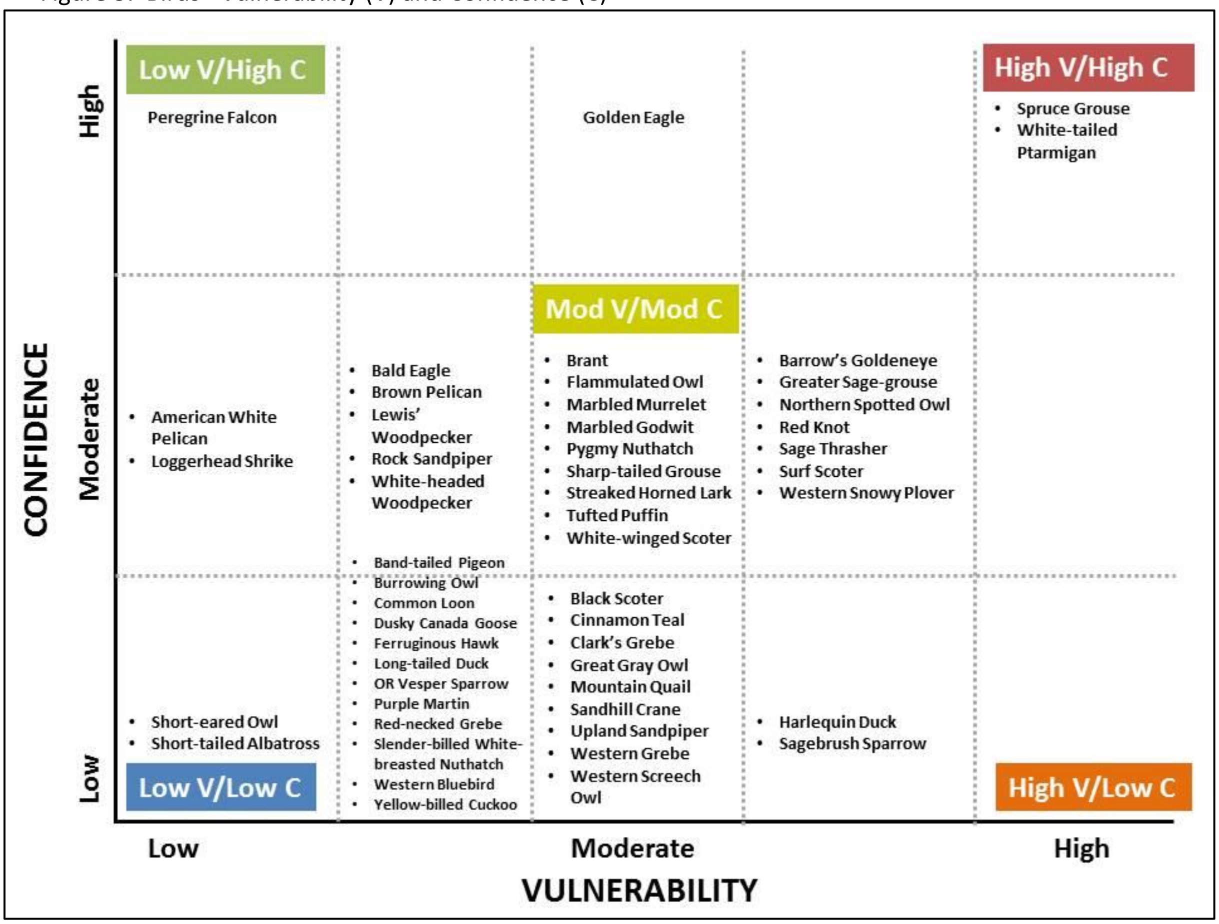
Figure 4-2: Mammals - Vulnerability (V) and Confidence (C)



## Birds

- Species evaluated with moderate-high or high vulnerability but low or moderate confidence included Barrow's Goldeneye, Harlequin Duck, Greater Sage-grouse, Northern Spotted Owl, Red Knot, Sage Thrasher, Sagebrush Sparrow, Surf Scoter, and Western Snowy Plover.
- Birds utilizing higher elevation habitats (e.g., White-tailed Ptarmigan and Spruce Grouse) as well as sagebrush-obligate species such as Greater Sage-grouse, Sage Thrasher, and Sagebrush Sparrow exhibit high sensitivity due to potential climate impacts on habitats (e.g., higher elevation habitats have higher vulnerability to warming temperatures and reduced snowpack while sagebrush habitats have higher vulnerability to altered fire regimes and invasive weeds). The sagebrush-obligates are not on the climate watch list because of a lower confidence level in exposure - the rate and timing of climate changes to the species range.
- Coastal species such as Red Knot, Surf Scoter, and Western Snowy Plover exhibit high vulnerability due to sea level rise impacts on nesting and/or foraging habitat, as well as climate-driven changes in phenology resulting in timing mismatches with prey availability.
- Many species evaluated as having low or low-moderate overall vulnerability are considered generalist species or are highly adaptable (e.g., occur within a range of habitats, including human-altered landscapes); e.g., Bald Eagle, American White and Brown Pelicans, Dusky Canada Goose, Loggerhead Shrike, and Peregrine Falcon.

Figure 3: Birds - Vulnerability (V) and Confidence (C)



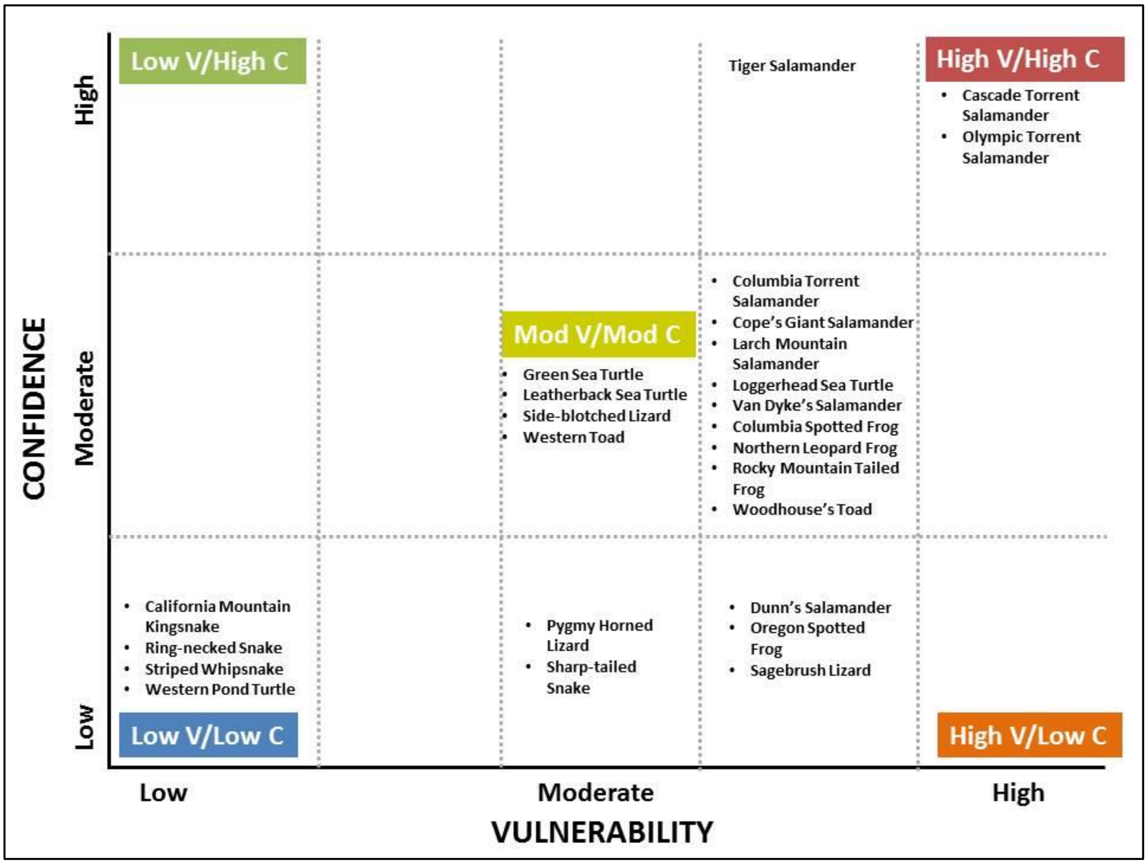
### Reptiles

- No reptiles were evaluated as having moderate-high or high vulnerability *and* high confidence
- Species evaluated with moderate-high or high vulnerability but low or moderate confidence included: Loggerhead Sea Turtle and Sagebrush Lizard.
- The Green Sea Turtle, Loggerhead Sea Turtle, and Leatherback Sea Turtle exhibit moderate or moderate-high sensitivity to climate change (e.g., increased ocean temperatures, declines in pH) however, exposure is thought to be moderate in this region.
- Overall, there is a lack of information regarding sensitivity of all snake species evaluated, which led to low or moderate vulnerability rankings.
- Side-blotched and Pygmy Horned Lizard both exhibit moderate vulnerability primarily due to their association with shrub-steppe habitats that are sensitive to altered fire regimes and invasive weeds that degrade or eliminate habitat.

### Amphibians

- All salamanders were evaluated as having moderate-high or high sensitivity to climate change due to physiological sensitivity to heat and desiccation and/or their dependence on specific habitats that are sensitive to changes in water supply (e.g., decreased precipitation or snowpack) that dry or reduce available habitat and/or shifts from snow to rain that lead to erosion and scouring of habitats. Cascade Torrent, Columbia Torrent, Olympic Torrent and Cope's Giant Salamanders exhibit greater vulnerability due to their association with headwater habitats that are sensitive to rain-on-snow events.
- Species evaluated with moderate-high or high vulnerability but low or moderate confidence included: Columbia Spotted Frog, Columbia Torrent Salamander, Cope's Giant Salamander, Dunn's Salamander, Larch Mountain Salamander, Northern Leopard Frog, Oregon Spotted Frog, Rocky Mountain Tailed Frog, Van Dyke's Salamander, Western Toad, and Woodhouse's Toad. The low confidence ranking was largely due to lack of information.
- Columbia Spotted, Northern Leopard, Oregon Spotted, and Rocky Mountain Tailed frogs exhibit moderate-high vulnerability to climate change primarily due to warmer temperatures and altered hydrologic regimes that lead to declines in available habitat.
- Sensitivity of the Western Toad and Woodhouse's Toad is primarily driven by their dependence on aquatic habitats for breeding and/or migration routes.

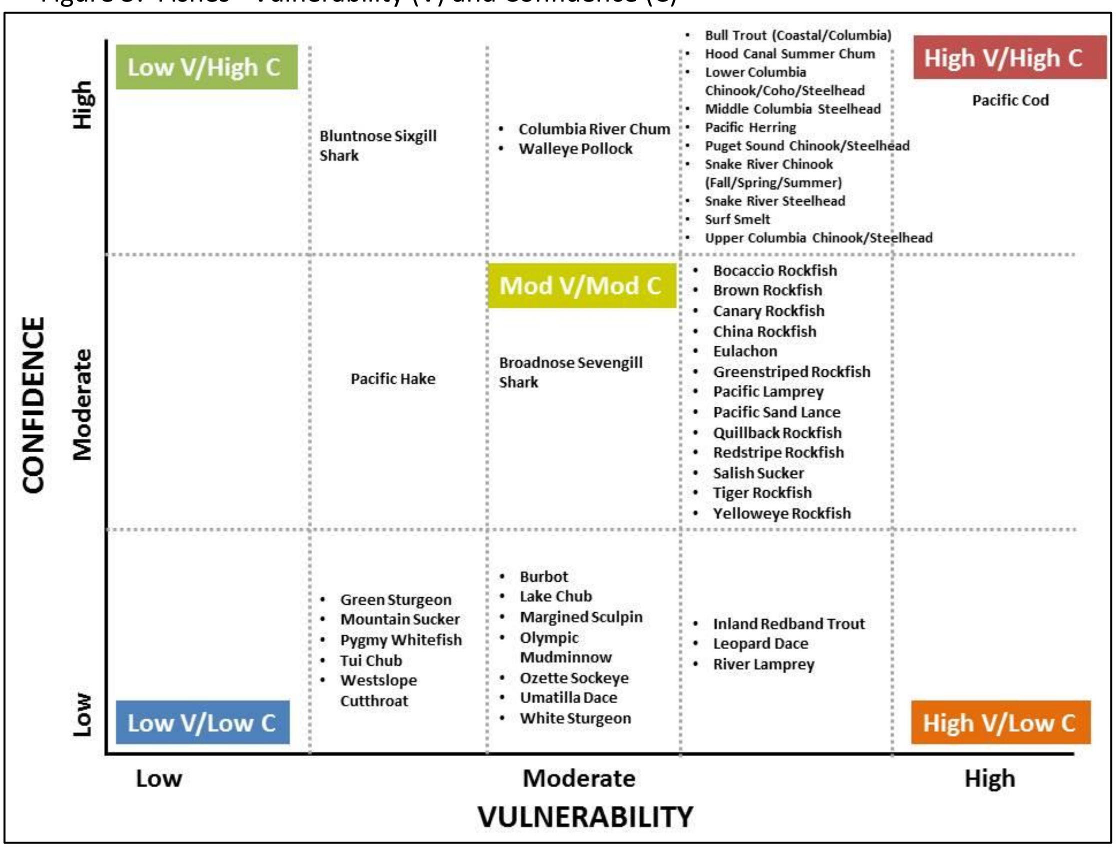
Figure 4: Amphibians and Reptiles - Vulnerability (V) and Confidence (C)



## Fishes

- Pacific Cod, Pacific Herring, and Surf Smelt received moderate-high or high vulnerability and high confidence scores – Pacific Cod and Pacific Herring primarily because of warming sea surface or ocean temperatures that can affect prey availability and/or spawning and recruitment, and Surf Smelt because of potential reductions in beach spawning habitat due to sea level rise.
- Species evaluated with moderate-high or high vulnerability but low or moderate confidence included: Bocaccio, Brown, Canary, China, Copper, Greenstriped, Quillback, Redstripe, Tiger and Yelloweye Rockfishes; Eulachon; Inland Redband Trout; Leopard Dace; Pacific Lamprey; Pacific Sand Lance; River Lamprey; and Salish Sucker.
- In general, rockfish species were evaluated as having moderate sensitivity to climate change due to potential impacts to their prey base and habitat requirements. Key exposure factors for Washington including increased ocean temperatures, declines in pH, sea level rise, and decreased oxygen contributed to an overall moderate-high vulnerability evaluation.
- While Bull Trout (Coastal and Mid-Columbia) received moderate-high vulnerability rankings, some of the literature suggests that future exposure to warmer temperatures, lower flows, and higher flows may be moderate within current distributions.
- Chinook, Coho, and Steelhead of the Lower and Upper Columbia and Snake River received moderate-high vulnerability rankings due to higher sensitivities and projected future exposure to warmer water temperatures and lower low flows.
- Puget Sound Chinook and Steelhead received moderate-high vulnerability rankings due to moderate future exposure to warmer water temperatures and lower summer flows but higher exposure to increased high flow events.

Figure 5: Fishes - Vulnerability (V) and Confidence (C)



**Invertebrates**

- Species evaluated with moderate-high or high vulnerability but low or moderate confidence included: Beller's Ground Beetle, Butterflies (see list below), Caddisflies (Limnephilus flavastellus, Psychoglypha browni), Northern Abalone, Sand-verbena Moth, Subarctic Bluet, Wenatchee Forestfly, Western Bumblebee, and White-belted Ringtail.
- Butterfly species such as Chinquapin and Johhson's Hairstreak, Island Marble, Mardon Skipper, and Taylor's Checkerspot exhibit both direct (e.g., activity and emergence are influenced by temperature) and indirect sensitivity to climate (i.e., due to habitat specialization).
- Similar to butterflies, dragonfly species exhibit moderate-high to high direct and indirect sensitivity to climate change; temperature is known to influence the phenology, development, and behavior of dragonflies while altered flow regimes and reduced water supply may degrade aquatic habitat.
- Several species of caddisflies including Allomyia acanthis, Goereilla baumanni, Limnephilus flavastellus, and Psychoglypha browni received moderate-high vulnerability rankings, primarily due to climate impacts on specialized habitat requirements (e.g., cold water streams).
- Marine invertebrate species including the Northern Abalone and Olympia Oyster received moderate-high or high vulnerability rankings due to high sensitivity and exposure to declines in pH.
- All snail species were evaluated as having low or low-moderate sensitivity to climate change, primarily driven by a lack of information.
- A number of invertebrate species had little to no information on climate sensitivity including Cryptomastix mullani hemphilli, Leschi's Millipede, Mission Creek Oregonian, Nimapuna tigersnail, and the Salmon River Pebblesnail.

Figure 6: Invertebrates part I, Vulnerability (V) and Confidence (C)

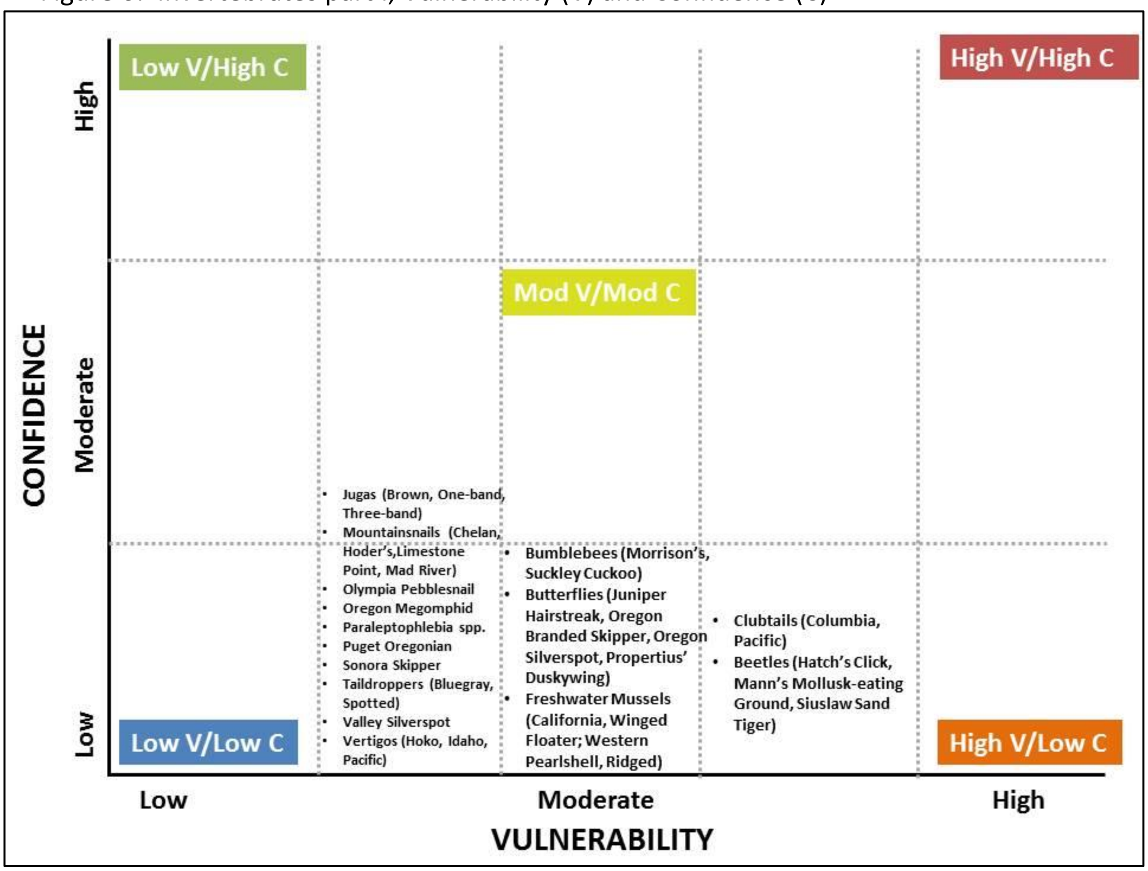
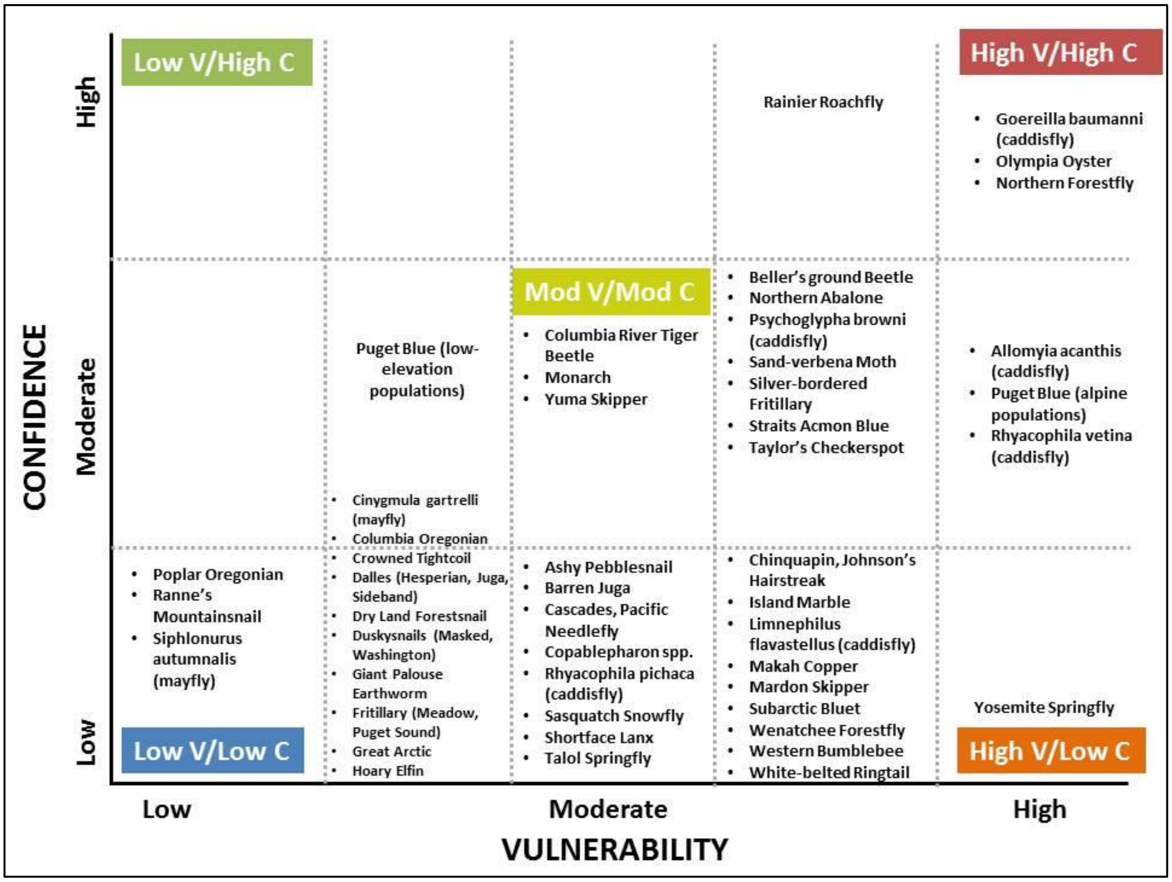


Figure 7: Invertebrates part 2, Vulnerability (V) and Confidence (C)



## 4.2 Climate Watch Species

The following table lists those SGCN which ranked highest in the overall vulnerability ranking (moderate-high or high) *and* for which we had a high confidence, based on the available literature. This list should be considered preliminary, as research on the impacts of climate change on species and habitats is growing rapidly and over time the confidence and/or vulnerability score for several species is expected to change.

**Table 5-1: SGCN – Preliminary Climate Watch List –** *SGCN with moderate-high or high vulnerability and high confidence.*

| | |
|---|---|
| **MAMMALS** | American Pika<br>Cascade Red Fox<br>Keen's Myotis<br>Killer Whale<br>Lynx<br>Northern Bog Lemming<br>Olympic Marmot<br>Pacific Marten<br>Wolverine<br>Woodland Caribou |
| **BIRDS** | Spruce Grouse<br>White-tailed Ptarmigan |
| **AMPHIBIANS** | Cascade Torrent Salamander<br>Olympic Torrent Salamander<br>Tiger Salamander |
| **FISHES** | Bull Trout Coastal Recovery Unit<br>Bull Trout Mid-Columbia Recovery Unit<br>Hood Canal Summer Chum ESU<br>Lower Columbia Chinook ESU<br>Lower Columbia Coho ESU<br>Lower Columbia Steelhead DPS<br>Middle Columbia Steelhead DPS<br>Pacific Cod (Salish Sea Population)<br>Pacific Herring<br>Puget Sound Chinook ESU<br>Puget Sound Steelhead DPS<br>Snake River Chinook – Spring/summer ESU<br>Snake River Basin Steelhead DPS<br>Surf Smelt<br>Upper Columbia Spring Chinook ESU<br>Upper Columbia Steelhead DPS |
| **INVERTEBRATES** | Caddisfly ((Goereilla baumanni)<br>Northern Forestfly<br>Rainier Roachfly<br>Olympia Oyster |

**Table 5-2: SGCN Preliminary Climate Watch List Descriptions**

| Taxa | Common Name | Vulnerability Ranking | Vulnerability Confidence | Description of Sensitivity | Description of Exposure |
|---|---|---|---|---|---|
| MAMMALS | American Pika | High | High | The American Pika displays high sensitivity because of its preferred habitat type and condition, very low reproductive rate, and limited dispersal ability. The Pika requires a moderate amount of snowpack in order to provide insulation during the winter months; decreasing snowpack because of rising temperatures and shifting precipitation patterns with more rain than snow will negatively impact this species. Pika have high energetic demands, partly because they do not hibernate; increasing temperatures and extreme heat events may affect the Pika's ability to forage during the day. In addition, climate change will likely alter the composition of vegetation in montane habitats; this shift may be to plant species less suited to the Pika's nutritional needs. | • Increased temperatures<br>• Reduced snowpack<br>• Shifts from snow to rain |
| | Cascade Red Fox | High | High | The Cascade Red Fox is presumably adapted to colder climates, and is restricted to alpine and subalpine ecosystems and high elevation meadows. The overall sensitivity of this species to climate change is likely driven by their dependence on these colder, high elevation habitats. Warmer temperatures and reduced snowpack may negatively impact this species by further contracting suitable habitat ranges and/or facilitating movement of coyotes (potential competitor and predator) into the range of Cascade Red Foxes. Altered fire regimes that degrade or eliminate alpine and subalpine habitat are also likely to negatively impact this species. | • Increased temperatures<br>• Reduced snowpack<br>• Altered fire regimes |
| | Keen's Myotis | Moderate-High | High | Keen's Myotis has a specialist's diet and its sensitivity is therefore tightly linked to both the timing and abundance of its prey. This species does not migrate, which makes it very sensitive to changes in microclimate, especially during winter hibernation; changes in temperature that drive the timing and length of winter hibernation could result in a mismatch in timing of insect prey availability and emergence from hibernation. It has a small geographic distribution; however, field identification of this species is difficult because of strong similarities with the Western Long-eared Myotis, making statements about distribution, population size, and trends less certain. Cooler temperatures may energetically stress this species. | • Increased temperatures |

| Taxa | Common Name | Vulnerability Ranking | Vulnerability Confidence | Description of Sensitivity | Description of Exposure |
|---|---|---|---|---|---|
| MAMMALS | Southern Resident Killer Whale | Moderate-High | High | Some Killer Whale populations occupy a wide temperature range; thus these are unlikely to experience physiological sensitivity to increasing ocean temperatures. However, their overall climate sensitivity is much higher due to potential declines in prey abundance. For the Southern Resident populations in particular, since they feed primarily on Chinook salmon, declines in Chinook abundance – which could stem from a number of climate factors, such as increases in sea surface and fresh water temperature or higher levels of precipitation and runoff – could lead to decreases in survival and fecundity of Southern Resident whales. | • Increased ocean and fresh water temperatures<br>• Increased precipitation<br>• Increased runoff<br>• Declines in pH |
| | Lynx | High | High | Lynx exhibit sensitivity to warming temperatures, decreased snowpack and earlier snowmelt, and altered fire regimes. Lynx are reliant on consistent snowpack during winter months for hunting, which provides them a competitive advantage over other predators. Lynx are usually considered hare specialists; increasingly variable timing of the arrival and melting periods of snowpack may lead to local extirpations of Snowshoe Hares, potentially affecting Lynx survivorship and recruitment. However, Lynx have been known to switch prey items when hares are limiting. Altered fire regimes and insect and disease outbreaks that reduce mature stands, early seral-stage coniferous stands and/or dense understory cover further increases the sensitivity of this species. | • Increased temperatures<br>• Reduced snowpack<br>• Earlier snowmelt<br>• Altered fire regimes<br>• Increased insect and disease outbreaks |
| | Northern Bog Lemming | Moderate-High | High | The Northern Bog Lemming's physiological sensitivity to climate is likely moderate-high, as Lemming populations may have historically been reduced in size and number when the climate was warmer and the Lemming is moderately restricted to relatively cool or cold environments in most of its range. Additionally, Washington is at the very southern edge of the species' geographic range, which may increase sensitivity to warming temperatures. The overall sensitivity of this species is likely driven by their dependence on cold, moist habitats such as peat lands and sphagnum moss, which are sensitive to changes in temperature and precipitation that lead to reduced moisture. Altered fire regimes that degrade or eliminate habitat may also impact this species. | • Increased temperatures<br>• Changes in precipitation<br>• Drought<br>• Altered fire regimes |

| Taxa | Common Name | Vulnerability Ranking | Vulnerability Confidence | Description of Sensitivity | Description of Exposure |
|---|---|---|---|---|---|
| MAMMALS | Olympic Marmot | Moderate-High | High | Olympic Marmots' sensitivity to climate is likely driven by their association with subalpine meadows that are vulnerable to increasing temperatures and reduced snowpack that result in habitat alterations (e.g., increased forest encroachment into meadows). Altered fire regimes may benefit subalpine meadows by preventing conifer encroachment. Olympic Marmots are also indirectly sensitive to climate change through effects on their primary predator, coyotes. Warmer winters and lower snowpack are thought to allow coyotes to persist at higher elevations than they could otherwise, increasing their predation on Olympic Marmots. Some evidence suggests that Olympic Marmots may also be directly sensitive to changes in snowpack; prolonged spring snow cover may be detrimental to survival and reproduction while sparse winter snow cover increases winter mortality. | • Increased temperatures<br>• Reduced snowpack<br>• Altered fire regimes |
| | Pacific Marten | Moderate-High | High | Sensitivity of the Marten to climate change will likely be driven by its habitat specificity and reliance on deep snowpack. Altered fire regimes and/or drought that result in reductions in the distribution and connectivity of important habitat features (e.g., large diameter tree stands with high canopy cover) may negatively impact this species. Martens rely on deep and persistent snowpack to exclude predators, provide high-quality hunting conditions, and provide winter resting and denning sites. Future reductions in snowpack may affect both Marten and its prey species due to creation of more thermally variable subnivean space, and may alter Marten spatial distributions and/or competition with fisher. | • Reduced snowpack<br>• Altered fire regimes<br>• Drought |
| | Wolverine | Moderate-High | High | Wolverines exhibit sensitivity to temperature and declines in snowpack. Wolverines are obligatorily associated with persistent spring snow cover, which provides critical thermal advantages such as predator refugia for denning females and young, preventing competition with other scavengers, and important prey caching/refrigeration areas. Temperature appears to play a role in fine-scale habitat selection, and may affect prey-caching success. Warming temperatures and declines in snowpack could lead to decreased habitat patch size, quality, and connectivity; reduced success of caching/refrigeration of carrion prey with subsequent impacts on survivorship and recruitment; limited den sites and/or loss of thermal refugia important for juvenile survival; and/or increased dispersal costs. | • Increased temperatures<br>• Reduced snowpack |

| Taxa | Common Name | Vulnerability Ranking | Vulnerability Confidence | Description of Sensitivity | Description of Exposure |
|---|---|---|---|---|---|
| MAMMALS | Woodland Caribou | High | High | Woodland Caribou occupy higher elevations and rely on old-growth Engelmann spruce/subalpine fir and western red-cedar/western hemlock forests that support arboreal lichens, which constitute a large portion of the Woodland Caribou diet. In combination with fire, warmer temperatures, precipitation changes, climate-driven increases in forest disease and insect mortality, and reduced snowpack and earlier snowmelt are likely to alter suitable habitat and predation risk for Woodland Caribou. Fire creates younger-age stands and edge habitat that attract deer, elk, and moose; higher ungulate densities increases associated predator density, and these predators (e.g., bears, wolves, cougars) prey opportunistically on Caribou. Woodland Caribou require deep, consolidated snow for movement at higher elevations during winter. Reduced snowpack and earlier snowmelt will affect the seasonal movements of Woodland Caribou and other ungulates, likely increasing predation risk by extending the length of time Caribou share habitat with other ungulates. | • Increased temperatures<br>• Changes in precipitation<br>• Altered fire regimes<br>• Reduced snowpack<br>• Earlier snowmelt<br>• Increased insect and disease outbreaks |
| | | | | | |
| BIRDS | Spruce Grouse | High | High | Sensitivity of spruce grouse appears to be driven by their dependence on high elevation conifer forests. Spruce grouse prefer relatively young successional stands of dense conifers, and populations appear to fluctuate over time in response to the degree of maturation of post-fire regrowth. Altered fire regimes and insect and disease outbreaks that lead to habitat degradation increase the sensitivity of spruce grouse to climate change. | • Altered fire regimes<br>• Increased insect and disease outbreaks |
| | White-tailed Ptarmigan | High | High | Physiological sensitivity of White-tailed Ptarmigan is likely low-moderate as this species is well-adapted to high altitude climatic variation and harsh conditions, although it has been shown that high winter minimum temperatures can retard population growth rates. The sensitivity of this species will primarily be driven by its dependence on high elevation habitats likely to be affected by or shrink in response to climate change, as well as its dependence on willow for foraging. | • Increases in winter minimum temperatures<br>• Increased temperatures overall<br>• Reduced snowpack |
| | | | | | |
| AMPHIBIANS | Cascade Torrent Salamander | High | High | Cascade Torrent Salamanders are likely highly sensitive to climate change due to their inability to tolerate desiccation and specialized habitat requirements. Declines in water availability and timing (e.g., due to reduced snowpack and earlier snow melt), as well as increased sedimentation (e.g., due to shifts from snow to rain), could decrease suitable headwater habitat for this species. This species may also be physiologically limited by high temperatures. | • Increased temperatureswater)<br>• Changes in precip<br>• Reduced snowpack<br>• Shifts from snow to rain<br>• Earlier snowmelt |

| Taxa | Common Name | Vulnerability Ranking | Vulnerability Confidence | Description of Sensitivity | Description of Exposure |
|---|---|---|---|---|---|
| **AMPHIBIANS** | Olympic Torrent Salamander | High | High | Overall sensitivity of this species is likely high due to high physiological sensitivity and specific habitat requirements (e.g., associated with permanent, high elevation cold water sources with steep gradients and silt-free). Increasing water temperatures and moisture loss will negatively impact this species as it is desiccation-intolerant and cannot survive where water temperatures are too high. Reduced snowpack and shifts from snow to rain that lead to high flow events, erosion and scouring could reduce headwater riparian habitat for the Olympic Torrent Salamander. | • Increased temperatures (air and water)<br>• Changes in precipitation<br>• Reduced snowpack<br>• Shifts from snow to rain |
| | Tiger Salamander | Moderate-High | High | This species likely exhibits sensitivity to warmer and drier conditions that reduce aquatic breeding habitat, lead to desiccation, and/or result in an inability to move. Warmer temperatures and a decrease in total annual precipitation (including snow), as well as an increase in drought, has led to wetland desiccation and significant population declines in Yellowstone National Park. Timing of reproduction may also be affected by increasing temperatures. | • Increased temperatures<br>• Changes in precipitation and/or reduced snowpack<br>• Drought |
| | | | | | |
| **FISHES** | Bull Trout - Coastal Recovery Unit and Mid-Columbia Recovery Unit | Moderate-High | High | Sensitivity of Bull Trout is primarily driven by water temperature. Bull Trout are the southern-most species of Western North American char and have lower thermal tolerance than other salmonids they co-occur with. Indeed the geographic distribution of Bull Trout, and the persistence of populations during contemporary warming has been most strongly related to maximum water temperature. The ability of Bull Trout to persist in sub-optimally warm temperatures likely depends on food abundance. As temperature increases metabolic costs, the extent to which Bull Trout can maintain positive energy balance depends on its ability to find food. Bull Trout historically relied heavily on salmon as a food resource and may be less resilient to temperatures in areas where foraging opportunities of salmon eggs and juveniles have declined. Invasive chars (brook and lake trout) now reside in many headwater streams and lakes, and may exclude Bull Trout from these potential cold water refuges, increasing their sensitivity to warming. Bull Trout sensitivity to flows is likely to occur during two critical periods: (1) direct effects of altered runoff timing and magnitude on emerging fry in late winter/spring, and (2) indirect effects of low summer flows on all life phases by mediating the duration and magnitude of thermal stress events. | • Increased water temperatures<br>• Altered runoff timing<br>• Increased winter/spring flood events<br>• Lower summer flows |
| | Chinook – Lower Columbia ESU, Puget Sound ESU, Snake River | Moderate-High | High | In general, Chinook salmon are sensitive to warmer water temperatures, low flows, and high flows. Warmer water temperatures can affect physiological performance and energy budgets, as well as developmental rates and the timing of key life-cycle transitions (i.e., phenology). Lower stream flows have been linked to mass mortality events of Chinook salmon. Extreme high flows can reduce the likelihood of egg survival during incubation, and both low and high flows can affect adult | • Increased freshwater temperatures<br>• Lower summer flows<br>• Increased winter/spring flood events |

| Taxa | Common Name | Vulnerability Ranking | Vulnerability Confidence | Description of Sensitivity | Description of Exposure |
|---|---|---|---|---|---|
| | Spring/ Summer ESU, and Upper Columbia Spring ESU | | | migration.<br><br>Temperature: Chinook salmon appear sensitive to elevated freshwater temperatures both as juveniles rearing in tributary streams and as adults migrating up river networks to spawn. Elevated water temperature reduces the amount of time a spawning adult can persist in freshwater and decreases the total distance a fish can migrate on a given level of energy stores. Also, temperatures in excess of ~63˚F begin to thermally stress individuals, making them more vulnerable to pathogens and other health issues. Puget Sound Chinook salmon may be more sensitive to warmer summer temperatures and lower flows, as their spawning migration encounters the warmest part of the watershed (the downstream portion) during the warmer part of the year (later summer and early fall). Cool tributaries may provide refuge from heat stress for migratory Chinook salmon, and may reduce the sensitivity of this species to warming temperatures.<br><br>Warming temperatures in the streams where Chinook salmon rear can have negative effects even when temperatures are not near the thermal maxima of the species. For example, warming temperatures decrease the carrying capacity of streams for rearing juvenile salmonids. Because Puget Sound Chinook salmon rear in streams for up to one year, they may be vulnerable to heat stress during low flow periods of late summer and fall. However, the life-history diversity of this species (particularly the diversity in age-at-maturity) likely enhances resilience to mortality events such as extreme flows or temperatures.<br><br>Flow regimes: Low flows during the summer and fall may be stressful for migrating adults. Mass mortality events in both fall and spring-run Chinook salmon have been linked to high temperatures due to low flows. Some salmon populations may also depend on high flows to allow passage to upstream spawning areas. Increased severity of winter floods has been linked to decreased egg-to-fry survival in Washington. Snowmelt and the resulting runoff in spring may be important for aiding the seaward migration of salmon smolts. The reduced stream velocities increase the travel time required for smolts to reach the ocean – this in turn increases the time of exposure to predators.<br><br>Marine: Increases in ocean and estuarine temperature, increased stratification of the water column, and/or changes in the intensity and timing of coastal upwelling may alter primary and secondary productivity, with potential impacts on growth, productivity, survival, and migrations of salmonids. | |

| Taxa | Common Name | Vulnerability Ranking | Vulnerability Confidence | Description of Sensitivity | Description of Exposure |
|---|---|---|---|---|---|
| | Hood Canal summer chum | Moderate-High | High | Washington State is near the southern extent of the geographic range for chum salmon, which suggests they may be sensitive to increases in water temperature (freshwater and ocean). Chum salmon incubate embryos in freshwater, but juveniles migrate to estuaries as age-zeros, typically during the spring; the spawning migrations of adult fish typically occur in early fall. Thus chum salmon may be sensitive to lower summer flows during adult migration to spawning areas. Altered freshwater thermal regimes could affect chum salmon by altering their phenology and potentially creating mismatch between arrival in estuaries and the timing of ideal ecological conditions in estuarine habitats. Chum salmon will likely be most sensitive to changes in marine thermal regimes. In general, Pacific salmon survival is positively related to sea surface temperatures (SST) at the northern extent of their distribution, and negatively related at the southern extent. However, recent evidence suggests that chum salmon may be less sensitive to SST at the southern extent of their range compared with pink and sockeye. Chum salmon embryos are vulnerable to flood events that can scour redds or bury them in silt. Chum may be vulnerable to altered flow regimes that include increased flood severity, particularly in watersheds where land use has enhanced stream flashiness. | • Increased water temperatures (freshwater and sea surface)<br>• Increased winter/spring flood events<br>• Lower summer flows |
| **FISHES** | Lower Columbia Coho | Moderate-High | High | In general, coho salmon likely exhibit sensitivity to warmer water temperatures (freshwater and ocean) and lower summer flows.<br><br>Freshwater temperature and flow regimes: Central California represents the southern extent of the range for coho salmon, suggesting that they may be less sensitive to increases in water temperature than other species of Pacific salmon (i.e. pink, chum, and sockeye). However, due to their reliance on streams for freshwater rearing, coho are likely sensitive to both altered flow and thermal regimes. Juveniles prefer low-velocity habitat often in off-channel areas; reduced summer flows may increase the likelihood that such off-channel habitats become inaccessible, thermally stressful, or hypoxic.<br><br>Early run timing individuals might be more sensitive to fall flood events, which are projected to increase in Washington, and may also be more sensitive to warmer water temperatures and lower flows during peak migration timing (i.e., mid-August to September). Later run timing individuals should be less sensitive because they migrate as adults during cooler periods of the year and their embryos are not yet buried in the gravel during late fall flooding. However, late run individuals may be more likely to have embryos or recently emerged fry threatened by spring flooding that is predicted to increase in severity and frequency. | • Increased water temperatures (freshwater and sea surface)<br>• Lower summer flows |

| Taxa | Common Name | Vulnerability Ranking | Vulnerability Confidence | Description of Sensitivity | Description of Exposure |
|---|---|---|---|---|---|
| | | | | In general, coho salmon populations may be less resilient to episodic mortality events caused by climate stressors, because they exhibit only moderate levels of life history diversity and do not have as much variation in age-at maturity as do sockeye salmon and Chinook salmon.<br><br>Marine: Increases in ocean and estuarine temperature, increased stratification of the water column, and/or changes in the intensity and timing of coastal upwelling may alter primary and secondary productivity, with potential impacts on growth, productivity, survival, and migrations of salmonids. For example, cool Pacific-Decadal Oscillation (PDO) years have historically coincided with high returns of coho salmon, while warm PDO cycles coincided with declines in salmon numbers. Cooler SSTs during the winter prior to and after smolt migration have also been linked to higher coho survival. In general, changes in coastal ocean habitat quality and productivity could negatively impact coho salmon. | |
| FISHES | Pacific cod (Salish Sea population) | Moderate-High | High | Though limited information is available regarding the sensitivity of the Salish Sea population of Pacific Cod to climate change, their main sensitivity will be due to potential increases in sea surface temperature. Pacific Cod recruitment is strongly linked to temperature, with colder water supporting larger hatch size and maximizing growth performance. Cooler waters also support higher abundance of zooplankton prey (e.g., copepods), which is thought to be linked to increased recruitment. Temperature over 45°F appears to be associated with poor spawning success and limited recruitment. For Atlantic cod, declines in recruitment with increasing temperature were particularly high for cod at the limits of their distribution. Pacific Cod in Washington are already at the upper end of their thermal preference, which is likely to increase their sensitivity to any increases in temperature and could lead to northward population shifts. | • Increased ocean temperatures |
| | Pacific Herring | Moderate-High | High | A main way in which Pacific herring will be sensitive to climate change is through change in their prey availability and the distribution of appropriate spawning habitat. Primary and secondary productivity are strongly linked to juvenile abundance, as juveniles tend to prey on zooplankton (e.g., copepods). Predicted increases in sea surface temperature and changes in upwelling, such as delayed and shorter upwelling seasons, could affect the timing and abundance of available prey for juveniles, though the magnitude of these effects is uncertain. In Washington, herring populations have already shown northward movement for spawning and smaller juvenile cohorts, and these patterns could increase with predicted increases in sea surface temperature. Increased temperatures could also lead to northward shifts and increased abundance of Pacific hake, which prey upon | • Increased ocean temperatures<br>• Altered upwelling patterns<br>• Changes in salinity<br>• Saltwater intrusion in estuarine habitat |

| Taxa | Common Name | Vulnerability Ranking | Vulnerability Confidence | Description of Sensitivity | Description of Exposure |
|---|---|---|---|---|---|
| | | | | herring and could thus lead to population declines through increased predation. Herring will also be sensitive to potential changes in nearshore and estuarine spawning habitat, such as increased salinity due to sea level rise and saltwater intrusion in estuaries, which could create suboptimal conditions for spawning and larval growth. Additionally, the suite of vegetative species used by herring as spawning substrate could change with long-term variation in water temperature and acidity. The prevalence and composition of this algal mat could result in degradation of spawning habitat to a degree that ultimately reduces incubation success. | |
| | Steelhead – Lower Columbia DPS, Middle Columbia DPS, Puget Sound DPS, Snake River Basin DPS, and Upper Columbia DPS | Moderate-High | High | In general, steelhead appear sensitive to warmer water temperatures, low flows, and high flows. Warmer water temperatures can affect physiological performance and energy budgets, as well as developmental rates and the timing of key lifecycle transitions (i.e., phenology). Lower stream flows (particularly summer and early fall) can reduce the probability of survival in rearing juveniles. Extreme high flows can reduce the likelihood of egg survival during incubation, and both low and high flows can affect adult migration. Steelhead may be able to shift the timing of a life stage transition to reduce the probability of exposure to changes in temperature or flow through phenotypic plasticity.<br><br>Similar to Chinook salmon, steelhead exhibit alternative life histories in regards to run-timing, which confer different sensitivities to climate. Summer-run steelhead migrate higher in river networks, entering freshwater between late spring and fall, and overwinter before spawning the following spring. In contrast, winter-run steelhead migrate during winter or early spring and spawn immediately. Because they spend more time in freshwater, summer-run populations of steelhead may be more sensitive to changes in flow and temperature regimes across river networks. For example, higher temperatures will increase the metabolic costs accrued by summer-run steelhead during the several months that they hold in streams prior to spawning.<br><br>The existence of a resident life history form likely buffers O. mykiss from environmental stochasticity and may make populations less vulnerable to extirpation. For example, anadromous individuals can survive ephemeral periods of unsuitability in their natal streams while they are away at the ocean, whereas residents can survive in years where conditions are poor along migratory routes.<br><br>Temperature: Steelhead may exhibit some sensitivity to warming water temperatures. Direct measures of Oncorhynchus mykiss thermal physiology | • Altered spring runoff timing and amount/magnitude<br>• Increased water temperatures |

| Taxa | Common Name | Vulnerability Ranking | Vulnerability Confidence | Description of Sensitivity | Description of Exposure |
|---|---|---|---|---|---|
| | | | | suggest many parameters do not differ significantly from those of other salmonids (except in locally adapted populations of redband rainbow trout in desert streams). In addition, contemporary temperature regimes in the Columbia River cause steelhead and Chinook salmon to use the same thermal refuges during spawning migrations. Similar to Chinook salmon, steelhead are vulnerable to high angling pressure when seeking refuge in cold refugia such as tributary junctions; thus warmer temperatures can have indirect effects on mortality. However, the geographic distribution of steelhead suggests they may be less sensitive to warm temperatures than other anadromous salmonids—steelhead occur in Southern California, farther south than any Pacific salmon. Further, the resident life history form of O. mykiss can persist in desert streams that often exceed 68˚F through what appears to be local adaptation. Whether steelhead populations from warmer streams exhibit higher thermal tolerance is poorly understood, as is the potential rate of evolution in attributes of thermal physiology.<br><br>Flow regimes: The survival of steelhead embryos or recently emerged fry may be sensitive to the timing and magnitude of spring runoff rather than the fall and winter aspects of flow regimes. For example, high winter flows that threaten the egg-to-fry survival of fall-spawning salmonids are not predicted to negatively affect steelhead.<br><br>Marine: Increases in ocean and estuarine temperature, increased stratification of the water column, and/or changes in the intensity and timing of coastal upwelling may alter primary and secondary productivity, with potential impacts on growth, productivity, survival, and migrations of salmonids. | |
| | Surf Smelt | Moderate-High | High | Surf Smelt may experience some physiological sensitivity to climate change since warmer and drier beach conditions have been shown to lead to higher levels of smelt egg mortality. Surf Smelt sensitivity will be increased by potential changes in zooplankton prey availability. Predicted delayed and shorter upwelling systems could affect the timing and abundance of prey and lead to declines in prey availability, particularly for juveniles, though the magnitude of these impacts is uncertain. Additionally, since Washington Surf Smelt tend to use a small number of beaches for spawning, changes in beach habitat due to sea level rise and stronger and increased storms could lead to declines in available spawning area. | • Increased air temperatures<br>• Altered upwelling patterns<br>• Sea level rise<br>• Increased storminess |

| Taxa | Common Name | Vulnerability Ranking | Vulnerability Confidence | Description of Sensitivity | Description of Exposure |
|---|---|---|---|---|---|
| INVERTEBRATES | Caddisfly (*Goereilla baumanni)* | High | High | *Goereilla baumanni* is a species of caddisfly found only in few sites and always in very low numbers in Washington, Idaho, and Montana. They are restricted to headwater springs and seepage in high-elevation forested areas during their larval and pupae stages, and within this habitat are associated with the surrounding muck comprised of decomposing organic materials. Sensitivity for this species is likely tied primarily to their specialized habitat, which is particularly vulnerable to warming air and water temperatures, low summer flows, sedimentation from upstream erosion, and habitat fragmentation from nearby human activity (i.e. forestry practices and road construction). The close association of *Goereilla baumanni* to organic muck may make this species particularly sensitive to high temperatures, drought, and precipitation changes which may make these areas more likely to dry out. Caddisflies in general are often considered an indicator of high-quality streams, suggesting that they are particularly vulnerable to changes in their habitat. | • Increased air and water temperatures<br>• Drought and/or changes in precipitation<br>• Low summer flows<br>• Increased sedimentation and erosion |
| | Northern Forestfly | High | High | The Northern Forestfly is a species of stonefly with only one currently known location in the northern Cascades. It is associated with a high-elevation spring and stream which flows into an alpine lake, and in fact all 3 species in the *Lednia* genus are restricted to alpine or subalpine springs and glacial streams (the proposed name for the genus is "Meltwater Stoneflies"). This species is extremely sensitive to climate change because of its dependence on coldwater habitats, which are likely to warm significantly along with disappearing glaciers. | • Increased water temperatures<br>• Reduced glacier size and increased glacier melting |
| | Olympia Oyster | High | High | Olympia oysters are likely to be sensitive to a number of climate factors, including declines in salinity, oxygen, and pH. Olympia oysters are sensitive to low salinity levels, and potential increased precipitation (particularly during winter and spring) can lead to lower salinity levels and potential juvenile mortality, as juveniles have a more sensitive salinity threshold. Additionally, increases in extent and time of hypoxic conditions could limit oyster growth. Predicted declines in ocean pH in Washington are also likely to lead to decreases in growth, weight, and metamorphic success of oyster larvae, which could also trigger increased mortality at later life stages. The effects of acidification on oyster larvae could be more severe if low pH conditions are coupled with decreases in phytoplankton food availability. | • Declines in salinity<br>• Decreased oxygen and pH |

| Taxa | Common Name | Vulnerability Ranking | Vulnerability Confidence | Description of Sensitivity | Description of Exposure |
|---|---|---|---|---|---|
| INVERTEBRATES | Rainier Roachfly | Moderate-High | High | The Rainier Roachfly has only been documented within Mt. Rainier National Park (mostly on the west side). It is found in seeps, springs, and small spring-fed streams. Climate sensitivity for this species is tied to melting glaciers and an associated rise in stream temperatures. Relatively little is known about this species, but stoneflies as a whole are sensitive to drought or precipitation changes that may affect seep moisture, springs, and stream flow. Decreased water quality, habitat fragmentation and nearby development also alter the quality and availability of suitable habitat. | • Increased water temperatures<br>• Reduced glacier size and increased glacier melting<br>• Changes in precipitation and/or drought<br>• Altered flow regimes |

## 5.0 Results: Vulnerability Rankings for Habitats of Greatest Conservation Need

The following section highlights climate change vulnerability rankings for Washington State habitats of greatest conservation need. As discussed in Chapter 4, the SWAP Update uses vegetation formations (representing coarse scale or landscape level habitats) and ecological systems (representing fine scale habitats) as the basis for understanding and identifying habitats of greatest conservation need. Both vegetative formations and ecological systems are collectively referred to as habitats in this chapter. Please refer to Chapter 4 for maps and further information about vegetation formations and ecological systems. Table 5-2 summarizes climate change vulnerability information for the 12 Washington vegetation formations, while Table 5-3 highlights those ecological systems of concern with moderate-high or high vulnerability and high confidence[2]. Habitats that received moderate-high or high vulnerability rankings but low or moderate confidence evaluations are not listed in this table, as more research, data, and/or expert consultation is required to improve confidence.

It is important to note that our initial assessment did not review all ecological systems in Washington, but focused on those already known to be imperiled from existing stressors (these are referred to as Ecological Systems of Concern in the SWAP). In this context Table 5-3 represents an incomplete picture of climate risk to ecological systems across Washington – it focuses exclusively on those already known to be imperiled. Table 5-4 represents a work in progress that will be updated as more of the ecological systems in Washington are assessed for climate vulnerability. These vulnerability assessments are updatable so that as new information becomes available on sensitivity or exposure for a given habitat, it can be incorporated into the table and used to re-evaluate vulnerability.

A few themes emerged in evaluating habitats for climate vulnerability:

- Vulnerable habitats can generally be grouped into two primary categories: (1) those that are vulnerable to changes in precipitation type, timing, and amount leading to reduced water supply and soil moisture (e.g., Bog & Fen, Flooded & Swamp Forest), and (2) those that are vulnerable to altered fire regimes and drought/reduced soil moisture (Semi-Desert Scrub and Grassland, Temperate Forest).
- In general, habitats in the East Cascades and Rocky Mountains appear more sensitive to climate change, and received overall moderate-high vulnerability rankings.
- Moisture-dependent habitats in the North Pacific such as Bog & Fen, Lowland Riparian Forest and Shrubland, and Hypermaritime Western Red-cedar-Western Hemlock Forest also received higher sensitivity and vulnerability rankings.

[2] Confidence reflects the average sureness assessors had in a vulnerability ranking.

## 5.1 Climate Vulnerability for Vegetation Formations

**Table 5-3: Climate change vulnerability summaries for Washington vegetation formations.**

| FORMATION | DESCRIPTION OF VULNERABILITY |
|---|---|
| **Alpine Scrub, Meadow & Grassland** | Climate change, which may result in reduced snowpack and encroachment by trees and shrubs is considered a major stressor. |
| **Barren** | Climate change is a significant stressor for the Alpine Ice Field ecological system (decline of glaciers and reduction in snowpack) and unconsolidated shore in coastal areas (sea level rise, shoreline armoring limiting the flow of sediment). |
| **Bog & Fen** | Climate changes such as decreased precipitation, reduced snowpack, or prolonged drought that reduce water availability and recharge may lead to range contraction and/or habitat conversion, increased invasion of dry-adapted species, or tree encroachment in bog and fen habitats. Shifts from snow to rain that enhances winter/spring flood risk may increase erosion of moist peat and topsoil, reduce opportunities for recharge, and/or lead to drying of habitats. |
| **Cliff, Scree & Rock Vegetation** | Climate change could alter species composition of this system possibly by allowing more vascular plant species to establish as well as a shift in species composition. Inter-mountain basins active and stabilized dune habitats are highly dynamic by nature, with varying vulnerabilities to climate changes such as increased temperatures and moisture stress. High moisture years enhance dune stabilization by limiting sand movement and/or favoring invasive vegetation establishment (e.g., cheatgrass) and dominance, whereas warmer, drier years enhance dune erosion and movement, facilitating habitat diversity and/or the establishment of new habitat areas. |
| **Flooded & Swamp Forest** | Flooded and swamp forests are generally adapted to high moisture levels, making them vulnerable to projected climate changes in hydrology and fluvial processes from precipitation shifts, reduced snowpack and earlier snowmelt, drought, and altered flow regimes. Declining summer and spring stream flows, particularly when combined with drought, could reduce available water for riparian communities, affecting seedling germination and adult survival and potentially contributing to shifts to more xeric and drought-adapted vegetation. Increasing winter flood frequency and volume may also affect vegetation composition, potentially selecting for hardwoods, smaller trees, and younger age classes. Alteration of seasonal and annual flooding regimes will likely alter vegetation establishment, succession, and composition. Drought periods may exacerbate fire risk. |
| **Freshwater Aquatic Vegetation, Wet Meadow & Marsh** | Climate changes such as drought, increasing temperatures, and changes in precipitation type, timing, and amount that alter hydrologic regimes and rates of evaporation and recharge may have significant impacts in wetland habitats. For example, these climate changes could lead to wetland drying, shifts in species assemblages (native and non-native), habitat conversion, and/or decreased quality and quantity of habitat available for aquatic biota. Changes in winter precipitation type and timing, as well as earlier runoff, could positively (e.g., create side channels or additional habitat) or negatively (e.g., reduced opportunities for water storage and recharge, increased erosion) impact these habitats. Intertidal freshwater wetlands are also vulnerable to rising sea levels and intrusion of brackish water that can lead to vegetation changes, increased eutrophication, and expansion of invasive plant species. |

| FORMATION | DESCRIPTION OF VULNERABILITY |
|---|---|
| **Grassland, Meadow & Shrubland** | In general, prairies and grasslands are well-adapted to warm and dry conditions and periodic soil drought, and projected future increases in temperature and/or drought for the region are unlikely to disadvantage (and may benefit) these systems. Grasslands may be somewhat sensitive to altered wildfire regimes, particularly increased fire frequency or severity that could limit native species regeneration or increase invasion rates and abundance of non-native annual grasses and weeds. However, increases in wildfire may also benefit grasslands and savannas by preventing conifer encroachment. Conifer encroachment associated with warmer temperatures likely represents the greatest stressor for alpine and subalpine meadows, shrublands, and grasslands. |
| **Open Water** | Climate changes such as reduced glacial and snowpack runoff as well as more frequent, intense, and longer-lasting droughts may affect replenishment of open water systems. Increased water temperatures and changes in precipitation type, timing, and amount that lead to altered flow regimes and/or shifts in water supply represent important climatic stressors for open water. Warming water temperatures may cause shifts in species distribution, phenology, and life histories. Changes in precipitation type, timing, and amount may affect habitat complexity, quality, and quantity; reduce connectivity of aquatic habitats; modify food web structure or productivity; or cause range contraction and/or loss of local species. |
| **Salt Marsh** | Climate changes that lead to changes in water levels may impact inter-mountain basin playa, alkaline closed depressions and greasewood flats. Changes in precipitation may lead to fluctuations in salinity levels (e.g., increased salinity with decreased precipitation), which could lead to shifts in vegetation composition. Increases in runoff that increase nutrient levels in basin playas and alkaline closed depressions could also threaten vegetation. Projected sea level rise represents a key climate stressor for tidal salt and brackish marshes, as it could lead to submergence of habitats and declines in vegetation unless they are able to migrate inwards through sediment accretion. |
| **Scrub & Herb Coastal Vegetation** | Sea level rise, increased coastal erosion, and increased storminess and wave action represent significant climate stressors. Projected sea level rise could cause erosion and/or landward shift of dunes and cliffs. Similarly, greater wave and wind action from storms could cause increased disturbance and erosion of cliffs, dunes, and dune vegetation. Climate induced-changes or declines in dune vegetation that help stabilize and protect dunes could make dune habitat more vulnerable to disturbances from increased erosion, waves, and winds. |
| **Semi-Desert Scrub & Grassland** | Climate changes including shifts in precipitation, drought, and altered fire regimes may affect plant composition, density, and distribution in semi-desert scrub and grassland habitats. Precipitation likely influences plant composition, growth, and recruitment, and drought negatively affects seedling survival in sagebrush systems, reduces shrub cover, and elevates herbaceous diversity and cover. Increasing fire frequencies and/or intensities will likely negatively affect sagebrush and shrub habitats, and may favor grassland expansion. However, fire also favors cheatgrass and other non-native annual establishment, which can alter ecosystem function. |
| **Temperate Forest** | Increasing temperatures, decreased moisture availability, and altered fire regimes represent the most significant climate stressors to temperate forests. Altered fire regimes appear to be the greatest threat, particularly given fire suppression practices of the past century that have led to the invasion of shade-tolerant and fire-intolerant species and/or altered forest structure and composition (i.e., increased stand density, smaller diameter trees. Warmer temperatures and decreased moisture availability may increase insect outbreaks in some temperate forests. In general, North Pacific temperate forests likely exhibit less vulnerability to climate change than temperate forests of the East Cascades and Rocky Mountains. |

## 5.2 Ecological Systems of Concern at highest risk from climate change

Figure 8 summarizes the vulnerability and confidence ranks for all of the ecological systems of concern – the symbols indicate the formation in which the ecological system is found. Table 5-4, following, lists and describes those systems which were evaluated as having moderate-high or high vulnerability *and* high confidence. As noted previously, WDFW plans to evaluate all ecological systems for climate vulnerability – the list below represents only a partial list of the ecological systems of concern currently found in Washington.

Figure 8: Ecological Systems of Concern – Vulnerability and Confidence

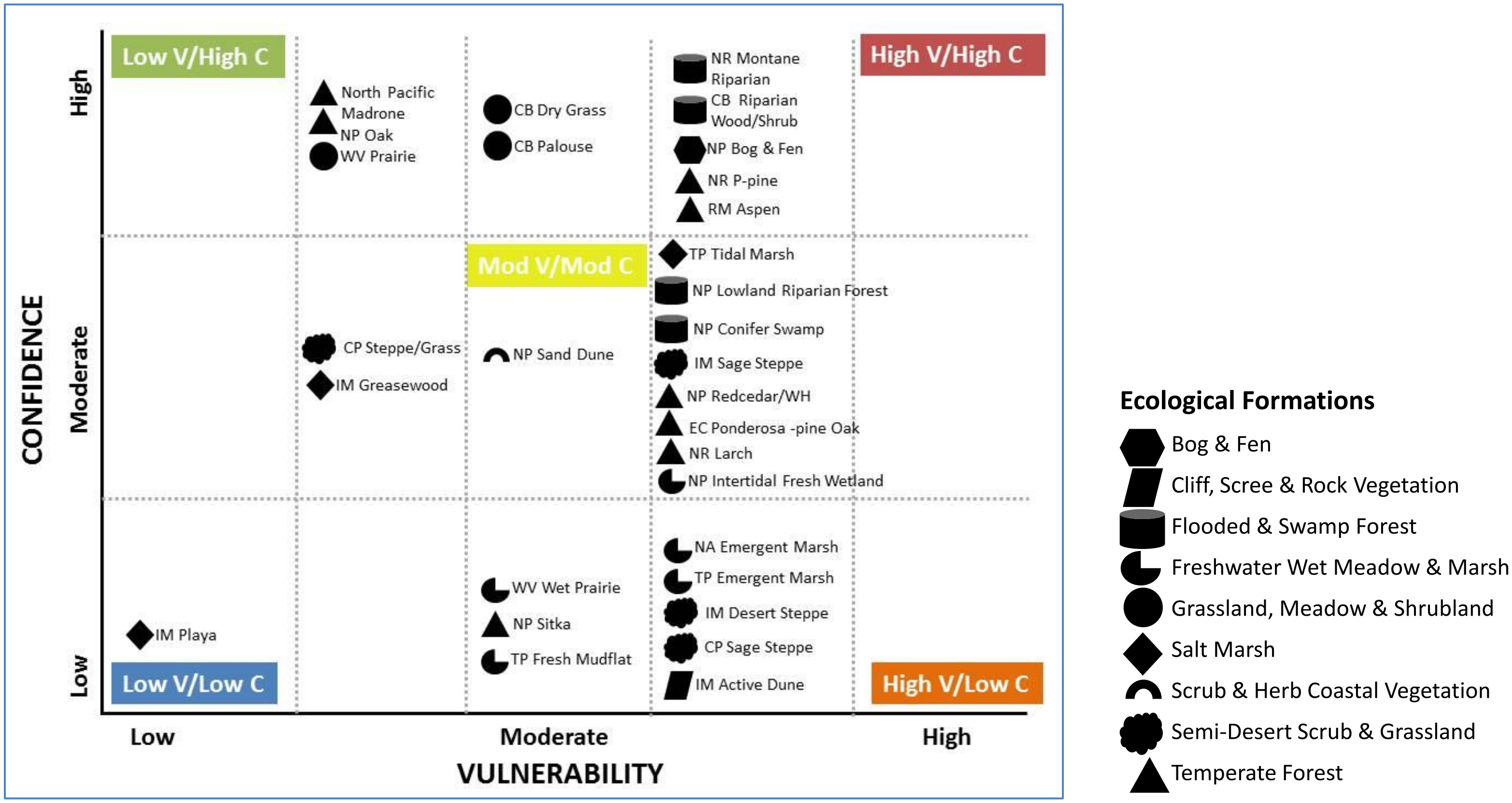


**Table 5-4: Ecological Systems of Concern evaluated as having moderate-high or high vulnerability and high confidence.**

| Forma-tion | Ecological System of Concern | Vulnerability Ranking | Vulnerability Confidence | Description of Sensitivity | Description of Exposure |
|---|---|---|---|---|---|
| BOG & FEN | North Pacific Bog and Fen | Moderate-High | High | Bog and fen habitats, particularly those that depend on surface water, are sensitive to drier climate conditions (i.e., decreased precipitation, reduced snowpack, shifts from snow to rain) that can lead to range contraction and/or habitat conversion, increased invasion of dry-adapted species, or tree encroachment. Groundwater-dependent bog and fen habitats may be more resilient to climate changes, but also exhibit sensitivity to prolonged drought as well as reduced snowpack and the subsequent impacts to groundwater recharge. Bog and fen habitats are also sensitive to shifts from snow to rain that lead to increased winter/spring flood risk, as this may increase erosion of moist peat and topsoil, reduce opportunities for recharge, and/or lead to drying of habitats. | • Changes in precipitation<br>• Decreased snowpack<br>• Shifts from snow to rain<br>• Prolonged drought |
| FLOODED & SWAMP FOREST | Columbia Basin Foothill Riparian Woodland and Shrubland | Moderate-High | High | Columbia Basin Foothill Riparian Woodlands and Shrublands are adapted to high moisture levels and depend upon spring and late-winter floods for re-establishment, and are likely sensitive to changes in hydrology and fluvial processes resulting from precipitation shifts, reduced snowpack and earlier snowmelt, drought, and altered flow regimes. Declining summer and spring streamflows, particularly when combined with drought, will likely reduce available water for riparian communities, affecting seedling germination and adult survival and potentially contributing to shifts to more xeric and drought-adapted vegetation. Habitats along intermittent or ephemeral streams may be particularly vulnerable. Shifts in flood timing in magnitude (i.e., larger winter floods, lower spring floods) will likely affect riparian succession, age classes, and ecological composition, as many flood-adapted riparian species exhibit phenology (e.g., seed dispersal) timed with historic streamflow patterns. Drought periods may also exacerbate fire risk. Young foothill riparian woodlands and shrublands are fairly sensitive to fire, while mature riparian stands may be more resilient to low-intensity surface fires. In general, these riparian habitats experience infrequent fire; they can re-colonize after disturbance (including fire), but regeneration of many species post-fire is dependent on soil moisture. | • Changes in precipitation<br>• Decreased snowpack<br>• Shifts in runoff timing<br>• Drought<br>• Altered flow regimes (high and low)<br>• Altered fire regimes |

| Forma -tion | Ecological System of Concern | Vulnerability Ranking | Vulnerability Confidence | Description of Sensitivity | Description of Exposure |
|---|---|---|---|---|---|
| **FLOODED & SWAMP FOREST** | Northern Rocky Mountain Lower Montane Riparian Woodland and Shrubland | Moderate-High | High | Sensitivity of this system is likely driven by soil moisture changes, altered hydrological and fluvial processes, and fire. This habitat is dependent on abundant soil moisture and adapted to seasonal flood regimes, both of which can be affected by temperature increases, precipitation shifts, reduced snowpack and earlier snowmelt, drought, and altered stream flow regimes. Soil moisture declines can affect germination and growth of component species. Alteration of seasonal and annual flooding regimes will likely alter vegetation establishment, succession, and composition. For example, declining summer and spring stream flows, particularly when combined with drought, will likely reduce available water for riparian plant communities, affecting seedling germination and adult survival and potentially contributing to shifts to more xeric and drought-adapted vegetation and associated losses in disturbance-adapted vegetation. Increasing winter flood frequency may facilitate shifts to younger overall age classes and annual species. This habitat occasionally experiences fire, and component species (e.g., deciduous trees) are able to recover fairly quickly. However, increasingly xeric conditions, increasing temperatures, and drought may increase fire frequencies, which will affect riparian age classes and vegetation composition. | • Reduced soil moisture<br>• Altered flow regimes (high and low)<br>• Altered fire regimes |
| **TEMPERATE FOREST** | Northern Rocky Mountain Ponderosa Pine Woodland and Savanna | Moderate-High | High | This ecosystem exhibits sensitivity to reduced soil moisture and drought as well as wildfire. Seasonal precipitation and drought influence the establishment of ponderosa pine and Douglas fir, and soil moisture deficits can increase old growth ponderosa pine mortality due to heightened competition with dense stands of young trees. This system is also sensitive to insect outbreaks, which may increase due to warmer temperatures and/or increased environmental stress (e.g., decreased soil moisture) that make tree species more susceptible to infestation. Wildfire is likely the most significant sensitivity for this system. In general, low severity, high frequency fires maintained and expanded this ecosystem, and even severe, large crown fires may be beneficial by helping cultivate an open forest structure (i.e., by restoring to initial stand establishment phase). However, wildfires that re-burn a previous severe-burn area may limit forest establishment due to lost seed source, reduced soil moisture, and high surface soil temperature. Additionally, much of this system features altered structure and composition (i.e., increased stand density, smaller diameter trees), which increases sensitivity to altered fire regimes that may limit regeneration potential of this ecosystem. | • Reduced soil moisture<br>• Drought<br>• Altered fire regimes<br>• Increased insect outbreaks |

| Forma-tion | Ecological System of Concern | Vulnerability Ranking | Vulnerability Confidence | Description of Sensitivity | Description of Exposure |
|---|---|---|---|---|---|
| | Rocky Mountain Aspen Forest and Woodland | Moderate-High | High | This ecosystem exhibits sensitivity to increasing temperatures, decreased moisture availability, and altered fire regimes. In general, aspen is a water-limited, drought-intolerant species, and warmer, drier conditions can affect aspen mortality, growth, and regeneration. Prolonged drought can lead to significant aspen die-offs, and recent declines in aspen extent may be partially explained by warmer temperatures and reduced moisture over the last several decades. Aspen sensitivity to climate change may be moderated by its tolerance of fire and other disturbances (e.g., wind, floods); interactions between multiple disturbance factors may favor aspen expansion because they negatively impact competitor species (i.e., conifers). However, severe fire and reburns may eliminate some stands in hotter and drier areas. | • Increased temperatures<br>• Reduced soil moisture<br>• Drought<br>• Altered fire regimes |

## 5.3 Other Ecological Systems of Concern with high vulnerability but less than high confidence

Other habitats evaluated with moderate-high or high vulnerability but low or moderate confidence included those listed in Table 5-5. As more research or information becomes available, some of these ecological systems could move to those in the high risk category. Descriptions of the specific impacts considered for each of these systems is available in Appendix C.

**Table 5-5. Ecological systems of Concern evaluated with moderate-high or high vulnerability but low or moderate confidence.**

| FORMATION | HABITAT |
|---|---|
| Cliff, Scree & Rock Vegetation | Inter-Mountain Basins Active and Stabilized Dune |
| Flooded & Swamp Forest | North Pacific Hardwood-Conifer Swamp |
| | North Pacific Lowland Riparian Forest and Shrubland |
| Freshwater Wet Meadow & Marsh | North American Arid West Emergent Marsh |
| | North Pacific Intertidal Freshwater Wetland |
| | Temperate Pacific Freshwater Emergent Marsh |
| Salt Marsh | Temperate Pacific Tidal Salt and Brackish Marsh |
| Semi-Desert Scrub & Grassland | Columbia Plateau Low Sagebrush Steppe |
| | Inter-Mountain Basins Big Sagebrush Steppe |
| | Inter-Mountain Basins Semi-Desert Shrub Steppe |
| Temperate Forest | East Cascades Oak-Ponderosa Pine Forest and Woodland |
| | North Pacific Hypermaritime Western Red-cedar-Western Hemlock Forest |
| | Northern Rocky Mountain Western Larch Savanna |

## 5.4 Additional Ecological Systems likely to be at high risk

Although not covered in Table 5-4 or Table 5-5 above, preliminary research suggests the following ecological systems are also likely to be at least moderately sensitive to climate change:

- North Pacific Dry and Mesic Alpine Dwarf-Shrubland, Fell-field and Meadow
- Rocky Mountain Alpine Tundra/Fell-field/Dwarf-shrub
- Unconsolidated Shore
- North American Alpine Ice Field
- Rocky Mountain Subalpine-Montane Fen
- North Pacific Montane Riparian Woodland and Shrubland
- North Pacific Shrub Swamp
- Northern Rocky Mountain Conifer
- Rocky Mountain Lower Montane Woodland and Shrubland
- Rocky Mountain Subalpine-Montane Riparian Woodland
- Great Basin Foothill and Lower Montane Riparian Woodland and Shrubland
- Inter-Mountain Basins Montane Riparian Systems

- Columbia Plateau Vernal Pool
- Rocky Mountain Alpine-Montane Wet Meadow
- Temperate Pacific Montane Wet Meadow
- Rocky Mountain Subalpine-Montane Riparian Shrubland
- Rocky Mountain Subalpine-Montane Mesic Meadow
- North Pacific Maritime Eelgrass Bed
- Temperate Pacific Intertidal Mudflat
- Open Water
- North Pacific Coastal Cliff and Bluff
- Inter-Mountain Basins Big Sagebrush Shrubland
- Inter-Mountain Basins Semi-Desert Grassland
- Inter-Mountain Basins Montane Sagebrush Steppe
- East Cascades Mesic Montane Mixed-Conifer Forest and Woodland
- North Pacific Dry-Mesic Silver Fir-Western Hemlock-Douglas-fir Forest
- North Pacific Mesic Western Hemlock-Silver Fir Forest
- North Pacific Mountain Hemlock Forest
- Northern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest
- Northern Rocky Mountain Mesic Montane Mixed Conifer Forest
- Rocky Mountain Subalpine Dry-Mesic Spruce-Fir Forest and Woodland
- Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland

Additional work is underway to fully assess the vulnerability of these habitats to climate change.

## 6.0 Management Considerations

This section discusses important considerations in applying the climate change vulnerability information for species and habitats, and provides a general overview of adaptation approaches.

### 6.1 Important Considerations

***Non-climate stressors***

Non-climate stressors have the potential to exacerbate the effects of climate change on species and habitats, or vice versa, although they may also have independent or antagonistic effects. For example, elevated abundance of cheatgrass may contribute to altered fire regimes due to higher fuel densities and shorter fire return intervals. Habitats or species that have to endure multiple non-climate stressors may be more sensitive to climate changes. For example, the overall vulnerability of Columbia Basin Palouse Prairie habitats to climate change may be greater due to a current stressor of invasive species that can outcompete native vegetation for soil moisture and/or increase fire intensity, even if this habitat is currently evaluated as having moderate vulnerability (Figure 5-1). Managers are encouraged to consider climate vulnerabilities for all resources, not just the target species under consideration, as they have the potential to interact with non-climate stressors in unanticipated ways and may lead to significant impacts on species or habitats.

***Expert consultation***

Information used in the species and habitats vulnerability assessment came primarily from the scientific and unpublished (gray) literature. An important component of this process is expert consultation, which helps to better characterize uncertainty and fill in data gaps where traditional scientific research or data are not yet available. WDFW anticipates updating and refining these vulnerability assessments and rankings over time with additional expert review.

### 6.2 Adaptation Approaches

Adaptation refers to efforts to avoid or ameliorate climate change effects that are already being or are expected to be experienced. In the context of vulnerability, adaptation refers to actions that reduce exposure or sensitivity to climatic changes. Examples of reducing exposure include protecting resources and infrastructure from flood damage or sea level rise, planting riparian vegetation buffers that enhance water quality, or restoring wetlands to limit flooding. Examples of reducing sensitivity include replanting with a mix of species that can cope with a range of climatic conditions, reducing or limiting levels of pollutants, or removing invasive species.

In general, there are five approaches to facilitating adaptation:

1. **Enhance Resistance**
   Resistance strategies help prevent the effects of climate change from reaching or affecting a resource. Examples of resistance adaptation options include limiting non-climate stressors, preventing invasive species establishment after disturbances, reducing non-natives, reducing the impacts of disease and fire, protecting vulnerable areas from sea level rise, or reducing erosion, among others.

2. **Promote Resilience**
   Resilience strategies help weather the impacts of climate change by avoiding or recovering from the effects. Examples of resilience strategies include employing a risk diversification approach to forest management and silvicultural practices, promoting native genotypes and adapted genotypes of

native species, requiring setbacks or buffers for future coastal developments, or upgrading culverts, bridges, and stream crossings to deal with higher peak flows, among others.

3. **Facilitate Transition**
   Transitional or response strategies involve taking a new course or path because the effects of climate change are unlikely to be dealt with in a current location or given current conditions. Examples of transitional or response strategies include facilitating change to desired assemblages, promoting connected landscapes to facilitate forest species migration along climatic gradients, or identifying and protecting projected future refugia, among others.

4. **Increase Knowledge**
   Increasing knowledge will help to fill data and information gaps to make better climate-informed decisions. Examples of increasing knowledge strategies include increasing or enhancing monitoring, continuing to gather and integrate data for refinement of vulnerability information, or improving understanding of patterns, characteristics, and rates of change in species distributions, among others.

5. **Management Coordination**
   Management coordination will better align values and efforts to improve conservation success in light of climate change. Examples of coordination strategies include aligning budgets and priorities for climate-focused work, establishing regional monitoring networks, or increasing communication and collaboration among local, regional, and state entities, among others.

No single adaptation strategy or individual management action will be appropriate to all situations or in all places. As with all management actions, adaptation strategies need to be tailored to particular resource locations and management contexts.

## 6.3 Next Steps

The following possible next steps have been identified. Please note that this list is not comprehensive; additional steps may be considered at a later date.

1. Complete vulnerability assessments for all ecological systems in Washington.
2. Convene workshops for expert review and refinement of vulnerability assessment summaries for species and ecological systems.
3. Evaluate existing non-climate stressors for climate watch species and assess priority in the context of added climate risk.
4. Explore the feasibility of additional adaptation actions for climate watch species.
5. Consider climate risk in other agency action prioritization.

## 7.0 References

### Climate Impacts Overview

*The information in the climate impacts overview was compiled from various synthesis reports on climate change projections and impacts for the Pacific Northwest region. Specific citations for information not derived from these reports can be found in-text. Otherwise, primary literature sources can be found within the following synthesis reports:*

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### Species and Habitat Vulnerability

*Information sources used to assess the climate vulnerability of species, ecological systems and formations can be found in Appendix C – Supporting Information for Climate Change, and also in Appendix F - Master Bibliography.*

# Chapter 6

# Monitoring and Adaptive Management

## Table of Contents

# Chapter 6
# Monitoring and Adaptive Management

## 1. Introduction and Overview

Monitoring is a key element in fulfilling the Washington Department of Fish and Wildlife's (WDFW) mission of preserving and perpetuating Washington's fish and wildlife resources. The 5th element required of State Wildlife Action Plans (SWAP) is that they provide for periodic monitoring of Species of Greatest Conservation Need (SGCN), habitats (represented by Ecological Systems of Concern in this document), effectiveness of conservation actions, and monitoring to use for adapting conservation actions as appropriate to respond to new information or changing conditions (adaptive management). The 6th required element is that the SWAP should provide for review and revision of the action plan. This chapter addresses both of these elements, by providing an overview of WDFW's approach and commitment to monitoring and adaptive management, describing how monitoring and adaptive management are addressed in the SWAP, and indicating how the SWAP will be reviewed and revised.

**Where monitoring needs are discussed in the SWAP**

Chapter 3 – Species of Greatest Conservation Need, provides an overview and summary of all the SGCN species and includes a high level discussion of threats and conservation actions, which may include monitoring or research oriented objectives. Detailed fact sheets for each SGCN (see Appendix A) include more discussion on monitoring needs and objectives for specific species. Similarly, Chapter 4 – Habitats of Greatest Conservation Need includes discussion of research and data needs, including monitoring, related to improving habitat for fish and wildlife at two scales (vegetation formation and ecological systems of concern). Fact sheets are provided for all ecological systems of concern, which include a discussion of stressors and conservation actions needed, and includes monitoring or baseline survey needs.

**Selective prioritization – monitoring outcomes may not be outlined for all conservation actions**

As discussed elsewhere in the SWAP, WDFW has adopted a flexible approach to prioritization of the SGCN and the ecological systems of concern, one that allows the agency to prioritize conservation activity in response to changes in internal priorities, organizational capacity, targeted funding opportunities or the availability of other resources. Our SGCN list is larger than in 2005, with an explicit recognition that the agency doesn't currently have capacity to adequately fund the conservations actions for all SGCN identified. Thus, inclusion of a species as an SGCN or inclusion of an ecological system as an ecological system of concern doesn't necessarily imply we will initiate action; rather that the need for conservation action exists. We will, however, consider the full suite of SGCN to inform actions directed towards higher priority species or ecological systems in an effort to maximize the effect of our conservation actions and increase the efficiency of our efforts.

Since we may not yet have projects in place of planned, monitoring objectives are not identified for all conservation actions. As funding or partnership resources become available and actions are queued up for implementation, monitoring and adaptive management plans will be developed. Where feasible, new WDFW monitoring programs will incorporate existing data and surveys and collaborate with monitoring partners. See Chapter 7 – Implementation for more discussion on prioritization within the SWAP and opportunities for working collaborative with conservation partners in advancing implementation of the SWAP.

## 2. WDFW Approach to Monitoring and Adaptive Management

There are many ways to describe and categorize the various types of monitoring related activities. For the purposes of this chapter, we will focus on two categories of monitoring activities as a means to describe WDFW's approach and commitment to monitoring and adaptive management: population assessment (status and trends) and compliance and effectiveness monitoring. For each category, we have described activities currently underway, and discussed outstanding needs and opportunities to address them.

### 2.1 Population Assessment (status and trends monitoring)

Population assessment, including inventory, status, and trends, can be defined as activities to track changes in wildlife and fish populations and their associated habitats over time, such as tracking the population status of four target species in a wildlife area.

WDFW works extensively with its partners to conduct baseline surveys or complete inventories in order to determine population numbers and distribution of a wide variety of wildlife species across the state. We will not present a comprehensive list of all the monitoring activities underway at WDFW, but rather we provide selected examples and focus on gaps and opportunities to address those gaps.

Examples include monitoring conducted for game species (several are on the SGCN list). Game species are monitored to evaluate their trends relative to the effects of different types of hunting seasons and to determine the numbers of animals that may be harvested when developing or modifying hunting seasons. Examples of these are breeding population surveys, midwinter counts and banding programs conducted for waterfowl. More information on game species monitoring is available in the WDFW Game Status and Trends Report for 2014, found here (wdfw.wa.gov/conservation/game/). About a third of our SGCN are salmonids. Intensive monitoring for salmonids is generally referred to as validation monitoring because the great body of knowledge surrounding anadromous salmon allows for hypothesis testing of the population response to specific management actions. WDFW also conducts validation monitoring to periodically reevaluate anadromous salmonid productivity, and basis fishery management on that information. WDFW's hatchery program also evaluates the effects of artificial production problems on wild salmonid stocks. Information on WDFW's salmon monitoring programs can be found here (wdfw.wa.gov/conservation/research/projects/salmon_abundance_research_methods).

**Priorities for Population Assessment Monitoring**

Monitoring is in place for only a portion of our 268 SGCN, and there is a significant need for expanded inventory and population assessments for SGCN and the habitats on which they depend. Our highest priority is to address outstanding monitoring needs for our 46 state and federally listed species – currently we have sufficient monitoring in place for only about half of these species. Addressing this gap is our highest priority because of their population persistence concern as well as our legal obligation to identify and report on the conservation status of these species and to develop status review documents, recovery plans and landscape management plans such as Habitat Conservation Plans.

A second tier of priority is a subset of species listed as "candidate" under Washington Administrative Code 232-12-297. These species may require survey activities to complete a full status assessment and make a recommendation regarding listing. Survey work will establish baseline data for long-term monitoring of species that are ultimately listed as threatened or endangered. A third tier of priority, are those SGCNs associated with an emerging or urgent threat; for example, bats at risk of white nose syndrome. And finally a fourth priority is to address gaps in our knowledge about species we know little about, including all taxa, but especially reptiles, amphibians, and invertebrates. For example, we only have sufficient occurrence data to map distribution for about 80 of our terrestrial SGCN.

Other priorities include the need for increased monitoring in order to better understand how climate change is affecting highly vulnerable species and ecosystems and how to develop appropriate response strategies. Each of our climate watch species (see Chapter 5) warrants additional monitoring to determine how distribution or habitat use may be shifting.

**Needs and Opportunities**
Strategies currently under consideration to address the needs for population assessment in a time of limited resources include the following:

- ***Conduct multi-species monitoring***
  With only about half of state-listed species with sufficient data to establish population trends, we currently lack the information and capacity to evaluate the status and distribution required to enact conservation measures for the majority of our SGCN. Multi-species monitoring is a strategy being developed by WDFW to increase the number of species for which we have credible, scientific information upon which to make inferences of population change. We aim to develop multi-species monitoring strategies that will link species occurrences to both associated habitats and to conservation action. In doing so, we hope to be able to efficiently evaluate species populations as well as their response to management actions. This will allow us to better understand what actions are directly impacting populations and/or habitats, where population growth constraints are, and how to improve our conservation effectiveness.

  In addition, survey methods for species monitoring will be developed with consideration of the threat of climate change. Data should be appropriate to conduct predictive modeling to understand the impact climate change has on species and their habitats, and inform decisions about targeting areas for long term conservation benefit.

- ***Employ citizen scientists or improve citizen science program to augment monitoring capacity***
  Citizen Scientists – volunteers working under the direction of professional biologists, trained to help answer a specific question, and following a set of data collection protocols – have long been recognized as an important asset to help our agency answer important species' and habitats' distribution and health questions. Beyond "volunteer opportunities," WDFW marries Citizen Scientists and professional biologists for specific targeted priorities set by the agency and our conservation partners. Recent examples include Greater Sage-grouse lek counts and Ecological Integrity Monitoring on Wildlife Areas. Baseline work by Citizen Scientists can identify questions we need to ask, inform the next stages of research-grade science, and help evaluate conservation actions.

  In 2014, WDFW committed a portion of the income from the Wild On Washington "Bald Eagle" license plate to create a more strategic network of Citizen Scientists and Citizen Science projects. WDFW is currently 1) creating a project development process to enhance purposeful data collection, high quality volunteer recruitment and retention, data compatibility, conservation effectiveness and communication; 2) supporting the use of certain online applications and tools to collect certain kinds of crowdsourced data (Sidebar C – eBird Northwest Sagebrush Songbirds Project, SGCN Range Maps); and, 3) drafting a framework for a statewide network of Citizen Scientist "nodes" to help in every ecoregion.

- ***Ecosystem monitoring***
  Focus on ecosystem monitoring as a coarse filter strategy. The SWAP Revision process has created new tools to understand the relationship between spatial habitat priorities and the SGCN that depend on

specific ecological systems for some or all or their life history needs. (See Chapter 4 – Habitats for more discussion on these tools).

## 2.2 Effectiveness and Compliance Monitoring

These are two related, but distinct concepts. Effectiveness monitoring can be described as activities intended to document the success of conservation actions in achieving the desired resource condition, such as determining whether a prescribed burn on a wildlife area achieved the desired result of maintaining a plant community of native prairie grasses. It is an essential component of adaptive resource management and is used to guide how we can improve resource management to achieve desired conditions. Compliance monitoring on the other hand, reports on the implementation of stated projects and programs, and gauges how well they achieved their stated goals, for example, did the prescribed burn occur as planned and what was the result. Combined, the products of these monitoring activities helps us to inform and prioritize programmatic decisions so we can maximize conservation benefit with existing resources. Each is discussed in more detail below.

**Compliance Monitoring**

Many of the conservation strategies and actions described in the Washington SWAP will be implemented by WDFW, either alone or in cooperation with our conservation partners. Other projects may be carried out solely by conservation partners, either as part of their own mandates and programs or through funding arrangements with WDFW. Projects that are carried out and funded by WDFW will be monitored to ensure that the funds were properly spent and to document that the projects were effective in addressing the objectives stated in specific grants.

A prime example of compliance monitoring efforts at WDFW include monitoring under the Adaptive Management Program of the Forests and Fish Agreement, which addresses timber-managed landscapes and became law in 2000. Forests and Fish is a multi-stakeholder agreement in which the timber industry, three Washington State agencies (the Departments of Ecology, Natural Resources, and Fish and Wildlife), Native American tribes, Washington State counties, and the US Fish and Wildlife Service participate. This agreement, the largest Habitat Conservation Plan in North America, covers over 9 million acres. Since 2000, WDFW has designed and implemented several research-linked monitoring projects, the ultimate purpose of which is to evaluate the effectiveness of the state riparian buffer prescription for non-fish-bearing streams in protecting natural resources. Amphibians, as the focal aquatic vertebrates in non-fish-bearing streams, are a focus of this monitoring.

A recent effort has focused on assessing the effectiveness of the Hydraulic Project Approval (HPA) program in protecting fish life. WDFW has designed and implemented an HPA compliance and effectiveness monitoring program for culvert-related water crossing structures on fish bearing streams and marine shoreline bank protection. Results of this monitoring of water crossing structures and marine bank protection is being used to improve HPA Program performance over time.

To ensure compliance with our grants, WDFW has been using a system known as "CAPS". It is a shared database system for tracking WDFW contracts and their associated projects. Previously, WDFW has successfully used CAPS for compliance monitoring on several Federal Energy Regulatory Commission (FERC) projects, as well as on projects affected by Washington Forest Practice laws. We are currently in the process of transitioning to Novatus, a similar type of contract management system. Novatus is designed to provide necessary management controls and reporting capabilities and to address the various programmatic and financial accountability expectations of federal, state, and local contracting and grant agencies. WDFW will use Novatus to build accountability for contract and grant performance. In particular, it contains a nexus with the US Fish and Wildlife Service's (USFWS) Tracking and Reporting Actions for the Conservation of Species (TRACS) system. Wildlife TRACS is the tracking and reporting system for conservation and related actions funded by the, USFWS's Wildlife and Sport Fish Restoration (WSFR) Program. When fully implemented, the results achieved through State Wildlife Grant projects will be available for review through a publicly available website, found here.

**Effectiveness Monitoring**

Effectiveness monitoring is an ongoing and emerging need at WDFW. It is particularly important within the context of SWAP implementation and revolves around Adaptive Resource Management. The approach for effectiveness monitoring for species and habitats is a focus of the multi-species monitoring approach described above. Functionally, the steps taken in this SWAP revision to link species to closely and generally associated habitats will form the basis for being able to monitor the effectiveness of on-the-ground conservation action through appropriate indicators of either habitat response or species response or both.

## 3. Review and Revision of the SWAP

Element 6 of the required SWAP elements states that there must be provisions to review the plan at intervals not to exceed ten years. WDFW intends to initiate a formal review of progress on the SWAP and changes needed in preparation for an updated revision no later than two years prior to the next submission date (assumed to be October 1st, 2025).

In addition, if changes are needed to either the SGCN list of list of Habitats of Greatest Conservation Need prior to the date of the next SWAP submission, WDFW will submit a request to USFWS as per USFWS guidance.

We also fully expect that the data provided in this document will change over the years. For example, timing of the submittal date only allowed for a preliminary assessment of climate change vulnerability for our SGCN. In some cases, we identified species with likely high vulnerability, but were not able to locate sufficient references to establish a high confidence in this ranking. As our work to understand how climate change will impact our SGCN and the habitats on which they depend continues, we expect to be updating our rankings and perhaps as a result identifying new actions or priorities. The State Wildlife Action Plan as represented by this document is a snapshot in time, but the data products that comprise it are designed to be dynamic and accommodate the availability of new research, or other changes in the understanding of the conservation needs or status of an individual species.

The maps depicting range and potential habitat distribution presented in Appendix B are another example of a product that is designed to be responsive to new data and updated continuously as new information becomes available.

## 4. Summary

Monitoring and adaptive management are critical elements of Washington's State Wildlife Action Plan. The commitment to status and trends, and project effectiveness and implementation monitoring efforts as described in this chapter provide the means for gauging the health of Washington wildlife and fish populations and for determining whether or not conservation projects and programs are meeting WDFW's goals. These monitoring activities also serve as the cornerstone of Washington's adaptive management approach to implementing agency conservation programs, including the SWAP. Through systematic, ongoing review of conservation management strategies and monitoring programs, WDFW will aim to continually improve its effectiveness at conserving Species of Greatest Conservation Need, associated habitats and ecological systems at both the localized and regional scales, and will ensure that the monitoring requirements of the State Wildlife Grants program are met.

# Chapter 7: Implementation

## Table of Contents

# CHAPTER 7
# Implementation

## 7.1 SWAP Guides Conservation Implementation

Washington's State Wildlife Action Plan (SWAP) includes a variety of tools to guide the design, planning, and implementation of conservation projects. An important feature of the SWAP, and one that distinguishes it from many other plans, is that it is based on a comprehensive assessment of ecological systems and species in Washington. By first evaluating the full breadth of the state's species and ecological systems for conservation need, the SWAP could then assess the relative conservation priority of each, identify key stressors and threats, and outline actions to conserve species and habitats over the long term. This means that tools from the SWAP can inform, to varying degrees, projects dealing with any ecosystem or species throughout the state.

Ultimately, this comprehensive approach provides resource planners and managers information to help apply limited conservation dollars in the most efficient way possible. Specifically, the SWAP includes a set of tools to help users prioritize, design, and implement their conservation projects and activities. Although the primary intent of the SWAP is to guide the work of WDFW over the next decade, these tools are also applicable to other agencies or organizations engaged in conserving, protecting, or managing our state's fish and wildlife resources. Examples are described below.

**Species and Habitat Data**

The species and habitats data included in the SWAP identifies important traits such as rarity, trends, threats, and current status for both species and habitats. We used these data to systematically prioritize species into a subset of those that warrant greater conservation attention (SGCN), and those habitats (ecological systems) considered imperiled and/or of high value to SGCN into a subset of higher priority ecological systems (habitats of greatest conservation need).

**Spatial Data**

The mapped information produced as part of Washington's State Wildlife Action Plan is of particular value for prioritizing proposed activities and for guiding limited resources and investments to specific locations, ecosystems, or landscapes. Examples of specific opportunities include:

1. Range maps developed for a number of SGCN identify areas of known occurrence as well as those likely to provide habitat if suitable habitat conditions are present. These maps will help to prioritize species survey efforts, restoration activities, and the creation of policy and funding opportunities to direct conservation actions to these places.
2. Ecological systems maps, used in conjunction with SGCN association data and the ecological system fact sheets, can help conservation planners measure the potential value of projects by comparing how many Ecological Systems of Concern (ESOC) are benefitted and which actions to prioritize within them.
3. The SGCN distribution data from the SWAP can demonstrate how a project or initiative might aid species of interest or determine how much of a project area may contain suitable habitat for SGCNs, which also can inform the relative priority of projects.

**Stressors and Actions**
The information in the SWAP on stressors and the conservation actions essential to reduce stresses for ESOC and SGCN is useful as a decision support tool for evaluating and prioritizing specific projects or actions. These data can help practitioners determine the relative value of addressing stressors and selecting appropriate actions in specific places. Such data can also aid conservation planners in identifying gaps in knowledge and unmet needs for species and their habitats.

Table 7.1 summarizes components of the SWAP designed to contribute to the prioritization of conservation or recovery actions.

**Table 7.1 Description of Washington Wildlife Action Plan tools**

| SWAP Resource or Tool | Resource/Tool Description | Potential Application |
|---|---|---|
| SGCN fact sheets | Fact sheets for every SGCN in Washington describe:<br>• Species conservation status, biology and life history, distribution and abundance and habitat requirements.<br>• Key stressors as well as conservation actions necessary to reduce the influence of stressors.<br>• A preliminary ranking of vulnerability to climate change. | Develop, seek funding for, and implement priority conservation actions for SGCN. |
| Ecological system fact sheets | Fact sheets are available for each of the 18 vegetation formations in Washington. More detailed facts sheets are provided for 29 of Washington's Ecological Systems of Concern – imperiled and/or important to SGCN. These fact sheets identify:<br>• Distribution and conservation status and concerns.<br>• A list of closely and generally associated SGCN.<br>• Priority stressors to the ecological system and conservation actions needed.<br>• Research and data needs. | Develop, seek funding for and implement priority conservation actions for ecological systems. |
| SGCN range and distribution maps | Maps depicting the Washington range and potential habitat distributions of selected SGCN. Range maps will be added for other SGCN as sufficient occurrence data becomes available. | Guide decisions where to conduct conservation actions across a landscape. |
| Species associations with ecological systems | Comprehensive list describing the associations of SGCN to each of the ecological and cultural systems of Washington. | Prioritize conservation investment in areas of greatest benefit to SGCN. |
| Matrix of stressors and associated conservation actions for all SGCN | This matrix identifies threats and actions needed for all SGCN using standardized category descriptions. It highlights the most common shared stressors, and when combined with other tools (for example, the species association matrix), it provides a spatial perspective to understand the conservation threats facing SGCN. | Prioritize conservation actions across SGCN and across larger landscapes. |

| SWAP Resource or Tool | Resource/Tool Description | Potential Application |
| --- | --- | --- |
| Climate change vulnerability rankings, descriptions and references | A summary of projected climate change impacts to SGCN and their habitats. A spreadsheet includes rankings of relative vulnerability to climate change for every SGCN and includes narrative to explain and support the ranking. A climate watch list includes a list of highly vulnerable species and habitats across the state. | Prioritize conservation actions for SGCN at risk from climate change. Enhance knowledge regarding the threat of climate change. |
| Priority Landscapes Matrix | An analysis of existing large-landscape conservation initiatives overlaid with SGCN distribution and Habitats of Greatest Conservation Need. | Applies SWAP data to inform selection of on the ground conservation priorities (specific landscapes). |
| Prioritization Tool | Identifies actions that are either an Absolute Priority or Non-Priority, and uses 34 factors that contribute value to an action's ultimate priority ranking. | Uses SWAP data to prioritize species and habitats for conservation action. |

## 7.2 Approach to Prioritizing Species and Conservation Actions

The species and habitats in the SWAP are not prioritized into ranked lists for conservation attention in this document. WDFW recognizes that different priorities may emerge depending upon the specific questions being asked or the type of resources available. For example, the results of a funding priority analysis may result in different high priority actions than prioritizing based upon partnership opportunities, strictly by conservation need, or strictly through social or political lenses. As an alternative to prioritizing the SWAP itself, WDFW developed a tool that can be used to apply the SWAP data to inform prioritization, and allow for adaptation, depending on specific considerations.

### WDFW Prioritization Tool

WDFW developed and tested several approaches to evaluate conservation priorities, considering a variety of criteria such as the status of the species or habitat involved, biological need, political environment, funding availability, and legal obligations, and developed a tool that can be used for that purpose (Appendix E). However, it was recognized early in the process that the real value in such a tool comes from the identification of factors that may contribute to a priority value. Application of the tool itself to score particular actions is not as critical as using the criteria and considerations to compare and contrast actions, and to explain why a particular action has either a high or a low priority.

The following sections of this chapter provide more detail on how the agency intends to use the SWAP specifically to prioritize its work, reviews benefits and potential applications by conservation partners, and highlights a few case studies as examples.

## 7.3 Benefits to Department Programs and Operations

Many of the agency's existing, ongoing, or future initiatives for conserving fish and wildlife can benefit from the tools developed by the SWAP and described in Table 7.1. Below we briefly describe how these tools can support activities related to:

- Department lands;
- Technical assistance;
- Species recovery and management;
- Regional landscape initiative;
- Science, research, and data; and
- Outreach and education.

### 7.3.1 Department Lands

***Wildlife Area Planning*** — The SWAP identifies where SGCN and/or Ecological Systems of Concern (ESOC) occur on Wildlife Areas. Information developed regarding key stressors and actions will be consulted by practitioners in developing appropriate objectives for wildlife area management plans.

***Management and Restoration*** — Maps produced specifically for individual wildlife areas and wildlife area complexes using the SWAP spatial data will be useful for identifying where Ecological Systems of Concern likely occur. Information in the fact sheets for each ESOC can then provide wildlife area managers with guidance on what types of actions (e.g., fire management, invasive species control) are known to have the most benefit to the SGCN associated with those systems.

***Land Acquisition*** — A major goal of WDFW's land acquisition strategy, Lands 20/20, is to develop a portfolio of Department lands that ensures we provide multiple use benefits, including preserving, protecting, and managing Washington's fish and wildlife. SWAP tools which can help planners meet this need include the identification of Ecological Systems of Concern, and where they may occur on proposed acquisitions. Additionally, by linking all SGCN to their associated ecological systems, we can also better grasp the potential benefit to species through land conservation activities. The stressors and actions from both the SGCN and ecological system fact sheets also help identify places where acquisition or other conservation tools may be appropriate.

### 7.3.2 Technical Assistance

***Local Land-Use Planning*** — WDFW's Priority Habitats and Species program provides spatial information and management recommendations in support of land use decisions that take into account the needs of fish and wildlife. Counties and cities are called upon to protect PHS species and habitats through their land use plans and development regulations required by both the Growth Management Act (GMA) and Shoreline Management Act (SMA). WDFW Habitat Biologists provide technical assistance in the development and implementation of such plans and regulations. The Range and Potential Habitat Distribution maps in Appendix B as well as the Ecological Systems of Concern can be a valuable resource for PHS biologists as they advise on major land use decisions such as Urban Growth Area expansion boundaries or more localized actions such as site-specific mitigation.

***Assessing Energy Development*** — Energy from reusable sources such as from wind and solar has rapidly expanded in the past decade. Using PHS data, WDFW consults and advises in the proposed siting of these types of projects to ensure the needs of wildlife and their habitat is taken into account. As with technical assistance provided to counties and cities, the spatial data generated from SWAP will help us provide better advice about these projects' likely impact to PHS and SGCN species.

***Priority Habitats and Species*** —WDFW is continuously updating PHS spatial data, management recommendations, the list of PHS species and habitats, and vehicles to deliver PHS information to clients. The factsheets and spatial data gathered in support of SWAP will be reflected in forthcoming updates of PHS products. This crosswalk between the two programs is important for conservation in Washington State as PHS is the primary tool in local land using planning efforts. PHS is referred to in GMA, SMA, and energy siting regulations and is regularly referenced by local jurisdictions.

### 7.3.3 Species Recovery and Management

***Species-Specific Conservation Planning and Actions*** —Actions that are focused on a particular species' recovery include 1) surveys, monitoring and research to better understand the status and distribution of SGCNs, 2) the protection and management of habitats for SGCNs, 3) the protection of SGCNs from hunting, trapping, incidental mortality or disturbances, and 4) the management of SGCN populations (e.g., translocations, predator control, head-starting). These actions can be achieved through on-the-ground actions of biologists (e.g., surveys, nesting habitat maintenance), species protections (e.g., closed hunting season) and agreements between agencies (e.g., Candidate Conservation Agreements with Assurances, Habitat Conservation Plans, translocation agreements). WDFW produces Recovery Plans for its state-listed species, which outline the actions needed to conserve and rebuild populations of each species individually. In addition, many species that are an agency focus have or will have a shorter term Action Plan to guide resources as they are available. While many of the SWAP tools are helpful when planning for and implementing species conservation actions, the SGCN range and potential habitat distribution maps, the SGCN fact sheets, and the matrix of stressors will be especially valuable in shaping and supporting the conservation of state listed and non-listed SGCN.

***Annual Reporting and Status Updates*** — Among their many potential uses, each of the SWAP tools could serve as a baseline or reference point to measure the effect or success of an ongoing project, or they could simply be used to provide a relevant literature reference for a status update. For example, the SGCN range and habitat distribution maps could be used to indicate the extent that habitat protections or a translocation have aided the expansion or reestablishment of a SGCN in a portion of their historical range.

***Species Listing Decisions*** — Decisions to list a species at the state or federal level require reliable and current information about a species' status, distribution, vulnerabilities, and management history, as well as an understanding of the threats to a species. Given these needs, the SGCN range and habitat distribution maps, the matrix of stressors, the climate change vulnerability rankings, and the SGCN fact sheets will be essential for WDFW to prepare sound recommendations for species classifications to the Fish and Wildlife Commission.

### 7.3.4 Regional and Landscape Initiatives

***Priority Landscape Initiative*** — Statewide Priority Landscapes is a proactive initiative aimed at identifying and mobilizing cross-programmatic agency resources to conserve iconic landscapes whose future status depends on collaboration across multiple jurisdictions and interests. Many tools developed through the SWAP helped to identify these key landscapes. A primary example is the data describing the association of SGCN with Ecological Systems. Additionally, once Statewide Priority Landscapes are formally identified, the SWAP tools that allow spatial identification of priorities for conservation action will inform the development of place-based landscape conservation action plans in these Priority Landscapes.

***Arid Lands Initiative*** — The Washington Arid Lands Initiative represents a diverse assemblage of public, private and tribal interests working together to conserve and restore a viable, well-connected system of eastern Washington's arid lands and related freshwater habitats, sustaining native plant and animal communities, and supporting compatible local economies and communities. Partners include WDFW, Audubon Washington, US Fish and Wildlife Service, US Bureau of Land Management, Washington Department of Natural Resources, USDA Natural Resource Conservation Service, Washington Parks and Recreation Commission, The Nature Conservancy and others. This group is focused on developing and implementing a landscape conservation action plan for Washington's shrub-steppe and has identified priority areas for conservation. WDFW is currently working to identify which elements of the ALI action plan to integrate into our conservation actions. The SWAP tools will be used to inform which actions to prioritize on WDFW wildlife areas and which to integrate into our private lands incentive work.

***Landscape Conservation Cooperatives*** – Landscape Conservation Cooperatives (LCCs) are an initiative of the Department of Interior, designed to promote landscape and regional level strategies for understanding and responding to climate change and other natural resource threats across large geographies. Washington State is a part of two LCCs – the North Pacific and the Great Northern – and the agency is represented on the Steering Committee of both these entities. Both organizations have been interested in the development of the State SWAPs, in the interests of understanding how state priorities for species and habitat conservation relate to regional priorities and how regional efforts could be leveraged to advance state conservation priorities.

***Private Lands Incentive Programs*** — WDFW promotes, assists in the design of, and provides technical assistance for voluntary conservation programs that benefit private landowners, wildlife and the environment. This includes incentive programs through the Farm Bill such as the Conservation Reserve Program, Regional Collaborative Conservation Program, and State Acres for Wildlife Enhancement program, as well as Endangered Species Act programs such as Candidate Conservation Agreements with Assurances and Safe Harbor Agreements. WDFW will continue to tailor the development and application of these programs in Washington State so that they align with the SWAP. Each of these programs focuses on species that are identified as SGCN in Washington's SWAP (e.g. Greater Sage-grouse, Fisher, Pygmy Rabbit, and Ferruginous Hawk). Consequently, most of the SWAP tools will serve as sources of technical information to help guide the work of private lands biologists and managers that are initiating and implementing these important programs. The tools will also be used by the Wildlife Program's Lands Conservation and Restoration Section and the Habitat Program to develop and spatially direct existing and new private land incentive tools and easements. The ecological systems stressors and actions indicate which systems need these types of programs, and the spatial data allows us to identify where in the state to direct these needs through our work with Natural Resource Conservation Service (NRCS) and the State Technical Advisory Committee.

### 7.3.5 Science, Research, and Data Needs

***Identifying Research Needs*** — Each of our Department's resource programs have science divisions that are in charge of identifying and carrying out important fish and wildlife research. Much of this research is done to answer questions that will end up guiding many of the agency's decisions. The science divisions can use the SGCN and ecological systems fact sheets as a concrete tool to since each identifies research gaps for ESOC and SGCN that can be addressed through future agency research projects.

***Citizen Science Program*** — Spatial data produced in the SWAP along with fact sheet information will help the citizen science program identify the ecosystems and species in need of monitoring in Washington. Some of the data gaps outlined in the SWAP can be filled by our agency's network of citizen scientists. The SWAP tools can help to target their work to where multiple needs could be fulfilled efficiently and where those needs are most critical to the conservation of SGCN, and to biodiversity as a whole.

***Prioritizing Species Survey Needs*** — Each SGCN fact sheet in the SWAP, highlights actions needed to conserve the species or ecosystem. One such action is the need for surveys to better identify the range or distribution for SGCN that are lacking sufficient data. Consequently species fact sheets will provide additional guidance to the Department when deciding on which species require future surveys, and will help to prioritize among these species with similar needs.

## 7.4 Benefits to our Conservation Partners

Though Washington's Wildlife Action Plan will guide many of the Department's conservation activities over the next decade, it is by no means intended to be used solely by WDFW. In fact, early in the development of the SWAP, the agency sent out a survey to a broad range of current and potential conservation partners asking how the SWAP might help them to achieve their own related conservation objectives (see Chapter 8 – Outreach and Stakeholder Engagement)

This survey as well as the results from other briefings held during the development of the SWAP highlighted several activities that the SWAP could help inform, including:

- Updates to National Forest Planning;
- Identification of surrogate species through USFWS;
- GMA comprehensive planning;
- Biological assessments for National Forest Planning (e.g., with SWAP's mapping tools);
- Guiding the growth of cities to areas of most disturbance (e.g., SWAP cultural ecosystems);
- Identifying ALI private land demonstrate sites through use of stressors and actions in fact sheets along with mapped SWAP data;

- Prioritization of proposed Recreation and Conservation Office (RCO) grant recipients (e.g., SGCN and ESOC fact sheets and maps to guide ranking criteria); and,
- Prioritization of species and landscape conservation actions for tribal natural resource programs.

These are a few of the opportunities for leveraging the information in the SWAP to advance the goals of our conservation partners. The Department envisions working with partners to facilitate their orientation to and application of the SWAP tools to accomplish our shared goal to conserve, protect, and enhance fish and wildlife habitat statewide.

## 7.5 Future Implementation Needs

In the process of developing the SWAP, we identified a number of additional actions that would allow us to more effectively use and leverage the information and tools of the SWAP. These include the following:

**Build on the work and tools of the SWAP, including:**

- Developing a shared online platform to make all spatial and associated SWAP tools more easily available to department staffand conservation partners;
- Building a decision-support system to help resource and conservation planners outside of the agency more easily search out the most appropriate set of WDFW-developed tools;
- Developing a tool that allows us to spatially map key threats (using the Threats Matrix, ecological system maps and SGCN associations);
- Developing range maps for additional SGCN as new information becomes available;
- Further developing the priority landscapes initiative as a vehicle to translate the priorities for species and habitats identified through the SWAP into on the ground conservation action;
- Collaborating with Idaho Department of Fish and Game and Oregon Department of Fish and Wildlife regarding common objectives through our respective SWAP;
- Hosting workshops to thoroughly vet and build the climate vulnerability information with WDFW staff and our conservation partners;
- Increase our understanding and better account for the distribution of SGCN fishes in the ecological systems; and,
- Identify funding and partnership opportunities to address the research and data needs identified for SGCN and Ecological Systems of Concern.

State Wildlife Action Plan Update

# Appendix A-1

## Species of Greatest Conservation Need

## Fact Sheets

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# MAMMALS

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**Conservation Status and Concern**

**Biology and Life History**

**Distribution and Abundance**

**Habitat Needs**

**Stressors**

**Conservation Actions Needed**

Washington Department of Fish and Wildlife
2015

# Appendix A-1

## SGCN Mammals – Fact Sheets

# Table of Contents

# What is Included in Appendix A-1

**Introduction**
Appendix A-1 is one component of the State Wildlife Action Plan (SWAP) Update, and contains information about mammals included in our Species of Greatest Conservation Need (SGCN) list for 2015. Included are fact sheets for each of the mammals identified as Species of Greatest Conservation Need in the 2015 SWAP. The information provided includes a summary of the conservation concern and conservation status, a description of distribution and habitat, climate change sensitivity and an overview of key threats and conservation actions needed.

**Range and Habitat Distribution Maps**
For a selected number of species (those for which sufficient data was available), range and habitat distribution maps have been developed. The availability of range maps is indicated immediately under the name of the animal.

Separate documents are provided with similar information for birds (Appendix A2), amphibians and reptiles (Appendix A3), fish (Appendix A4) and invertebrates (Appendix A5).

**What it means to be an SGCN**
The SGCN list includes both animals that have some form of official protection status and those which may be in decline, but are not yet listed as part of either the Federal or State Endangered Species programs. One of the purposes of the SWAP is to direct conservation attention to species and habitats *before* they become imperiled and recovery becomes more difficult and costly. Presence on this list does not necessarily mean that conservation attention will be directed towards the animal; rather, that conservation actions for the species are *eligible* for State Wildlife Grants funding, and may be more competitive for other grant programs. It also raises the profile of an animal to a wide audience of conservation partners and may encourage other organizations to initiate projects that may benefit the species.

**Climate Vulnerability**
Please see Chapter 5 for an explanation of the methodology used to assess climate vulnerability. For a full list of all the SGCN ranks, including a narrative description of sensitivity and references, please see Appendix C.

**Explanation of terms used in the document**
Please see Section B (page 104) for a description of terms and abbreviations used in this document.

**Alphabetical List of Species**
For an alphabetical list of all the mammals included, please see Section A (page 92).

**References**
References are provided separately with each fact sheet, and also collectively for all SGCN mammals in the REFERENCES section at the end of this document.

# RABBITS

## AMERICAN PIKA (*Ochotona princeps*)

*See Appendix B for a range and potential habitat distribution map

**Conservation Status and Concern**

The American Pika is a montane talus habitat specialist that may face threats from climate change.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| None | None | No | G5 | S5 | Unknown/unknown | High |

**Biology and Life History**

Photo: S. Burgdorf

American Pikas are habitat specialists that live year-round in talus fields that are surrounded by meadows or forests, usually located above 8200 feet. Talus rocks generally range in size from 8 inches to 6.5 feet in diameter. The species is sensitive to temperatures above 78$^{o}$ F and relies on winter snow pack to insulate them from extreme cold conditions. Pikas are generalist herbivores that cache food in summer for winter consumption. Food sources typically include grasses, forbs, and leaves; ferns, moss and conifer needles may also be eaten depending on availability. Pikas reproduce in summer and may have two litters averaging one to three young/litter. However, usually only young born in the first litter survive to weaning. In most areas, births begin in May and peak in June, but young may be born as early as March in some low elevation areas. Young are dependent on their mother for at least 18 days, and are weaned as early as 3 to 4 weeks. Juveniles establish territories and hay piles in the summer of birth, but do not breed until their second summer. Maximum lifespan is 7 years.

**Distribution and Abundance**

American Pikas are found throughout the Cascade Mountains and at higher elevations of the northeast regions of Washington where suitable talus fields in close proximity to food resources are found. Although they are considered a high elevation species, Pika populations have been found at low elevations near sea level in the Columbia River Gorge and at selected locations in Snohomish and Skagit Counties as low as 1150 feet. Pika density is correlated with habitat size and quality. Population sizes and trends in Washington are unknown.

**Habitat**

Restricted to rocky talus slopes, primarily the talus-meadow interface. Often above tree line up to limit of vegetation. Also found at lower elevations in rocky areas within forests or near lakes. Occasionally on mine tailings, or piles of lumber or scrap metal. Does not dig burrows but may enlarge dens or nest sites under rock.

**References**

Bruggeman, J. E. 2011. Factors affecting pika populations in the North Cascades National Park Service Complex. Final Report, to North Cascades National Park Service, 110pp.
Smith, A. T. and M. L. Weston. 1990. *Ochotona princeps*. Mammalian Species 352:1-8.
Varner, J. and M. D. Dearing. 2014. Dietary plasticity in pikas as a strategy for atypical resource landscapes. Journal of Mammalogy 95:72-81.

### American Pika: Conservation Threats and Actions

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Climate change and severe weather | Climate change may be affecting species distribution and population trends. | Work with partners to better understand distribution of occupied sites; monitor to assess impacts of warming environment. | Nothing current - new action needed | Both |
| 2 | Fish and wildlife habitat loss and degradation | Disturbance to microclimate on talus slopes. Increase in rock climbing and bouldering at select American Pika sites in Columbia River Gorge. | Work with partners to better understand distribution of occupied sites; evaluate recreation intensity and access. | Current insufficient | Both |

NOTE: Numbers are for reference only and do not reflect priority.

## BLACK-TAILED JACKRABBIT (*Lepus californicus*)

*See Appendix B for a range and potential habitat distribution map

**Conservation Status and Concern**

Once abundant and broadly distributed in eastern Washington, the species is now rare and sparsely distributed due to habitat loss from fragmentation and possibly disease.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| None | Candidate | Yes | G5 | S2S3 | Low/declining | Moderate |

**Biology and Life History**

Photo: G. Lasley

Black-tailed Jackrabbits are herbivores that prefer green, succulent vegetation when available. In general, their diets are mainly grasses and forbs in summer and shrubs in winter. The species forages in the early mornings, late evenings and at night. Home ranges average less than 42 acres in size. Females are larger in body size than males. Males can breed after 7 months of age, but females typically do not breed during their first year. The length of the breeding season is variable and dependent on latitude and environmental factors. In Washington, breeding begins in February and extends through May. Females in the Pacific Northwest have up to two litters per year, with four to six kits born per litter. The gestation period ranges from 41 to 47 days. Females give birth to their young in shallow depressions (forms) in the soil. Young become independent of maternal care at two to three months of age. Most Black-tailed Jackrabbits do not live more than 1 year and maximum longevity is 7 to 8 years.

**Distribution and Abundance**

Populations in Washington are limited to the Columbia Plateau and are declining. Population size is small but additional surveys are needed to determine the species status.

**Habitat**

Black-tailed Jackrabbits occupy areas of shrub-steppe with sagebrush, rabbitbrush, and areas of mixed grass and sagebrush or rabbitbrush. This species prefers open, grass-dominated sites at night for feeding, and retreat to areas of shrub cover during the day.

**References**

Best, T. L. 1996. *Lepus californicus*. Mammalian Species 530:1-10.

Flinders, J. T. and J. A. Chapman. 2003. Black-tailed jackrabbit. Pp 126-146 in G. A. Feldhamer, B. C. Thompson, and J. A. Chapman, editors. Wild mammals of North America biology management and conservation, 2nd edition. Johns Hopkins University Press, Baltimore, Maryland.

**Black-tailed Jackrabbit: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Fish and wildlife habitat loss and degradation | Habitat loss and degradation of shrub-steppe and grasslands due to historic unsustainable grazing practices and invasion of exotic plants. | Conserve existing and restore degraded shrub-steppe and grassland habitats to provide necessary cover and food resources. | Current insufficient | Both |
| 2 | Fish and wildlife habitat loss and degradation | Conversion of grasslands and shrub-steppe to cropland. | Conserve existing and restore degraded shrub-steppe and grassland habitats affected by agriculture to provide necessary cover and food resources. Private landowner incentives such as CRP would be an example of beneficial habitat management. | Current insufficient | Both |
| 3 | Small population size | The species now only occupies a small portion of its historic range in the state and small sub-populations may be susceptible to local extinction. | Determine potential need and feasibility of reintroductions or augmentations to boost population. | Current insufficient | Both |
| 4 | Disease | Disease may have contributed to population declines. | Assess potential for Tularemia as a factor contributing to population decline. | Current insufficient | Both |
| 5 | Overharvesting of biological resources | Control of Black-tailed Jackrabbits through shooting, poisoning, and trapping may be a contributor to population declines. | Assess current levels of mortality due to these practices and take steps to minimize lethal control. | Current insufficient | Both |
| 6 | Resource information collection needs | Quantitative data on distribution and abundance are lacking. | Determine and map distribution; investigate cause of declines. | Current insufficient | Both |

NOTE: Numbers are for reference only and do not reflect priority.

## PYGMY RABBIT (*Brachylagus idahoensis*)

**Conservation Status and Concern**

The Columbia Basin Pygmy Rabbit, a distinct population segment (DPS) of this species, is a sagebrush obligate associated with shrub-steppe in eastern Washington. Large-scale loss and fragmentation of shrub-steppe habitat were likely the primary factors contributing to decline, but once the population dropped below a certain threshold, other factors such as environmental events (extreme weather and fire), predation, disease, and inbreeding likely became threats. A major recovery effort is currently underway for this species.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| Endangered (Columbia Basin DPS only) | Endangered | Yes | G4 | S1 | Low/increasing | Moderate-high |

**Biology and Life History**

Photo: P. Hendricks

This is the smallest rabbit species in North America and one of only two native rabbits known to dig its own burrows. Burrows are used for thermoregulation and safety from predators. Specialized natal burrows are excavated separate from residential burrows. Big sagebrush is the primary food source, comprising 90 percent of the winter diet, but grasses and forbs are also eaten in spring and summer. Activity occurs throughout the year. Pygmy Rabbits may be active at any time of day or night, but most activity is crepuscular. Breeding extends from February to July. Females have two to four litters per year, with up to six kits per litter. Predators include weasels, Coyotes, American Badgers, hawks, owls, and likely other carnivorous mammals and birds.

**Distribution and Abundance**

The Columbia Basin DPS is genetically distinct from the remainder of the species, and is believed to have been isolated for at least 10,000 years, perhaps much longer. Pygmy Rabbits were known from six relatively small, isolated populations in Central Washington in the 1990s. By 2001, only one population remained at Sagebrush Flat Wildlife Area (SBFWA) in Douglas County. In 2001, some of the remaining rabbits were captured and placed in a captive breeding program. Captive breeding was not able to produce sufficient numbers of rabbits for reintroduction and in 2011 a new strategy for recovery was developed. Semi-wild breeding in large (6 to 11 acre) enclosures was begun in Central Washington and offspring are released back to the wild. Future status depends on the success of this program.

**Habitat**

Due to its sagebrush and burrowing requirements, this species most often occurs in dense stands of big sagebrush growing in deep loose soils. Burrow systems are generally found on mounds or gentle slopes. Corridors of dense shrub cover connecting areas of suitable habitat are critical to recovery efforts.

**References**


US Fish and Wildlife Service (USFWS). 2012. Recovery plan for the Columbia Basin distinct population segment of the pygmy rabbit (*Brachylagus idahoensis*). U.S. Fish and Wildlife Service, Portland, Oregon.

WDFW 1995. Washington State recovery plan for the pygmy rabbit. Olympia, WA.

**Pygmy Rabbit: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Fish and wildlife habitat loss or degradation | Conversion of habitat to agriculture and development. Habitat fragmentation may hamper recovery efforts. | Use landowner incentives, conservation easements, Safe Harbor Agreements, and acquisitions to protect significant habitats. Coordinate with FSA, NRCS and USFWS. | Current insufficient | Both |
| 2 | Fish and wildlife habitat loss or degradation | Conversion of habitat to agriculture and development. Habitat fragmentation may hamper recovery efforts. | Recover species in the Columbia Basin through semi-wild breeding, releases, and translocations while working to recover habitat. | Current insufficient | Both |
| 3 | Resource information collection needs | Causes of the population decline in Washington are unknown, need to monitor status of reintroduced population closely to determine any potential problems and adjust accordingly. | Monitor reintroduced population for potential problems and success, and determine whether recovery actions are effective. Develop survey methods to efficiently detect long-distance dispersers from release sites. | Current insufficient | WDFW |
| 4 | Agriculture and aquaculture side effects | Livestock may cause degradation of shrub-steppe habitat (decreased quantity and quality of forage) and damage burrow systems. | Use land acquisitions, conservation easements and landowner agreements to protect significant habitats. Coordinate with FSA and NRCS. | Current insufficient | Both |
| 5 | Agriculture and aquaculture side effects | Old CRP lands do not provide suitable habitat for the species. | Continue to engage FSA and NRCS to encourage restoring old CRP habitat to native species through their various programs. | Current insufficient | Both |

NOTE: Numbers are for reference only and do not reflect priority.

## WHITE-TAILED JACKRABBIT (*Lepus townsendii*)

*See Appendix B for a range and potential habitat distribution map

**Conservation Status and Concern**

Once abundant and broadly distributed across the bunchgrass communities of eastern Washington, the species is now rare and sparsely distributed due to the loss, degradation, and fragmentation of habitat and possibly disease and competition with Black-tailed Jackrabbits.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| None | Candidate | Yes | G5 | S2S3 | Low/declining | Moderate |

**Biology and Life History**


Photo: Connormah

White-tailed Jackrabbits are nocturnal herbivores that feed primarily on grasses and forbs and secondarily on shrubs. Home ranges may extend 1.2 to 1.9 miles in diameter. Females are larger in body size than males. Individuals may begin to breed as early as 7 months of age. Breeding season begins in late February and may extend into May, with up to four litters produced per year. Nests for young are made of grasses and dry leaves and are hidden in vegetation. The gestation period may last from 30 to 43 days, depending on environmental factors, and the typical litter size is four or five young. Young become independent of maternal care at about 2 months of age. Maximum longevity is about 8 years. The species is typically more solitary than other hares.

**Distribution and Abundance**

This species was once common across the extensive grasslands of eastern Washington, but with the reduction of bunchgrasses due to overgrazing and encroachment of Black-tailed Jackrabbits, it is now rare and restricted primarily to the Okanogan Valley.

**Habitat**

Hilly, bunchgrass sites are preferred by White-tailed Jackrabbits. In winter, this species descends to sagebrush flats in valley bottoms. It rests by day in shallow holes dug in the ground at the bases of rocks or shrubs, and in winter rests in cavities connected by tunnels beneath the snow.

**References**

Dalquest, W. W. 1948. Mammals of Washington. University of Kansas Publications, Museum of Natural History 2:1-444.

Lim, B. K. 1987. *Lepus townsendii*. Mammalian Species 288:1-6.

**White-tailed Jackrabbit: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Fish and wildlife habitat loss or degradation | Habitat loss and degradation of shrub-steppe and grasslands due to historic unsustainable grazing practices and invasion of exotic plants. | Conserve existing and restore degraded shrub-steppe and grassland habitats to provide necessary cover and food resources. | Current insufficient | Both |
| 2 | Fish and wildlife habitat loss or degradation | Conversion of grasslands and shrub-steppe to cropland. | Conserve existing and restore degraded shrub-steppe and grassland habitats affected by agriculture to provide necessary cover and food resources. Private landowner incentives such as CRP would be an example of beneficial habitat management. | Current insufficient | Both |
| 3 | Population size | The species now only occupies a small portion of its historic range in the state and small sub-populations may be susceptible to local extinction. | Determine potential need and feasibility of reintroductions or augmentations to boost population. | Current insufficient | Both |
| 4 | Disease | Disease may have contributed to population declines. | Assess potential for Tularemia as a factor contributing to population decline. | Current insufficient | Both |
| 5 | Overharvesting of biological resources | Control of White-tailed Jackrabbits through shooting, poisoning, and trapping may be a contributor to population declines. | Assess current levels of mortality due to these practices and take steps to minimize lethal control. | Current insufficient | Both |

NOTE: Numbers are for reference only and do not reflect priority.

# SHREWS

## DESTRUCTION ISLAND SHREW (*Sorex trowbridgii destructioni*)

**Conservation Status and Concern**

This subspecies is endemic to Destruction Island. Its status and biology have not been assessed, but it may be threatened by herbivory from introduced European Rabbits.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| Species of Concern | None | No | G5T1Q | S1 | Unknown/unknown | Low-moderate |

**Biology and Life History**

This small shrew is a subspecies of Trowbridge's Shrew. It is primarily insectivorous, but also feeds on spiders, worms, and centipedes. It is active year-round.

Photo: UC Santa Cruz

**Distribution and Abundance**

This subspecies occurs only on Destruction Island in Jefferson County. Thirty specimens were collected in 1941 and six more were taken in 1983. The apparent decline in trapping success between these two capture efforts suggests a possible population decline. No further information on population status has been gathered since 1983.

**Habitat**

Grass, areas bordering brush, and human structures are the primary habitats of this shrew on Destruction Island.

**References**


Aubry, K. B., and S. D. West. 1984. The status of native and introduced mammals on Destruction Island, Washington. Murrelet 65:80-83.

Johnson, R. E., and K. M. Cassidy. 1997. Mammals of Washington state: location data and modeled distributions. Washington State GAP Analysis, Volume 3. Washington Cooperative Fish and Wildlife Research Unit, Seattle, Washington.

NatureServe. 2014. NatureServe Explorer: an online encyclopedia of life [web application]. Version 7.1. NatureServe, Arlington, Virginia. <http://explorer.natureserve.org> (accessed November 24, 2014).

**Destruction Island Shrew: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Resource information collection needs | Status and life history have not been assessed. | Current status and life history should be assessed. | Current insufficient | Both |
| 2 | Invasive and other problematic species | Herbivory by introduced European Rabbits may be causing a decline in habitat quality. | Eradication of European Rabbits is needed on Destruction Island. | Current insufficient | Both |

NOTE: Numbers are for reference only and do not reflect priority.

## MERRIAM'S SHREW (*Sorex merriami*)

**Conservation Status and Concern**

This relatively little known species appears rare but widespread in much of the Columbia Basin and several adjoining localities of eastern Washington. Additional sampling is needed to clarify its status. It may be threatened by habitat loss and fragmentation, and by the invasion of cheatgrass, which is probably detrimental by increasing the occurrence of wildfires.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| None | Candidate | Yes | G5 | S3S4 | Unknown/unknown | Low-moderate |

**Biology and Life History**

Merriam's Shrew is an insectivore that appears adapted to feeding on hard-bodied prey. Diet includes spiders, beetles, caterpillars, crickets, and wasps. Shrews are active year-round and forage under the snow in colder regions. In Washington, pregnant females have been captured from April to July, and nursing females in March, July, and October. Litter size ranges from five to seven young.

From Ingles 1965

**Distribution and Abundance**

This species occurs throughout much of the western United States. In Washington, it inhabits much of the Columbia Basin and its margins. A record in the southern Okanagan region of British Columbia suggests it probably also occurs in Okanogan County, Washington. No estimates of population size or density are available for Washington, but the species appears relatively rare. Where present, trapping effort generally requires at least several hundred trap nights for each individual captured. Population trends can only be hypothesized from the reduction in shrub-steppe habitats. Less than 50 percent of the historical shrub-steppe in Washington remains and much of the remainder is fragmented and degraded by wildfires, cheatgrass, and unsustainable grazing in the past.

**Habitat**

In Washington, Merriam's Shrew is generally found in sagebrush-bunchgrass habitats, especially in areas with Big Sagebrush, rabbitbrush, and bitterbrush. In other states, they have been captured in mountain-mahogany, pinyon-juniper, conifer woodlands, shortgrass prairie, and in wetlands or riparian situations within drier habitats.

**References**

Johnson, M. L., and C. W. Clanton. 1954. Natural history of *Sorex merriami* in Washington state. Murrelet 35:1- 4.

Johnson, R. E., and K. M. Cassidy. 1997. Mammals of Washington state: location data and modeled distributions. Washington state GAP analysis, Volume 3. Washington Cooperative Fish and Wildlife Research Unit, Seattle, Washington.

Verts, B. J., and L. N. Carraway. 1998. Land mammals of Oregon. University of California Press, Berkeley, California.

### Merriam's Shrew: Conservation Threats and Actions

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Resource information collection needs | Population status and life history have not been well assessed in Washington. | Current status and life history should be assessed. | Current insufficient | Both |
| 2 | Fish and wildlife habitat loss and degradation | Habitat loss and fragmentation have likely impacted the population. | Use landowner incentives, conservation easements, and acquisitions to protect significant habitats. Initiate efforts to restore and manage habitats. | Current insufficient | Both |
| 3 | Invasive and other problematic species | Invasion of shrub-steppe by cheatgrass and other non-native plants has degraded habitats through increased fire occurrence and other processes. | Restore and manage habitats degraded by invasive species. | Current insufficient | Both |

NOTE: Numbers are for reference only and do not reflect priority.

## PREBLE'S SHREW (*Sorex preblei*)

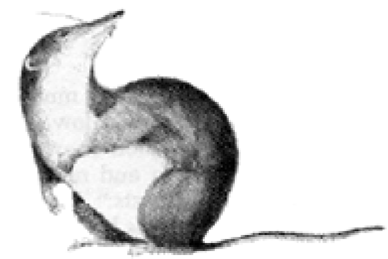
### Conservation Status and Concern

Preble's Shrew is a poorly known species that appears to be extremely rare in Washington; additional sampling is needed to understand distribution, habitat needs, and factors that affect populations.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| Species of Concern | Candidate | Yes | G4 | S1 | Unknown/unknown | Low-moderate |

### Biology and Life History

Preble's Shrew is an insectivore; mandible morphology suggests a diet of soft-bodied invertebrates, such as spiders and grubs. Litter size is estimated to be three to six young. Shrews are active throughout the year and forage under the snow in colder regions. Life expectancy is less than 1.5 years.



From Ingles 1965

### Distribution and Abundance

As currently recognized, the range of Preble's Shrew includes southern British Columbia, south to northeastern California, northern Nevada and Utah and east to western Wyoming and Colorado, and south to New Mexico and north to include much of Montana. However, a future taxonomic revision may split the species, restricting the name *S. preblei* to populations in Washington, Oregon, British Columbia, California and Nevada. In Washington, the only records of Preble's Shrew were from the Blue Mountains in 1956 to 1958, until 2004 when a single specimen was captured in Douglas County. There are no density estimates or data on population numbers in Washington or elsewhere. Preble's Shrews seem to be very rare, though this may partly be an artifact of inadequate sampling. Population trends can only be hypothesized from the reduction in steppe habitats; less than 50 percent of the historical shrub-steppe in Washington remains and much of the remainder is fragmented and degraded.

### Habitat

Preble's Shrews are most often associated with sagebrush and grasses, but have been collected in a wide variety of habitats, including subalpine shrubland, whitebark pine, and wetlands. In Washington, Preble's Shrews have been captured in dense lodgepole pine, dense subalpine fir/lodgepole, and grand fir/Engelmann spruce forest at 5000 to 6000 feet in the Blue Mountains, which is rather atypical habitat for the species. It was also recently captured in a Conservation Reserve Program grassland.

#### References


Carraway, L. N., and B. J. Verts. 1999. Records of reproduction in *Sorex preblei*. Northwestern Naturalist 80:115-116.

Cornely, J. E., L. N. Carraway, and B. J. Verts. 1992. *Sorex preblei*. Mammalian Species 416:1-3.

Gitzen, R. A., J. E. Bradley, M. R. Kroeger, and S. D. West. 2009. First record of Preble's Shrew (*Sorex preblei*) in the northern Columbia Basin, Washington. Northwestern Naturalist 90: 41-43.

Hope, A. G., K. A. Speer, J. R. Demboski, S. L. Talbot, and J. A. Cook. 2012. A climate for speciation: rapid spatial diversification within the *Sorex cinereus* complex of shrews. Molecular Phylogenetics and Evolution 64: 671–684.

Johnson, R. E., and K. M. Cassidy. 1997. Mammals of Washington state: location data and modeled distributions. Washington State GAP Analysis, Volume 3. Washington Cooperative Fish and Wildlife Research Unit, Seattle, Washington.

**Preble's Shrew: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Resource information collection needs | Lack of data on current distribution and population status. | Determine distribution and population status. | Current insufficient | Both |
| 2 | Resource information collection needs | Lack of adequate information on threats. | As better population distribution information is obtained, assess threats that may exist. | Current insufficient | Both |

NOTE: Numbers are for reference only and do not reflect priority.

# BATS

## HOARY BAT (*Lasiurus cinereus*)

*See Appendix B for a potential range and habitat distribution map

### Conservation Status and Concern

This is a widely distributed migratory bat that is vulnerable to mortality from wind turbines during migration. It also faces threats from habitat alteration throughout its range.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| None | None | No | G5 | S3 | Moderate/unknown | Low-moderate |

### Biology and Life History


Photo: Humboldt State

The Hoary Bat is the largest bat in Washington and is named for its distinctive brownish-grey, white-tipped pelage. Hoary Bats are relatively fast fliers with limited maneuverability that tend to favor open areas for foraging. They feed chiefly on large moths and to a lesser extent on other insects. Hoary Bats roost in the open foliage of deciduous and coniferous trees. Unlike most bat species that aggregate in maternity colonies, females with young roost solitarily and select trees that provide shelter from wind, stable sunlight exposure, and are near a clearing. Females typically give birth to one litter of twins in May and June, although up to four pups have been documented. Young are slow to develop and are capable of sustained flight at about 5 weeks of age. However, they remain with their mothers for several weeks after they begin flying. Males roost solitarily.

### Distribution and Abundance

Hoary Bats are the most widely distributed bat species in North America and are found throughout Washington in forested areas with associated clearings, from sea level to at least 5300 feet. They occur in the Columbia Basin if trees are available and sometimes in arid steppe during migration. Hoary Bats are resident in summer and considered to be a migratory species. In Washington, migrating individuals have been documented in spring and fall; however a few records document presence in winter. Winter range is unknown, but presumed to be located in southern California and Mexico.

**Habitat**

Habitat includes primarily deciduous and coniferous forests and woodlands, including areas altered by humans. Roost sites are usually in tree foliage 10 to 16 feet above the ground, with dense foliage above and open flying room below, often at the edge of clearings. In Saskatchewan, reproductive females roosted on the south (especially southeast) side of white spruce trees, where wind speed was reduced.

**References**


Hayes, G. and G. J. Wiles. 2013. Washington bat conservation plan. Washington Department of Fish and Wildlife, Olympia, Washington.

Klug, B. J., D. A. Goldsmith and R. M. R. Barclay. 2012. Roost selection by the solitary, foliage-roosting hoary bat (*Lasiurus cinereus*) during lactation. Canadian Journal of Zoology 90:239-336.

Nagorsen, D. W. and R. M. Brigham. 1993. The bats of British Columbia. UBC Press, Vancouver, British Columbia.

Willis, C. K. R. and R. M. Brigham. 2005. Physiological and ecological aspects of roost selection by reproductive female hoary bats (*Lasiurus cinereus*). Journal of Mammalogy 8:85-94.


## Hoary Bat: Conservation Threats and Actions

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Energy development and distribution | The species is highly susceptible to mortality from wind energy facilities. | Monitor wind farms for mortality, avoid siting wind farms in areas of high bat activity, and encourage power companies to curtail wind turbine use during periods of low wind speeds. | Current insufficient | Both |
| 2 | Fish and wildlife habitat loss or degradation | Logging and conversion to younger even-aged forest stands likely reduces the quality of roosting habitat. | Encourage logging techniques that maintain complex forest structure and large trees and snags. | Current insufficient | Both |
| 3 | Resource information collection needs | Better information is needed on migration behavior and routes, and the extent that individuals winter in WA. | Conduct research on migration patterns. | Current insufficient | Both |
| 4 | Resource information collection needs | Better information is needed on habitat requirements and population status. | Conduct research on habitat requirements and population status. | Current insufficient | Both |

NOTE: Numbers are for reference only and do not reflect priority.

## KEEN'S MYOTIS (*Myotis keenii*)

**Conservation Status and Concern**

In Washington, this species is poorly known and probably rare. Loss of large decadent trees and snags is likely an important threat.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| None | Candidate | Yes | G2G3 | S1 | Low/unknown | Moderate-high |

**Biology and Life History**


Photo: Alaska Dept. Fish & Game

Keen's Myotis is one of three small, long-eared myotis bats in Washington. It is so morphologically similar to the western long-eared bat (*M. evotis*) that species determination between the two is based on small skeletal differences and the two may actually be one species. Keen's Myotis flies rather slowly while foraging and is adapted to eat a variety of insects including spiders, caddis flies, moths, and flies. It is able to glean prey as well as gather prey on the wing. Its physical characteristics of long ears, short, broad wings, and high frequency, low intensity echolocation are adaptations that enhance the ability to fly and forage in structurally complex forests. Keen's Myotis females return to maternity colonies in May and give birth to a single pup between early June and mid- to late July. Males roost solitarily. Hibernation begins in late summer or fall.

**Distribution and Abundance**

This species has one of the smallest ranges of any North American bat, occurring in coastal areas from southeast Alaska to northwestern Washington, including the Olympic Peninsula and Puget Sound. Abundance in Washington is unknown, but it is assumed to be rare. Trend is unknown.

**Habitat**

Keen's Myotis is closely associated with low elevation, moist, mature coastal conifer forests during the active season and may move to hibernacula in mid-elevation caves for winter. Summer roosts are in tree cavities, snags, rock crevices, small caves, and buildings. The few documented maternity sites have been found in caves and trees. Males often roost in large trees or snags. Roost sites may be limiting in some parts of the range. Foraging occurs more frequently in mature and old growth forests than clearcuts or young forests; riparian areas are likely important foraging habitats.

**References**


Chatwin, T. 2004. Keen's long-eared myotis. British Columbia Ministry of Water, Land & Air Protection, Surrey, B.C. <http://wlapwww.gov.bc.ca/wld/identified/documents/Mammals/m_keensmyotis.pdf.>

COSEWIC. 2003. COSEWIC assessment and update status report on Keen's long-eared bat *Myotis keenii* in Canada. Committee on the Status of Endangered Wildlife in Canada, Ottawa, Ontario.

Hayes, G. and G. J. Wiles. 2013. Washington bat conservation plan. Washington Department of Fish and Wildlife, Olympia, Washington.

**Keen's Myotis: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Resource information collection needs | Species requirements may be misunderstood because of speciation question. | Conduct a full genetic analysis to understand relationship with western long-eared bats and to determine species identification traits. | Current insufficient | External |
| 2 | Resource information collection needs | Better understanding of habitat requirements is needed. | Conduct research to understand habitat relationships, including year-round roosting requirements. | Current insufficient | Both |
| 3 | Resource information collection needs | Lack of adequate information on threats. | As better population distribution is obtained, assess threats that may exist. | Current insufficient | Both |

NOTE: Numbers are for reference only and do not reflect priority.

## SILVER-HAIRED BAT (*Lasionycteris noctivagans*)

*See Appendix B for a potential range and habitat distribution map

**Conservation Status and Concern**

Although relatively common in much of Washington, Silver-haired Bats experience extensive mortality at wind turbines. Loss of large roost trees and snags locally and along migration routes is another important concern.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| None | None | No | G5 | S3 | Moderate/unknown | Low-moderate |

**Biology and Life History**

Photo: B. Fenton

The Silver-haired Bat is a medium-sized bat with very dark pelage tipped with silver or white. In Washington, some individuals migrate while others hibernate. Males and females occupy separate summer ranges throughout much of their range, but in Washington, the trend towards summer habitat separation may be less pronounced. Silver-haired Bats probably breed in fall and winter, with fertilization delayed until spring. One or two pups are born in June or July. Lactating females roost in small colonies of typically 5 to 25 individuals in the cavities of large dead or dying trees. Males and non-reproductive females roost solitarily in cavities or under loose bark of large decaying trees. Young are able to fly at about three weeks. Silver-haired Bats forage on a variety of small to medium-sized flying insects, especially moths and flies, over water bodies within forested areas. They winter alone or in small groups; both sexes may be found together. Non-migrating individuals may hibernate in trees as well as man-made structures. Wintering Silver-haired Bats may rouse from torpor and forage in western Washington when conditions are sufficiently warm.

**Distribution and Abundance**
Silver-haired Bats occur broadly across North America, from southeastern Alaska to northeastern Mexico. They are documented throughout Washington, predominantly where forest and riparian habitats occur. Surveys indicate that the species is relatively common in a number of areas of the state, but population trend is unknown.

**Habitat**
Silver-haired Bats occupy forests and riparian areas. They prefer uneven-aged forests with large dead and dying trees that offer structural complexity rather than intensively managed, even-aged stands. Large snags provide suitable roosts trees and a multi-layered canopy structure is favorable to flying and foraging. They are also sometimes found in man-made structures, especially during migration or hibernation.

**References**
Hayes, G. and G. J. Wiles. 2013. Washington bat conservation plan. Washington Department of Fish and Wildlife, Olympia, Washington.
Nagorsen, D. W. and R. M. Brigham. 1993. The bats of British Columbia. UBC Press, Vancouver, British Columbia.

**Silver-haired Bat: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Energy development and distribution | The species is highly susceptible to mortality from wind energy facilities. | Monitor wind farms for mortality, avoid siting wind farms in areas of high bat activity, and encourage power companies to curtail wind turbine use during periods of low wind speeds. | Current insufficient | Both |
| 2 | Fish and wildlife habitat loss or degradation | Logging and conversion to younger even-aged forest stands probably reduces the quality of roosting habitat. | Encourage logging techniques that maintain complex forest structure and large trees and snags. | Current insufficient | Both |
| 3 | Resource information collection needs | Better information is needed on migration behavior and routes, and the extent that individuals winter in WA. | Conduct research on migration patterns. | Current insufficient | Both |
| 4 | Management decision needs | Better information is needed on habitat requirements and population status. | Conduct research on habitat requirements and population status. | Current insufficient | Both |

NOTE: Numbers are for reference only and do not reflect priority.

## SPOTTED BAT (*Euderma maculatum*)

*See Appendix B for a potential range and habitat distribution map

**Conservation Status and Concern**

Individual populations are apparently disjunct and may be vulnerable to human disturbance. Population trends, life history, and habitat requirements are unknown.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| None | Monitor | No | G4 | S3 | Low/unknown | Low |

**Biology and Life History**

Photo: P. Cryan

The Spotted Bat is a relatively large bat identified by its large pink ears and white spots on dark pelage. It is one of the few bats with a call audible to humans that resembles insect-like high-pitched metallic clicks. Spotted Bats are aerial insectivores that feed on medium-sized moths, especially noctuid moths. This species is solitary and is never found in colonies. Females produce one young per year between mid-June to early July. Individuals forage alone, visiting several sites a night and returning to them over consecutive evenings. Day roosts are located in sheer, high cliffs. Night roosts are seldom used. Wintering behavior is poorly understood, but the species presumably hibernates near its summer range.

**Distribution and Abundance**

The Spotted Bat inhabits arid environments in western North America from south-central British Columbia to central Mexico; the core area of its distribution appears to be the southwestern United States. It was not known in Washington until 1991 but is now documented in seven eastern Washington counties. Populations are likely disjunct and highly localized around suitable roosting cliffs and water sources and absent in intervening areas. Population size in Washington is probably relatively small, and trend is unknown.

**Habitat**

Spotted Bat presence is most dependent on the availability of high, sheer cliffs in arid land, but in Washington and the Okanogan Valley of British Columbia, they forage over a variety of habitats adjacent to cliffs, including ponderosa pine forests, hay fields, rock cliffs, talus slopes, sagebrush bunch grass, sparse ponderosa pine bunchgrass, rivers, open water, and hardwood slopes. The presence of cliffs with suitable roosting crevices determines species presence. Occupied sites in Washington range in elevation from 980 to 2790 feet.

**References**

Hayes, G. and G. J. Wiles. 2013. Washington bat conservation plan. Washington Department of Fish and Wildlife, Olympia, Washington.

Luce, R. J. and D. Keinath. 2007. Spotted bat (*Euderma maculatum*): a technical conservation assessment. USDA Forest Service, Rocky Mountain Region, Golden, Colorado.

**Spotted Bat: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Resource information collection needs | Develop good census techniques that will help determine population status and trends. | Conduct research and surveys to determine populations and habitat requirements. | Current insufficient | Both |
| 2 | Resource information collection needs | Lack of adequate information on threats. | As better population distribution is obtained, assess threats that may exist. | Current insufficient | Both |

NOTE: Numbers are for reference only and do not reflect priority.

## TOWNSEND'S BIG-EARED BAT *(Corynorhinus townsendii)*

**Conservation Status and Concern**

This species occurs in small to moderately-sized aggregations at sites throughout the state, where it may be vulnerable to human disturbance during the breeding and wintering periods.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| None | Candidate | Yes | G4 | S2S3 | Low/stable | Moderate-high |

**Biology and Life History**

Females form nursery colonies seldom exceeding 100 adults; males roost separately (apparently solitary) during this time. Nearly all adult females breed every year. Flight activity usually begins well into the night, late relative to other bats. After an initial feeding period, these bats rest at night roosts, presumably before a later feeding bout. Individuals commonly arouse in winter, changing position within a hibernaculum or moving to a nearby cave or mine. Most are lethargic at air temperatures below 62°F. This species is relatively sedentary, with no evidence of long migrations. Most recaptures occur at the banding site or usually not more than a couple miles away. Foraging movements probably rarely exceed 11 miles. Solitary males and small groups of females are known to hibernate in buildings.

Photo: W. Leonard

**Distribution and Abundance**

Townsend's Big-eared Bats occur at scattered locations throughout Washington. Population size is probably relatively small, but trend may be stable.

**Habitat**

This species inhabits lowland conifer and deciduous forests, montane conifer forest, ponderosa pine forest and woodland, riparian forest, shrub-steppe, and open fields. Maternity and hibernation colonies typically are in caves, mine tunnels, and old buildings. Caves, tunnels, buildings and tree cavities are used as night roosts. Relatively cold places are preferred for hibernation, often near entrances and in well-ventilated areas.

**References**


Gruver, J. C. and D. A. Keinath. 2006. Townsend's big-eared bat (*Corynorhinus townsendii*): a technical conservation assessment. Rocky Mountain Region. USDA Forest Service, Golden, Colorado.

Hayes, G. and G. J. Wiles. 2013. Washington bat conservation plan. Washington Department of Fish and Wildlife, Olympia, Washington.

Pierson, E. D., M. C. Wackenhut, J. S. Altenbach, P. Bradley, P. Call, D. L. Genter, C. E. Harris, B. L. Keller, B. Lengus, L. Lewis, B. Luce, K. W. Navo, J. M. Perkins, S. Smith, and L. Welch. 1999. Species conservation assessment and strategy for Townsend's big-eared bat (*Corynorhinus townsendii townsendii* and *Corynorhinus townsendii pallascens*). Idaho Conservation Effort, Idaho Department of Fish and Game, Boise, Idaho.


### Townsend's Big-eared Bat: Conservation Threats and Actions

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Energy development and distribution | Reclamation of abandoned mines, and vandalism and disturbance of maternity roosts and hibernacula threatens roosting aggregations. | Construct bat-friendly gates on caves and mine structures to address human safety concerns and preserve maternity and hibernacula for bats. | Current insufficient | Both |
| 2 | Agriculture and aquaculture side effects | Silvicultural practices may result in short rotation forestry that limits the development and retention of snags suitable as roosting sites and high stocking densities that diminish foraging habitat. | Implement silvicultural practices that result in development and retention of large snags in lowland and upland topographic positions and manage for more open understory conditions that mimic natural disturbance regimes in west-side and east-side forests. Provide habitat buffers for important caves. | Current insufficient | Both |
| 3 | Agriculture and aquaculture side effects | Pesticide spraying in forests and agricultural areas near roosting and foraging sites that kill moths, a major prey of this species. | Limit pesticide spraying to control outbreaks of moth pests. | Current insufficient | External |

NOTE: Numbers are for reference only and do not reflect priority.

# RODENTS

## BRUSH PRAIRIE POCKET GOPHER (*Thomomys talpoides douglasii*)

*See Appendix B for a potential range and habitat distribution map

**Conservation Status and Concern**

Current status and distribution of the Brush Prairie Pocket Gopher in Washington is unknown. It is known only from southwestern Clark County, a developing urban/suburban area.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| None | None | No | G5T1T2 | S2 | Unknown/unknown | Low-moderate |

**Biology and Life History**


Photo: National Park Service

This pocket gopher is a subspecies of the Northern Pocket Gopher, the species commonly found in eastern Washington. Pocket gophers are the only truly subterranean rodents in North America, and thus are rarely observed above-ground. They are herbivores that require grasses and forbs to eat, and well-drained soil for burrowing, and are generally territorial and solitary outside the reproductive season. Females produce one litter of four to six young each year. Young are born in March to June. After weaning, female offspring often establish a burrow system nearby, but male offspring disperse. Burrows include foraging tunnels and chambers for nesting and caching of food. Though territorial, burrow systems are often aggregated in favorable habitat. Pocket gophers are ecologically important as prey items and in influencing soils and plant species diversity, and their burrows are a retreat for amphibians, reptiles, and many invertebrates. Pocket gopher predators include owls, hawks, Coyotes, and Bobcats.

**Distribution and Abundance**

Brush Prairie Pocket Gopher distribution in Washington is limited to southwestern Clark County. Population size and trend are unknown. The lack of recent confirmed records suggests it may be extinct.

**Habitat**

This species inhabits open grassy areas, including pastures, prairies, savannas, and open early seral woodlands and forests. It requires well-drained soil for burrowing.

**References**

Johnson, R. E., and K. M. Cassidy. 1997. Mammals of Washington state: location data and modeled distributions. Washington State GAP Analysis, Volume 3. Washington Cooperative Fish and Wildlife Research Unit, Seattle, Washington.

**Brush Prairie Pocket Gopher: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Resource information collection needs | Lack of data on current status and distribution. | Determine population status and distribution. | Current insufficient | Both |
| 2 | Resource information collection needs | Lack of information on current threats. | If this subspecies remains extant, determine threats that may exist. | Current insufficient | Both |

NOTE: Numbers are for reference only and do not reflect priority.

## GRAY-TAILED VOLE (*Microtus canicaudus*)

**Conservation Status and Concern**

Gray-tailed Voles are probably still common in pastures and grassy roadsides in Clark County, but current status and distribution is uncertain; southwestern Clark County is a developing urban/suburban area.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| None | Candidate | Yes | G4 | S2 | Unknown/unknown | N/A |

**Biology and Life History**


Photo: J. Gervais

Breeding likely takes place throughout the year. Litter size averages about 5 young. In the lab, females as young as 18 days of age were capable of mating and subsequently produced viable offspring. This species exhibits extreme population fluctuations like other members of its genus. Owls, hawks, foxes, skunks, and domestic and feral cats are common predators. Gray-tailed Voles eat a wide variety of green plants, including grasses, sedges, and forbs, such as clover, wild onions, and false dandelion. They construct intricate runway and burrow systems. Nests are built underground or above ground beneath boards, bales, and debris scattered in fields. Burrows are dug in soil or placed under fallen log debris.

**Distribution and Abundance**

Species distribution is limited to the lower elevations of Clark County, Washington, and the Willamette Valley of Oregon. Populations can be locally abundant. Population status and trends in Clark County are unknown.

**Habitat**

Gray-tailed Voles occur in hayfields, pastures, fallow grassy areas, and grain fields. In Oregon, Gray-tailed Voles are associated almost exclusively with agricultural lands, especially grasses grown for seed, small grains, and permanent pastures of legumes and grasses. The species also exists along grassy highway and railroad rights-of-way.

**References**
Johnson, R. E., and K. M. Cassidy. 1997. Mammals of Washington state: location data and modeled distributions. Washington State GAP Analysis, Volume 3. Washington Cooperative Fish and Wildlife Research Unit, Seattle, Washington.
Verts, B. J. and L. N. Carraway. 1998. Land mammals of Oregon. University of California Press, Berkeley, California.
Verts, B. J. and L. N. Carraway. 1987. *Microtus canicaudus*. Mammalian Species 267:1-4.

**Gray-tailed Vole: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Resource information collection needs | Lack of data on current status and distribution. | Determine population status and distribution. | Current insufficient | Both |
| 2 | Resource information collection needs | Lack of information on current threats. | Determine threats to the population. | Current insufficient | Both |

NOTE: Numbers are for reference only and do not reflect priority.

## KINCAID MEADOW VOLE (*Microtus pennsylvanicus kincaidi*)

*See Appendix B for a potential range and habitat distribution map

**Conservation Status and Concern**
The Kincaid Meadow Vole is a unique subspecies endemic to eastern Washington. Its distribution is poorly defined and there is little current information on the status of populations.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| None | Monitor | No | G5T3 | S2 | Low/unknown | Low-moderate |

**Taxonomic note:** Specimens at the Slater Museum, University of Puget Sound, from Stevens and Pend Oreille Counties and labeled as this subspecies need to be reexamined and confirmed. A comprehensive taxonomic review of the entire species is warranted. An alternate common name is the "Potholes Meadow Vole."

**Biology and Life History**
This large, isolated subspecies of Meadow Vole is poorly known. Meadow Vole diet consists mainly of grasses, sedges, seeds, roots, bark, and occasionally animal matter. Kincaid Meadow Voles create distinct runways in dense cover and build a round nest of leaves and stems. Meadow Voles can be prolific. Peak breeding activity occurs April to October, but they may breed throughout the year, when snow provides an insulating layer. Litter size averages four to six. Young are weaned in 10 to 14 days and are sexually mature 2 to 3 weeks later.


*Microtus pennsylvanicus* Photo: J. White

**Distribution and Abundance**

The Kincaid Meadow Vole may be endemic to Grant and Lincoln Counties. Records exist for sites 10 miles south of Moses Lake, along Crab Creek north of Moses Lake, north to Coulee City, and east to Sylvan Lake. There are specimens of *M. pennsylvanicus* from Adams, Lincoln, and extreme northern Grant Counties that either extend the range of *M. p. kincaidi* or belong to *M. p. funebris* or possibly an undescribed subspecies, but the taxonomic affinities of these specimens have not been examined in detail. Populations may undergo cyclic fluctuations in abundance every 2 to 5 years. Current population size and trend are unknown.

**Habitat**

Kincaid Meadow Voles are found in damp meadows, marshy areas along creeks, and around lakes within the otherwise semi-arid Columbia Basin.

**References**

Booth, E. S. 1947. Systematic review of the land mammals of Washington. Ph.D. Dissertation, State College of Washington, Pullman, Washington.

Dalquest, W. W. 1948. Mammals of Washington. University of Kansas Publications, Museum of Natural History 2:1-444.

MacDonald, S. O., J. A. Cook, G. L. Kirkland, Jr, and E. Yensen. 1998. *Microtus pennsylvanicus* (Ord 1815) meadow vole. Pp. 99-100 in D. J. Hafner, E. Yensen, and G. L. Kirkland, Jr. (compilers and editors). North American rodents: status survey and conservation action plan. IUCN/SSC Rodent Specialist Group, IUCN, Gland, Switzerland and Cambridge, United Kingdom.

### Kincaid Meadow Vole: Conservation Threats and Actions

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Resource information collection needs | Lack of data on current status and distribution. | Determine population status and distribution. | Current insufficient | Both |
| 2 | Resource information collection needs | Lack of information on current threats. | Determine threats to the population. | Current insufficient | Both |

NOTE: Numbers are for reference only and do not reflect priority.

## MAZAMA POCKET GOPHER (*Thomomys mazama*)

**Conservation Status and Concern**

Some subspecies are threatened by habitat loss from human development. Species existence is compatible with some levels of development, but high density development likely leads to extirpation.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| Threatened* | Threatened | Yes | G4 | S2 | Low/declining | Low-moderate |

*Federally threatened only in Thurston and Pierce Counties.

**Taxonomic note:** Recent research suggests a revision of recognized subspecies may be appropriate, but additional data are needed.

**Biology and Life History**

Photo: R. Gilbert

Pocket gophers are the only truly subterranean rodents in North America and are rarely observed above-ground. They are herbivores that require grasses and forbs for food and well-drained soil for burrowing. They are generally territorial and solitary outside the reproductive season. Mazama Pocket Gophers produce one litter per year, with an average litter size of five young. After weaning, female offspring often establish a burrow system nearby, but male offspring disperse. Burrows include foraging tunnels and chambers for nesting and caching of food. Though territorial, burrow systems are often aggregated in favorable habitat. Pocket gophers are ecologically important as prey items and in influencing soils and plant species diversity, and their burrows are a retreat for amphibians, reptiles, and many invertebrates. Pocket gopher predators include owls, Coyotes, and Bobcats.

**Distribution and Abundance**

Mazama Pocket Gophers occur in grasslands in Thurston, Pierce, and Mason Counties, and on a few alpine meadows in Olympic National Park. Washington has six described subspecies; three occur in Thurston County; and Pierce County, Mason County, and the Olympic Mountains each contain different subspecies. Two other subspecies, one near Tacoma and one in Wahkiakum County, appear to be extinct. Historically, the species was more widespread on south Puget Sound prairies, but was reduced by habitat loss caused by development, agriculture, and succession or planting of trees and shrubs. Other subspecies of Mazama Pocket Gopher occur in western Oregon and northern California. Population sizes for the different subspecies are unknown, but trends are declining for those in Thurston and Pierce Counties.

**Habitat**

This species occurs in grasslands, including glacial outwash prairies, pastures, subalpine meadows, and occasionally clearcuts or Christmas tree farms. Requires well-drained soil for burrowing and appears to be most abundant in loamy sand soil types. It is absent from areas with clay soil or seasonal flooding.

**References**

Stinson, D. W. 2013. Draft Mazama pocket gopher status update and Washington state recovery plan. Washington Department of Fish and Wildlife, Olympia, Washington.

**Mazama Pocket Gopher: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Fish and wildlife habitat loss or degradation | Loss and fragmentation of prairie/grassland habitat. | Acquire lands and easements in strategic locations and restore habitat. | Current insufficient | Both |
| 2 | Fish and wildlife habitat loss or degradation | Degradation of prairie/grassland habitat. | Remove invasive trees and scotch broom from prairie/grassland areas. | Current insufficient | Both |
| 3 | Overharvesting of biological resources | Trapping by landowners and mortality by pets. | Inform local residents of gopher colonies and trapping restrictions. Promote non-lethal methods of damage control. | Current insufficient | Both |
| 4 | Resource information collection needs | Genetic and demographic effects of small population size and catastrophic events. | Determine status and conduct surveys to monitor presence and relative abundance. | Current insufficient | Both |

NOTE: Numbers are for reference only and do not reflect priority.

## NORTHERN BOG LEMMING (*Synaptomys borealis*)

### Conservation Status and Concern

The Northern Bog Lemming is known from about 12 locations in Washington, where it reaches the southwestern limit of its range. Its glacial relict habitats are isolated and patchy in nature, making the risk of extinction very high.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| Petitioned | Monitor | No | G5 | S3 | Low/unknown | Moderate-high |

**Taxonomic note:** Three described subspecies occur in Washington: *S. b. truei* is found west of the Cascades, *S. b.* chapmani occurs in northeastern Washington, and *S. b. artemisiae* occurs in between. The taxonomic validity of *S. b. artemisiae* may need re-evaluation.

Photo: J. Reichel

### Biology and Life History

Northern Bog Lemmings primarily eat grasses and sedges, but also eat fungus, mosses, snails, slugs, and other invertebrates. In summer, they clip vegetation and create runway systems through the underbrush where they forage.

They nest underground during summer, and in winter construct globular nests of mosses, grasses, and sedges on the ground surface under the snow. Underground burrow systems may be up to one foot deep. The breeding season lasts from May through late August. Litter size ranges from two to eight young, and females may have two to three litters in a breeding season.

**Distribution and Abundance**
This species is found only in subarctic climates from the northern tree line south into Washington, Idaho, Montana, Minnesota, and New England. The Washington watersheds that contain known records include the Lower Pend Oreille, Middle Pend Oreille, Upper Methow, Lost River, Upper Chewuch, and Sinlahekin Creek. A recent record from Bothell, Snohomish County, needs confirmation. The status of populations of the three subspecies in Washington is unknown, but the species is considered rare throughout its range.

**Habitat**
Northern Bog Lemmings typically inhabit sphagnum bogs and fens, wet meadows, moist mixed and coniferous forests, alpine sedge meadows, krummholz, spruce-fir forest with dense herbaceous and mossy understory, and mossy stream sides. *S. b. artemisiae* was thought to be associated with sagebrush, but recent records suggest it is more often found in typical mossy habitats.

**References**
Jones, T., and L. L. Melton 2014. Petition to list the northern bog lemming (*Synaptomys borealis*) under the U. S. Endangered Species Act. Wild Earth Guardians, Denver, Colorado.
Reichel, J. D., and J. G. Corn. 1997. Northern bog lemmings: survey, population parameters, and population analysis. Unpublished report to the Kootenai National Forest, Montana Natural Heritage Program, Helena, Montana.
Yensen, E., and G. L. Kirkland. 1998. *Synaptomys borealis* (Richardson 1828): northern bog lemming. In D. J. Hafner, E. Yensen, and G. L. Kirkland, editors. North American rodents: status survey and conservation action plan. International Union for the Conservation of Nature, Gland, Switzerland.

**Northern Bog Lemming: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Resource information collection needs | Lack of data on current status and distribution. | Determine distribution and population status. | Current insufficient | Both |
| 2 | Fish and wildlife habitat loss or degradation | Habitat disturbance by road-building. | Identify and protect sites. | Current insufficient | External |
| 3 | Agriculture and aquaculture side effects | Habitat disturbance by grazing. | Identify and protect sites from unsustainable grazing. | Current insufficient | External |
| 4 | Fish and wildlife habitat loss or degradation | Potential impact of snow compaction by snowmobiles. | Investigate this potential conflict. | Current insufficient | External |

NOTE: Numbers are for reference only and do not reflect priority.

## OLYMPIC MARMOT (*Marmota olympus*)

*See Appendix B for a range and potential habitat distribution map

**Conservation Status and Concern**

Endemic to mountainous meadows of the Olympic Peninsula, Olympic Marmot populations have possibly stabilized since 2007 after declining from 2002 to 2006. Threats potentially include increased Coyote predation, and habitat fragmentation due to rising tree line (caused by declining snow pack and climate change), resulting in greater population isolation and increasing the risk of inbreeding and extinction.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| None | Candidate | Yes | G2 | S2 | Low/possibly stable | Moderate-high |

**Biology and Life History**

Photo: R. Gilbert

Olympic Marmots are gregarious and form colonies ranging in size from a few to more than 40 animals. Marmots dig burrows that are used for shelter throughout the year. Diet is comprised of herbaceous plants, roots, and woody vegetation. The species hibernates without eating or drinking for seven to eight consecutive months from fall to late spring, relying on accumulated body fat and a much reduced metabolism. Olympic Marmots have a long maturation period, low rate of reproduction, and high juvenile mortality. The average age of females at first reproduction is 4.5 years. Only about 30 percent of adult females produce litters in any given year. Litters range in size from one to six pups and are born in underground burrows. Juvenile mortality during the first year is about 50 percent. Young females are fairly sedentary and rarely disperse more than a few hundred meters to establish new home ranges. Predation by Coyotes, not present prior to the 20th century, was the most common cause of mortality for adult females from 2002 to 2006.

**Distribution and Abundance**

Olympic Marmots are endemic to the Olympic Mountains. Localized declines and extirpations have occurred since the late 1980s, while numbers at some sites have remained stable.

**Habitat**

Typical habitat for Olympic Marmots encompasses subalpine and alpine meadows and talus slopes near timberline. Many colonies are located on south-facing slopes, where food availability is probably greater because of earlier snowmelt. The proximity of nearby suitable meadow habitat may be a limiting factor for colonization or recolonization of vacant habitats. Suitable meadow habitat is naturally fragmented, being distributed in discontinuous patches of varying quality and size (from 12 to more than 250 acres) across exposed mountain slopes.

**References**
Edelman, A. J. 2003. *Marmota olympus*. Mammalian Species 736:1-5.
Griffin, S. C. 2007. Demography and ecology of a declining endemic: the Olympic Marmot. Ph.D. dissertation, University of Montana, Missoula.
Griffin, S. C., M. L. Taper, R. Hoffman, and L. S. Mills. 2008. The case of the missing marmots: are metapopulation dynamics or range-wide declines responsible? Biological Conservation 141:1293-1309.
Witczuk, J., S. Pagacz, and L. S. Mills. 2013. Disproportionate predation on endemic marmots by invasive Coyotes. Journal of Mammalogy 94:702-713.

## Olympic Marmot: Conservation Threats and Actions

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Invasive and other problematic species | Predation by an expanding Coyote population has caused a decline in Olympic Marmot populations. | Control Coyotes to reduce predation on Olympic Marmots. | Current insufficient | External |
| 2 | Invasive and other problematic species | Controlling fires has favored tree survival, resulting in a gradual decline in suitable open meadow habitat for Olympic Marmots. | Continue monitoring suitable and historical Olympic Marmot habitat throughout the range and determine habitat availability over time. Assess habitat use by marmots. Model data to determine management actions. | Current insufficient | External |
| 3 | Management decision needs | Controlling fires has favored tree survival, resulting in gradual decline in suitable open meadow habitat for Olympic Marmots. | Manage fires to retain contiguous natural alpine meadow openings that benefit Olympic Marmots. | Current insufficient | External |
| 4 | Climate change and severe weather | Reduced snowpack for multiple decades has resulted in loss of habitat and a shift of Coyote occurrence to higher elevations, making Olympic Marmots more vulnerable to predation than before. | Continue monitoring marmot occupancy in suitable habitat throughout the range and determine habitat availability over time. Model data to determine needed management actions. | Current sufficient | External |
| 5 | Education needs | Visitors that feed Coyotes may increase the likelihood of Olympic Marmot predation by Coyotes. | Work with wildlife rehabilitators to stop the release of Coyotes on Olympic Peninsula. | Current insufficient | External |

NOTE: Numbers are for reference only and do not reflect priority.

## SHAW ISLAND TOWNSEND'S VOLE (*Microtus townsendii pugeti*)

### Conservation Status and Concern

This subspecies occurs on at least 16 islands in the San Juan Archipelago. Overall population status is unclear, but populations appear secure on several larger islands. Apparent threats include habitat loss and mortality from agricultural practices.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| None | Monitor | No | G5T1T2 | S1S2 | Moderate/unknown | N/A |

### Biology and Life History


*Microtus townsendii*
Photo: National Park Service

The type specimen was collected from Neck Point, Shaw Island, Washington, in 1938. Subspecies designation was based on morphometric measurements that differ from other known subspecies of *Microtus townsendii. Microtus t. pugeti* appears smaller, with wider skull characteristics compared to other subspecies. The Shaw Island Townsend's Vole may be more closely associated with water than other subspecies of *M. townsendii*. The original taxonomic designation has not been re-evaluated. These voles live in underground burrows and open grasslands, and are primarily vegetarian. The subspecies' presence can often be recognized by travel runways that are clipped and maintained within their territories.

### Distribution and Abundance

The Shaw Island Townsend's Vole is found only in the San Juan Archipelago. Museum specimens from the late 1930s to the 1960s exist from Allen, Cypress, Deception, Dot, Frost, Guemes, Lopez, Orcas, Saddlebag, San Juan, Shaw, Sucia, and Turn islands in San Juan and Skagit Counties. Island residents reported voles present on Henry and McConnel islands in the late 1960s. Surveys conducted in 2012 and 2014 confirmed presence on Lopez, Orcas, San Juan, and North Finger islands, but did not detect them on Blakely, Vendovi, and Waldron islands. Recent surveys on other islands have not been conducted and status is unknown. Populations appear to be robust where they occur on Lopez, Orcas, San Juan, and North Finger Islands, but no formal population assessments have been conducted for this subspecies.

### Habitat

Shaw Island Townsend's Voles have been found in fresh, brackish, and salt water marshes, under driftwood on beaches, as well as in dry fields, forests, and agricultural fields. Specific habitat requirements or limitations are unknown.

#### References

Hafner, D. J., E. Yensen, and G. L. Kirkland, Jr. (compilers and editors). 1998. North American rodents: status survey and conservation action plan. IUCN/SSC Rodent Specialist Group, IUCN, Gland, Switzerland and Cambridge, United Kingdom.

**Shaw Island Townsend's Vole: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Fish and wildlife habitat loss or degradation | Conversion to agriculture and other human development. Habitat fragmentation may isolate remaining populations. | Develop better understanding of species' habitat needs and work with local planners to protect key areas from development. | Nothing current - new action needed | Both |
| 2 | Fish and wildlife habitat loss or degradation | Direct mortality occurs from agricultural practices that are unfavorable to Shaw Island Townsend's Voles. | Work with farmers to increase tolerance for voles; develop methods for compatible farming practices. | Nothing current - new action needed | Both |
| 3 | Resource information collection needs | Subspecies designation is based on morphological comparisons in the 1940s. | Need genetic assessment to determine validity of the current subspecies designation. | Nothing current - new action needed | Both |
| 4 | Resource information collection needs | Current data regarding distribution among islands and population estimates do not exist. | Conduct surveys on all likely islands, including population assessments. | Current insufficient | WDFW |

NOTE: Numbers are for reference only and do not reflect priority.

## TOWNSEND'S GROUND SQUIRREL (*Urocitellus townsendii*)

*See Appendix B for a range and potential habitat distribution map

### Conservation Status and Concern

Population status of this Washington-endemic ground squirrel requires clarification. Significant declines have occurred in many areas, yet this species is common at a number of human-modified locations.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| None | Candidate | Yes | G3 | S3 | Unknown/unknown | Moderate |

### Biology and Life History


Photo: M. Livingston

Townsend's Ground Squirrels are a burrowing species found primarily in small to fairly large colonies, but they also occur solitarily. They are active for only 4 to 5 months, spending the rest of the year hibernating. Adults emerge from hibernation from January to February and mate soon after. Litters average about eight pups and first appear above ground in March to April. Adults and juveniles consume large amounts of food before hibernation in an effort to gain adequate fat reserves to survive through hibernation. Animals enter hibernation in May and June. Burrows provide safety from predators, shelter from bad weather, protection for raising young, and a stable environment for hibernation. Diet is broad and comprised mainly of grasses, forbs, and seeds. American Badgers, raptors, and snakes are the most important predators.

### Distribution and Abundance

This species is endemic to Benton, Kittitas, Klickitat, and Yakima Counties in south-central Washington. Total population size and trend are unknown, but the species has greatly declined or become extirpated in many areas. However, it remains relatively common at some sites, including human-altered locations.

### Habitat

Townsend's Ground Squirrels historically occurred primarily in native shrub-steppe, grasslands, and large patches of sagebrush at the lower edges of forest. A variety of human-modified habitats are now also occupied, including pastures, abandoned fields, orchards, vineyards, hop fields, canal banks, and sites adjacent to irrigated fields and springs. Occupied sites must have ample soil depths to provide space for burrow construction.

#### References

Sato, C.L. 2012. Habitat connectivity for Townsend's ground squirrel (Urocitellus townsendii) in the Columbia Plateau Ecoregion. Washington Department of Fish and Wildlife, Olympia, Washington.

Washington Department of Fish and Wildlife (WDFW). 2013. Threatened and endangered wildlife in Washington: 2012 annual report. Washington Department of Fish and Wildlife, Olympia, Washington.

**Townsend's Ground Squirrel: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Resource information collection needs | Adequate data on species abundance, trend, and threats are lacking. | Undertake comprehensive field surveys to determine abundance, habitat use, and threats. | Current insufficient | Both |
| 2 | Fish and wildlife habitat loss or degradation | Habitat loss and fragmentation due to agriculture and other development. Habitat fragmentation may isolate remaining populations. | Use landowner incentives, agreements and conservation easements to protect significant colonies. Conduct translocations to establish new populations in suitable habitat. | Current insufficient | Both |
| 3 | Invasive and other problematic species | Invasion of shrub-steppe by cheatgrass and other non-native plants has degraded habitats. | Restore and manage degraded habitat at colonies and sites chosen for translocations. | Current insufficient | Both |
| 4 | Overharvesting of biological resources | Some level of shooting and other forms of control continues despite partial legal protection. | Perform analysis to determine if this species warrants classification as protected wildlife. Conduct education and outreach to landowners and recreationists. | Current insufficient | Both |

NOTE: Numbers are for reference only and do not reflect priority.

## WASHINGTON GROUND SQUIRREL (*Urocitellus washingtoni*)

*See Appendix B for a potential range and habitat distribution map

### Conservation Status and Concern

This species is associated with shrub-steppe and steppe in eastern Washington and is threatened by a number of factors, especially habitat loss, degradation, and fragmentation.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| Candidate | Candidate | Yes | G2 | S2 | Low/declining | Moderate |

### Biology and Life History

Photo: R. Finger

Washington Ground Squirrels are a burrowing species found primarily in small to fairly large colonies, but sometimes occurring solitarily. They are active for only 4 to 5 months, spending the rest of the year hibernating. Adults emerge from hibernation during mid-January to February. Mating occurs soon after emergence. Litters average five to eight pups and first appear above ground in March to April. During the two months before hibernation, adults and juveniles consume large amounts of food in an effort to gain adequate fat reserves to last through hibernation. Adults typically enter hibernation in late May and early June, but juveniles usually wait until mid to late June. Burrows provide safety from predators, shelter from bad weather, protection for raising young, and a stable environment for hibernation. Diet is broad and comprised of mainly grasses, forbs, and seeds, with at least 100 plant species eaten. Life span is relatively short, probably averaging 2 to 3 years. Badgers, raptors, and snakes are the most important predators.

### Distribution and Abundance

This species is endemic to portions of the Columbia River basin in southeastern Washington and north-central Oregon. Population size is unknown, but the species has greatly declined or become extirpated in many areas.

### Habitat

Shrub-steppe and native grassland habitats are preferred, especially those occurring on deep silty loam soils, which provide ample digging space for burrows. Plants frequently found in these habitats include sagebrush, native bunchgrasses, and various forbs. Where adequate food is present, highly disturbed sites may also be occupied, including degraded weedy locations, highway rights-of-way, lawns, and edges along crop fields.

#### References

Finger, R., G. J. Wiles, J. Tabor, and E. Cummins. 2007. Washington ground squirrel surveys in Adams, Douglas, and Grant Counties, Washington, 2004. Washington Department of Fish and Wildlife, Olympia, Washington.

USFWS. 2011. Species assessment and listing priority assignment form: *Urocitellus washingtoni*, Washington ground squirrel. U.S. Fish and Wildlife Service, Portland, Oregon.

**Washington Ground Squirrel: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Fish and wildlife habitat loss or degradation | Habitat loss and fragmentation due to agriculture and other development. Habitat fragmentation may isolate remaining populations. | Use landowner agreements and conservation easements to protect significant colonies. | Current insufficient | Both |
| 2 | Fish and wildlife habitat loss or degradation | Habitat loss and fragmentation due to agriculture and other development. Habitat fragmentation may isolate remaining populations. | Conduct translocations to establish new populations in suitable habitat. | Current insufficient | Both |
| 3 | Invasive and other problematic species | Invasion of shrub-steppe by cheatgrass and other non-native plants has degraded habitats. | Restore and manage degraded habitat at colonies and sites chosen for translocations. | Current insufficient | Both |
| 4 | Overharvesting of biological resources | Some level of shooting and poisoning continues despite legal protection. | Enforce existing protective regulations. Conduct education and outreach to landowners and recreationists. | Current insufficient | Both |
| 5 | Resource information collection needs | Current distribution and causes of recent declines are not well understood. | Conduct surveys to monitor populations and trends. Conduct research to determine the causes of ongoing declines. | Current insufficient | Both |

NOTE: Numbers are for reference only and do not reflect priority.

## WESTERN GRAY SQUIRREL (*Sciurus griseus*)

### Conservation Status and Concern

The three remaining populations of this species in Washington are isolated and face a number of threats, including habitat loss and degradation, wildfires, highway mortality, and disease.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| None | Threatened | Yes | G5 | S2 | Low/unknown | Low-moderate |

### Biology and Life History


Photo: R. Gilbert

Western Gray Squirrels are generally arboreal and solitary, but commonly forage and travel on the ground near trees. Mating occurs from January to June, with Washington litters born from March to July and averaging about three young. Pine nuts, acorns, seeds, green vegetation, hypogeous fungi (truffles and false truffles), and fruit are the main foods. The species is active year-round. In Washington, individual western gray squirrels occupy multiple nests (average = 3.5 to 14.3 nests per animal). Stick nests are mostly used for resting and sleeping, whereas cavity nests are often used by females for giving birth and rearing young. The species may compete with non-native squirrels for food and nest sites. Bobcats, Coyotes, owls, and hawks are important predators. Population density varies with food supply and occurrence of disease.

### Distribution and Abundance

Western Gray Squirrels are limited to three isolated populations in Washington: Klickitat and southern Yakima Counties, western Okanogan and northern Chelan Counties, and Joint Base Lewis-McChord in Pierce and Thurston Counties. The species has experienced significant declines in abundance and distribution in the state, but current trend is unknown. Total statewide abundance may number in the low thousands.

### Habitat

Habitat use varies with region of the state. The species occupies oak woodlands and conifer forests in Klickitat and Yakima Counties, low to mid-elevation conifer forests in Okanogan and Chelan Counties, and oak woodlands and conifer forests in Pierce and Thurston Counties. The North Cascades population is the only one living outside the range of Oregon white oak in Washington. Nesting frequently occurs in either large conifers (especially ponderosa pine and Douglas-fir) or oaks averaging greater than 16 inches in diameter. Most nest trees are located inside or on the edge of a forest stand and have crowns connecting with surrounding trees. Mistletoe infections are another common characteristic of nest trees.

#### References


Gregory, S. C., W. M. Vander Haegen, W. Y. Chang, and S. D. West. 2010. Nest site selection by western gray squirrels at their northern range terminus. Journal of Wildlife Management 74:18-25.

Linders, M. J. and D. W. Stinson. 2007. Washington state recovery plan for the western gray squirrel. Washington Department of Fish and Wildlife, Olympia, Washington.

Vander Haegen, W. M., G. R. Roth, and M. J. Linders. 2013. Survival and causes of mortality in a northern population of western gray squirrel. Journal of Wildlife Management 77:1249–1257.

**Western Gray Squirrel: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Fish and wildlife habitat loss or degradation | Habitat loss and degradation from human development, catastrophic wild fires, logging, fire suppression, and invasion by weeds. | Work with landowners to protect habitat features favored by western gray squirrels during timber harvest, protect habitat by reducing risk of catastrophic wildfires, and undertake measures to enhance habitat. | Current insufficient | Both |
| 2 | Fish and wildlife habitat loss or degradation | Road mortality. | Use signing, reduced speed limits, controlled access, and possibly squirrel bridges to reduce highway mortality. | Current insufficient | Both |
| 3 | Invasive and other problematic species | Disease (e.g., mange, tularemia). | Investigate the feasibility and effectiveness of treating western gray squirrels for mange. | Nothing current - new action needed | WDFW |
| 4 | Invasive and other problematic species | Possible competition with non-native squirrels and wild turkeys. | Explore need and feasibility to control non-native squirrels. In important squirrel areas, expand turkey harvest, where appropriate, to minimize potential impacts. | Current insufficient | Both |
| 5 | Fish and wildlife habitat loss or degradation | Loss of genetic diversity and inbreeding resulting from the small sizes and isolation of populations. | Conduct translocations and enhance habitat to expand the genetic diversity and connectivity of small populations. | Current sufficient | Both |

NOTE: Numbers are for reference only and do not reflect priority.

# TERRESTRIAL CARNIVORES

## AMERICAN BADGER (*Taxidea taxus*)

*See Appendix B for a potential range and habitat distribution map

**Conservation Status and Concern**

The status of American Badgers in Washington is poorly understood due to a lack of survey effort and the small amount of occurrence data available to indicate its current distribution.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| None | None | No | G5 | S4 | Unknown/unknown | Low-moderate |

**Biology and Life History**

The American Badger is a mid-sized (10 to 11 pounds), fossorial mammal of the weasel family (Mustelidae) that uses underground burrows for resting, denning, and prey caching. They also forage underground by digging into the burrow systems of prey species, which commonly include ground squirrels, prairie dogs, marmots, and pocket gophers. Badgers also feed on carrion, insects, reptiles, and birds. Burrows excavated by American Badgers are used by other bird and mammal species. They are largely solitary. They use large home ranges that may overlap with other American Badgers of either sex. Gray Wolves, Coyotes, bears, and Cougars are reported predators of American Badgers; however for many populations, anthropogenic causes (i.e., vehicle collisions, illegal shooting, and trapping) appear to be a more significant source of mortality.


Photo: National Park Service

**Distribution and Abundance**

The current distribution of American Badgers includes portions of eastern Washington from the eastern Cascade foothills to the Idaho border. Population size in the state is unknown, but there is concern that the statewide population is declining. The American Badger is classified as a furbearing species in Washington; however, few captures have been reported since 1995.

**Habitat**

American Badgers are generally found in grassland, shrub-steppe, desert, dry forest, parkland, and agricultural areas. They require soils that allow the excavation of den sites and support fossorial prey species (e.g., ground squirrels).

**References**

Lindzey, F. G. 2003. Badger (*Taxidea taxus*). Pages 683-691 in G. A. Feldhamer, B. C. Thompson, and J. A. Chapman, editors. Wild mammals of North America: biology, management and conservation, 2nd edition. Johns Hopkins University Press, Baltimore, Maryland.

Rahme, A. H., A. S. Harestad, and F. L. Bunnell. 1995. Status of the badger in British Columbia. Wildlife Working Report WR-72, Ministry of Environment, Lands and Parks (Wildlife Branch), Victoria, British Columbia.

**American Badger: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Resource information collection needs | Adequate data on species abundance, trend, and threats are lacking. | Undertake comprehensive field surveys to determine abundance, habitat use, and threats. | Current insufficient | Both |
| 2 | Fish and wildlife habitat loss or degradation | Habitat loss and fragmentation from agriculture and other development. | Conduct research and modeling of habitat using findings of habitat associations from badger surveys. Use these findings to prevent further loss and decline of habitat. | Current insufficient | Both |
| 3 | Overharvesting of biological resources | Illegal killing and persecution. | Enforce existing protective regulations. Conduct education and outreach to landowners and recreationists. | Current insufficient | Both |
| 4 | Overharvesting of biological resources | Lack of adequate prey availability may limit badger abundance in some areas. | Work to restore populations of ground squirrels and other prey species. | Current insufficient | Both |

NOTE: Numbers are for reference only and do not reflect priority.

## CASCADE RED FOX (*Vulpes vulpes cascadensis*)

*See Appendix B for a range and potential habitat distribution map

### Conservation Status and Concern

Little information is available on the distribution and status of this fox in Washington, although recent surveys suggest that populations are likely to be small and may be isolated. Climate change could reduce the availability of habitat for this species.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| None | Candidate | Yes | G5T1T2 | S1 | Unknown/unknown | High |

### Biology and Life History

The Cascade Red Fox is a subspecies of Red Fox that occurs only in the montane environments of the Cascade Range in Washington. Individuals commonly occur in three color phases: red, cross, and silver/black. All three phases have been reported within a single litter of pups. They are prey generalists and prey upon a variety of small and mid-sized mammals, insects, fruits, birds, and carrion. Pocket gophers, voles, and Snowshoe Hares are the most common mammalian prey. Coyotes, Bobcats, Gray Wolves, Cougars, Lynx, and dogs are predators of Cascade Red Foxes. Seasonal home ranges for this species vary in size from 1 to 4 square miles.

Photo: M. Reid

### Distribution and Abundance

The subspecies is confined to high elevations in the Cascades. Based on surveys and observations since 2005, there are concentrations of recent verifiable detections in the southern Cascades in the vicinity of Mt. Adams, Indian Heaven Wilderness Area, Goat Rocks Wilderness Area, and Mt. Rainer National Park. Similar surveys have not been conducted in the northern Cascades, and fewer verifiable detections are available from that area. Overall population size and trend are unknown. Available evidence suggests that some populations may be small and/or isolated.

### Habitat

Subalpine meadows, parklands, and open forests are primary habitats occupied by Cascade Red Foxes. They avoid wet, dense forests of the westside Cascades and tend to prefer the drier mid-elevation eastside forests of grand fir, Douglas-fir, and ponderosa pine.

### References

Akins, J. 2014. Cascades carnivore project: 2014 spring progress report. http://cascadescarnivoreproject.blogspot.com/

Aubry, K. B. 1983. The Cascade red fox: distribution, morphology, zoogeography and ecology. Dissertation, University of Washington, Seattle, Washington.

Sacks, B. N., M. J, Statham, J. D. Perrine, S. M. Wisely, and K. A. Aubry. 2010. North American montane red foxes: expansion, fragmentation, and the origin of the Sacramento Valley red fox. Conservation Genetics 11:1523-1539.

**Cascade Red Fox: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Resource information collection needs | Basic information is needed on distribution, abundance, and threats. | Undertake comprehensive field surveys to determine abundance, habitat use, and threats. | Current insufficient | Both |
| 2 | Resource information collection needs | Habituation to people occurs at Mt. Rainier National Park. | Determine whether habituation is a problem for the species, visitors, and the National Park Service at the park. | Current insufficient | External |
| 3 | Climate change | Climate change may represent a threat from loss of higher elevation meadows and parklands. | Research is needed to better determine distribution and habitat associations. Results may allow further assessment of the impacts of climate change. | Current insufficient | Both |

NOTE: Numbers are for reference only and do not reflect priority.

## FISHER (*Pekania pennanti*)

### Conservation Status and Concern

Historical over-trapping, incidental mortality, and habitat loss and fragmentation caused the extirpation of Fishers in Washington by the mid-1900s. A reintroduction project to recover the species on the Olympic Peninsula was completed in 2010. A Cascades Fisher reintroduction is scheduled to begin in 2015.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| Proposed Threatened | Endangered | Yes | G5T2T3Q | SH | Unknown/unknown | Moderate-high |

### Biology and Life History

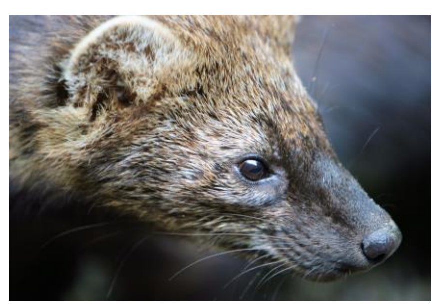


Photo: J. Jacobson

Fishers are a mid-sized carnivore (4.4 to 13 pounds) in the weasel family (Mustelidae) that use forested habitats. They commonly prey upon small and mid-sized mammals, such as Snowshoe Hares, squirrels, mice, and voles. They also feed on ungulate carrion, fruit, insects, and birds. Fishers are known for their ability to prey upon porcupines. Trapping, vehicle collisions, and predation by Bobcats, Coyotes, and Cougars are common sources of mortality. Females give birth when they are 2 years of age or older, and litter sizes range from one to four kits. Fishers use uncharacteristically large home ranges for an animal of their size (average sizes are more than 19 square miles in northern portions of its range), with male home ranges typically being twice as large as those of females.  Large trees, large snags, and large logs with cavities are important habitat features and are commonly used as rest sites and den sites.

**Distribution and Abundance**

Fishers occur only in the boreal and temperate forests of North America.   They once occurred throughout the forested areas of western, northeastern, and southeastern Washington, but were extirpated from the state by the mid-1900s, mainly as a result of over-trapping.  Ninety Fishers were reintroduced to the Olympic Peninsula from 2008 to 2010 as the first step in Fisher recovery in Washington, and surveys in 2013 and 2014 indicate that reintroduced Fishers are now reproducing and are widely distributed on the Olympic Peninsula.  Population size and trend are unknown, but are currently under investigation.

**Habitat**

Fishers inhabit coniferous and mixed coniferous-deciduous forests and they tend to avoid areas with significant human activity and developed areas.  Home ranges are commonly characterized by a mosaic of forest stand ages in low to mid-elevation forest landscapes, and these mosaics tend to be dominated by forests with mid-sized to large diameter trees.  Fishers are consistently associated with forests that provide moderate to high canopy closure and the presence of large woody structures such as cavity trees, snags and logs.

**References**


Hayes, G. E. and J. C. Lewis. 2006. Washington state recovery plan for the fisher. Washington Department of Fish and Wildlife, Olympia, Washington.

Lofroth, E. C., C. M. Raley, J. M. Higley, R. L. Truex, J. S. Yaeger, J. C. Lewis, et al. 2010. Conservation of fishers (*Martes pennanti*) in south-central British Columbia, western Washington, western Oregon, and California–Volume I: conservation assessment. USDI Bureau of Land Management, Denver, Colorado.


**Fisher:  Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Overharvesting of biological resources | Incidental trapping capture, highway mortality, and other mortality sources pose a risk for the reintroduced population on the Olympic Peninsula. | Continue to monitor this population to determine reintroduction success. | Current sufficient | Both |
| 2 | Management decision needs | Historical extirpation/absence of fishers in the Cascades Recovery Area, which makes up a major portion of the Fisher's historical range in Washington. | Work with officials in British Columbia to procure fishers and conduct reintroductions in the southern and northern Cascades. | Current sufficient | Both |

NOTE:  Numbers are for reference only and do not reflect priority.

## GRAY WOLF (*Canis lupus*)

### Conservation Status and Concern

Gray Wolves were once common throughout most of Washington, but human persecution led to their extirpation from the state by the 1930s. Wolves have started to recover in recent years, with pack numbers increasing from one in 2008 to 16 in 2014. Human-related mortality is the greatest threat to the population.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| Endangered* | Endangered | Yes | G4 | S1 | Low/increasing | Low-moderate |

*Federally listed only in the western two-thirds of Washington.

### Biology and Life History

Photo: USFWS

Gray Wolves are highly social and form packs consisting of a breeding male and female, pups from the current year and previous years, and sometimes other individuals. Typical pack size in the northern U.S. Rockies is five to 10 animals. Packs defend territories that generally average 193 to 386 square miles. One litter usually numbering four to six pups born each year in April. Wolves are carnivores and feed primarily on hoofed mammals. Elk, deer, and moose are the main prey in western North America, with other ungulates (e.g., bison, bighorn sheep, caribou), beavers, and smaller animals eaten to a lesser extent. Wolves are also natural scavengers and readily feed on the carcasses of dead animals. As top-level predators, Gray Wolves influence the abundance and behavior of their prey and other predators, which in turn can affect vegetation patterns, occurrence of other wildlife, and other ecological processes. About 10 to 15 percent of the members of a population are comprised of younger solitary animals dispersing from their natal pack to seek a mate, vacant habitat, or another pack to join. Dispersal distances average 37 to 62 miles but occasionally exceed 180 miles.

### Distribution and Abundance

As of December 31, 2014, Washington's wolf population numbered at least 68 individuals in 16 known packs, including five breeding pairs. Pack territories were predominately located in northeastern Washington (12 of 16 packs), with three packs also present in the northern Cascade Mountains and one pack in the Blue Mountains. No packs have yet been confirmed in the southern Cascades or in western Washington.

### Habitat

Wolves are habitat generalists and can thrive in almost any habitat (i.e., forests, prairies, swamps, mountains, deserts, and tundra) with sufficient prey and limited human-caused mortality. In western North America, the species is generally found in forests and nearby open habitats characterized by lower elevations and gentle terrain, especially during winter.

**References**

Becker, S. A., T. Roussin, G. Spence, E. Krausz, D. Martorello, S. Simek, and K. Eaton. 2014. Washington gray wolf conservation and management 2013 annual report. Pages WA-1 to WA-20 *in* U.S. Fish and Wildlife Service Rocky Mountain Wolf Program 2013 Annual Report. U.S. Fish and Wildlife Service, Helena, Montana.

Wiles, G. J., H. L. Allen, and G. E. Hayes. 2011. Wolf conservation and management plan for Washington. Washington Department of Fish and Wildlife, Olympia, Washington.

## Gray Wolf: Conservation Threats and Actions

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Overharvesting of biological resources | Lack of correct information on biology of Gray Wolves among the public can result in misimpressions about Gray Wolves and illegal killing. | More accurate knowledge of Gray Wolves is needed among conservationists, landowners, livestock owners, hunters, and the general public. Improved public knowledge could reduce illegal killing of Gray Wolves. | Current insufficient | Both |
| 2 | Coordination/ administration needs | Human-wolf conflict resulting from livestock depredations. | Expand use of non-lethal techniques and control measures to deter livestock depredation. | Current insufficient | Both |
| 3 | Overharvesting of biological resources | Illegal killing and persecution. | Expand available resources for law enforcement. Enforce and prosecute wolf poaching. | Current insufficient | Both |

NOTE: Numbers are for reference only and do not reflect priority.

## GRIZZLY BEAR (*Ursus arctos*)

### Conservation Status and Concern

This omnivore is extirpated from most of the state; however, two populations of uncertain viability have been identified and each plays an important role in the range-wide conservation and recovery of the species. Grizzly populations in Washington are very small and isolated due to habitat fragmentation caused by human settlement and highways, which makes the species more vulnerable to inbreeding, wildfire, illegal harvest and other threats.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| Threatened | Endangered | Yes | G4T3T4 | S1 | Critical/unknown | Moderate |

### Biology and Life History

Photo: National Park Service

Grizzly Bears can be distinguished from black bears by longer, curved claws, humped shoulders, and a face that appears concave. They are long-lived and can reach 25 years of age. Breeding occurs in late spring and early summer. Litter size is one to four, with an average of two cubs. Young are born in winter and typically remain with the mother through two winters. Although adult Grizzly Bears are normally solitary, home ranges frequently overlap and they are not considered territorial. They are wide-ranging but may congregate in areas with abundant food. Grizzly Bears are opportunistic omnivores with high diet variability among individuals, seasons, and years. They generally enter dens in October or November for 4 to 6 months of hibernation.

### Distribution and Abundance

Grizzly Bears once occurred in most of Washington, but are now restricted to remote areas of the Selkirk Mountains, the North Cascades, and certain places near the northern border of Washington between these two ecosystems. These areas probably support the best remaining “seclusion” habitat in the state. Washington’s total Grizzly Bear population is small (perhaps 0 to 20 animals on a year-round basis), and is likely the periphery or periodic expansion area from populations in British Columbia and Idaho. Trends in the North Cascades and Selkirk populations are unknown. Grizzlies have not been documented in the North Cascades since October 2010.

### Habitat

The species is now found mostly in arctic tundra, alpine tundra, and subalpine mountain forests, but once occurred in a wider variety of habitats including open prairie, brushlands, riparian woodlands, and semi-desert scrub. Most populations require huge areas of habitat remote from most human activity. Grizzly bears are common only where food is abundant and concentrated (e.g., salmon runs, caribou calving grounds). Hibernation dens are usually on steep north-facing slopes where snow accumulates. Young are born in a den, cave, crevice, hollow tree, hollow dug under rock, or similar site.

#### References

Romain-Bondi, K. A., R. B. Wielgus, L. Waits, W. F. Kasworm, M. Austin, and W. Wakkinen. 2004. Density and population size estimates for North Cascade grizzly bears using DNA hair-sampling techniques. Biological Conservation 117:417428.

Wakkinen, W. L., and. 2004. Demographics and population trends of grizzly bears in the Cabinet–Yaak and Selkirk Ecosystems of British Columbia, Idaho, Montana, and Washington. Ursus 15:65-75.

**Grizzly Bear: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Management decision needs | Washington law (RCW 77.12.035), other species conflict and conservation issues and other challenges exist in WDFW's participation in Grizzly Bear recovery activities. | Participation in the Interagency Grizzly Bear Committee, in the North Cascades environmental impact statement process, and in recovery activities in the Selkirks. | Current sufficient | Both |
| 2 | Education and outreach | Negative Grizzly Bear/human interactions and the perceived threat of dangerous encounters impact the public's willingness to have Grizzly Bears on the landscape. | Implement human safety and other education programs identified in existing recovery and management plans, including implementation of sanitation and food storage actions, and regulations to prevent human-bear conflicts. | Current insufficient | Both |
| 3 | Education and outreach | Mortality from hunters mistaking Grizzly Bears for Black Bears. | Continue efforts to educate Black Bear hunters about recognition of Grizzly Bears. | Current sufficient | Both |
| 4 | Resource information collection needs | Uncertainty of the current status and future viability of the small Grizzly Bear populations in WA. | Continue periodic assessment of occurrences in the North Cascades and Selkirks using hair snares and other methodology. | Current insufficient | External |
| 5 | Habitat loss or degradation | Small sizes and isolation of populations result in part from habitat fragmentation caused by human settlement and highways, leading to increased risk of inbreeding within populations. | Use landowner agreements, conservation easements, and land acquisitions to protect dispersal habitats from development. Engage in local and state planning for roads and other large infrastructure. | Current insufficient | WDFW |
| 6 | Habitat loss or degradation | Increased future catastrophic forest fires could reduce habitat availability in WA. | Increase practices that promote healthy forests and expand fire management activities to protect large areas of contiguous habitat. | Current insufficient | WDFW |

NOTE: Numbers are for reference only and do not reflect priority.

## LYNX (*Lynx canadensis*)

### Conservation Status and Concern
Washington's Lynx population is small (likely less than 100 animals) and restricted to a small portion of its historical range. Small population size, habitat loss from large wildfires, and climate change are threats to Lynx in Washington.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| Threatened | Threatened | Yes | G5 | S1 | Low/declining | High |

### Biology and Life History
The Lynx is a mid-sized member (11 to 38 pounds) of the cat family (Felidae) that occurs only in the boreal forests of North America. Lynx are prey specialists because snowshoe hares make up the bulk of their diet; they are physically adapted to foraging for Snowshoe Hares in deep snow. The size of northern Lynx populations cycles every 8 to 11 years in response to the population cycles of Snowshoe Hares. Cycling of this type does not occur or is less pronounced in southern populations, including the one in Washington.


Photo: WDFW

### Distribution and Abundance
Lynx once occurred throughout the northern counties of Washington but are now largely restricted to a single area that encompasses western Okanogan, northern Chelan, and eastern Whatcom and Skagit Counties. The size of the Lynx population in this area was estimated at approximately 87 animals in the early 2000s, but this estimate was based on the extent of habitat prior to the large Tripod fire that substantially reduced Lynx habitat in Okanogan County in 2006. This loss of habitat has likely caused Washington's Lynx population to decline over the last 10 years. Maintenance of the state's population is likely dependent upon demographic support from neighboring populations in British Columbia and Alberta.

### Habitat
Lynx occupy subalpine and boreal coniferous forests that have substantial accumulations of snow during the late fall, winter, and early spring. In Washington, Lynx habitat includes Engelmann spruce and subalpine forests higher than 4600 feet in elevation. Lynx typically hunt for snowshoe hares in early successional forest, where hares are most abundant. Females commonly use mature forest stands for denning and their den sites are often located in tangled piles of fallen trees.

#### References

Anderson, E. M. and M. J. Lovallo. 2003. Bobcat and Lynx. Pages 758-786 in G. A. Feldhamer, B. C. Thompson and J. A. Chapman, editors. Wild mammals of North America: biology, management and conservation, 2nd edition. Johns Hopkins University Press, Baltimore, Maryland.

Koehler, G. M., B. T. Maletzke, J. A. Von Kienast, K. B. Aubry, R. B. Wielgus, and R. H. Naney. 2008. Habitat fragmentation and the persistence of Lynx populations in Washington State. Journal of Wildlife Management 72:1518-1524.

Stinson, D. W. 2001. Washington state recovery plan for the Lynx. Washington Department of Fish and Wildlife, Olympia, Washington.

**Lynx: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Fish and wildlife habitat loss or degradation | Lynx habitat in existing Lynx management zones is threatened by major wildfires that can make conditions unsuitable for Lynx over large areas. | Protect mid- and late seral forest habitats until younger forests become suitable foraging habitats. | Current insufficient | External |
| 2 | Resource information collection needs | Threat of small population size, population isolation, and lack of immigration. | Assessment of population's genetic characteristics to determine the extent that immigration from British Columbia is essential for population persistence. Population modeling of carrying capacity of existing Lynx management zones. | Current sufficient | Both |
| 3 | Fish and wildlife habitat loss or degradation | Declining habitat connectivity may inhibit movements between Washington and British Columbia. | Maintain landscape connectivity to facilitate immigration into Washington. Work with authorities in British Columbia to help achieve this goal. | Current insufficient | Both |
| 4 | Resource information collection needs | Inadequate information on population size and trend. | Conduct population monitoring to determine changes in population size and trend. | Current insufficient | Both |

NOTE: Numbers are for reference only and do not reflect priority.

## PACIFIC MARTEN – COASTAL POPULATION (*Martes caurina caurina*)

*See Appendix B for a potential range and habitat distribution map

**Conservation Status and Concern**

Recent detections in 2015 in Olympic National Park indicate that one or more Pacific Marten coastal populations still exist on the Olympic Peninsula. Given the small number of verifiable detections in the last 20 years, populations are likely to be small, isolated and may be limited to high elevation habitat where surveys are limited by accessibility. Historical trapping, loss and fragmentation of late-successional forests at low elevations, and small population size are likely factors that contributed to the decline of the species in Washington.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| None | None | Yes | GNR | SH | Critical/unknown | Moderate-high |

**Biology and Life History**

Pacific Martens are a small to mid-sized (0.9 to 3.3 pounds) forest carnivore in the weasel family. Pacific Martens are terrestrial, arboreal, and forage in and underneath the snow. They are prey generalists and feed on a variety of small mammals, birds, insects, carrion, and berries. Bobcats, Coyotes, raptors, and Fishers are predators of martens; however, trapping is the largest source of mortality for many populations. This species uses cavities in large woody structures (e.g., live trees, snags, logs, log piles, stumps) and talus for resting and denning. Despite their small size, they use relatively large home ranges (0.8 to 10.5 square miles).

Photo: WDFW

**Distribution and Abundance**

The distribution of Pacific Martens in Washington historically included the Olympic Peninsula and southwestern portion of the state. Two detections in high elevation habitats in Olympic National Park in 2015 (in the upper Hoh Valley and at Mt. Cruiser) indicate that one or more Pacific Marten coastal populations still exist on the Olympic Peninsula. They were previously detected in 2008 and 1990 in the eastern part of Olympic National Forest. The limited number of detections indicates that the Pacific Marten coastal population is likely to be very small and its trend unknown.

**Habitat**

American Martens occur in boreal forest and taiga ecosystems, as well as mid- and high-elevation forests in mountainous regions at more southern latitudes. The coastal and Humboldt martens are the exceptions to this, as they use lower elevation forests. Anecdotal information suggests that Pacific Martens on the Olympic Peninsula used late-successional conifer forests at low and mid-elevations (e.g., cedar forests on the west side of the peninsula). The association with these forests likely placed coastal the species at greater risk to trapping and the loss and fragmentation of habitat due to extensive road-building and logging.

**References**

Powell, R. A., S. W. Buskirk, and W. J. Zielinski. 2003. Fisher and marten. Pp 635-649 in G. A. Feldhamer, B. C. Thompson and J. A. Chapman, editors. Wild mammals of North America: biology, management and conservation, 2nd edition. Johns Hopkins University Press, Baltimore, Maryland.

Zielinski, W. J., K. M. Slauson, C. R. Carroll, C. J. Kent, and D. G. Kudrna. 2001. Status of American martens in coastal forests of the Pacific States. Journal of Mammalogy 82:478-490.

**Pacific Marten: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| | Resource information collection needs | There is a lack of adequate information on the current status and distribution of this population. | Initiate surveys to detect Pacific Martens in both coastal forests and high elevation forests on the Olympic Peninsula. Although ongoing Fisher surveys recently detected one Pacific Marten in Olympic National Park, these surveys sample only some high elevation habitats where Pacific Martens could occur in the Park and Olympic National Forest. | Currently insufficient | External |

## WESTERN SPOTTED SKUNK (*Spilogale gracilis*)

**Conservation Status and Concern**

There is inadequate information on the current status and distribution of this species in much of its range in western and southeastern Washington. The increased occurrence of Opossums and loss and fragmentation of forest habitats due to urban and agricultural development may explain the apparent substantial decline of verified occurrences in the Puget Trough since the 1970s.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| None | None | No | G5 | S4 | Unknown/declining in Puget Trough | Low |

**Biology and Life History**

The Western Spotted Skunk is a small to mid-sized member of the skunk family (Mephitidae) and the smallest of the four North American skunks (1 to 4 pounds). This species is nocturnally active. The bulk of the diet is made up of small mammals and insects, but this omnivore will also eat carrion, berries, fruit, birds, bird eggs, reptiles, and amphibians. Great Horned Owls, Bobcats, and domestic dogs and cats are documented predators of Western Spotted Skunks. Anthropogenic causes (i.e., vehicle collisions, trapping, and pest control) may be the prevalent sources of mortality in many populations.

Photo: Wikimedia Commons

**Distribution and Abundance**

The range of Western Spotted Skunks includes much of western Washington from the western Cascade foothills to the coast; they also occur in the Blue Mountains in southeastern Washington. Population size in the Puget Trough is unknown, but the few recent reports suggest a substantial population decline has occurred there. Data from numerous recent carnivore surveys on the Olympic Peninsula indicate that Western Spotted Skunks continue to be widespread and common there. Current status and trend in southeastern Washington are also poorly known.

**Habitat**

Western Spotted Skunks are associated with habitats that have dense ground cover, dense understory vegetation, burrows of other species, rocky outcrops, and woody structures (e.g., logs, snags, stumps, log and brush piles). These features are important as resting, denning and foraging sites and are found in a variety of land cover types including conifer forests, riparian areas, thickets and brushy habitats, and farmlands. Western Spotted Skunks generally occur from sea level to 1970 feet in elevation in the Olympics and occasionally up to 2950 feet in the Cascades. In southeastern Washington, this species uses rocky outcrops, brushy habitats, and riparian areas up to 1970 feet in elevation.

**References**

Carey, A. B., and J. E. Kershner. 1996. *Spilogale gracilis* in upland forests of western Washington and Oregon. Northwestern Naturalist 77:29–34.

Rosatte, R. and S. Lariviere. 2003. Skunks. Pages 692-707 in G. A. Feldhamer, B. C. Thompson, and J. A. Chapman, editors. Wild mammals of North America: biology, management and conservation, 2nd edition. Johns Hopkins University Press, Baltimore, Maryland.

Verts, B. J., L. N. Carraway, and A. Kinlaw. 2001. *Spilogale gracilis*. Mammalian Species 674: 1-10.

### Western Spotted Skunk: Conservation Threats and Actions

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Resource information collection needs | Basic information on distribution and abundance is lacking for this species in much of western and southeastern Washington. | Initiate population and trend surveys in the Puget Trough and southeastern Washington. | Current insufficient | Both |
| 2 | Resource information collection needs | Basic information on threats is lacking for this species in much of western and southeastern Washington. | Initiate research to determine threats in the Puget Trough and southeastern Washington. | Current insufficient | Both |

NOTE: Numbers are for reference only and do not reflect priority.

## WOLVERINE (*Gulo gulo*)

*See Appendix B for a range and potential habitat distribution map

**Conservation Status and Concern**

Washington's Wolverine population is small, largely restricted to the North Cascades, and is an extension of a larger population in southern British Columbia. Climate change is considered a likely threat to the species in Washington.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| None | Candidate | Yes | G4 | S1 | Critical/stable | Moderate-high |

**Biology and Life History**

The Wolverine is a wide-ranging carnivore and the largest terrestrial member of the weasel (Mustelidae) family. It occurs in remote, mountainous areas in Washington and avoids humans and developed areas. Wolverines are prey generalists and commonly feed on small and mid-sized mammals and ungulate carrion, and may opportunistically kill adult ungulates. For an animal of their size (18 to 33 pounds in Washington), Wolverines use very large activity areas (i.e., 77 to 770 square miles). Anthropogenic sources (e.g., trapping, hunting) appear to be the most significant causes of Wolverine mortality. Predators include Gray Wolves, Cougars, and other Wolverines.

Photo: J. Heinlen

**Distribution and Abundance**

Wolverines occur in the remote mountainous areas of the Cascades and in northeastern Washington. A population of 13 Wolverines has been studied in the North Cascades from 2005 to 2013. Wolverines have recently been detected near Mt. Adams and in the Goat Rocks Wilderness in the South Cascades, but the existence of a breeding population in that region has not yet been determined. The statewide population is probably less than 20 animals, but appears to be relatively stable.

**Habitat**

Wolverines commonly occur in boreal forest, taiga, and tundra ecosystems. In Washington, they occupy alpine and subalpine-forest habitats, especially within North Cascades National Park and the wilderness areas of Okanogan-Wenatchee National Forest. Denning sites are commonly located in north and northeastern facing cirque habitats. Dens are typically associated with a passage through deep snow to a space within talus or under a fallen tree(s) or other large woody debris.

**References**

Aubry, K. B., J. Rohrer, C. M. Raley, and S. H. Fitkin. 2013. Wolverine distribution and ecology in the North Cascades Ecosystem, 2013 annual report. Pacific Northwest Research Station, U.S. Forest Service, Olympia, Washington.

Copeland, J. P., and J. S.Whitman. 2003. Wolverine (*Gulo gulo*). Pages 672-682 in G. A. Feldhamer, B. C. Thompson, and J. A. Chapman, editors. Wild mammals of North America: biology, management and conservation, 2nd edition. Johns Hopkins University Press, Baltimore, Maryland.

**Wolverine: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Resource information collection needs | Information on abundance, distribution, movements, and reproduction is lacking for the central and southern Cascades, and northeastern Washington. | Initiate or extend current monitoring activities into the central Cascades (especially north and south of the I-90 corridor) and the southern Cascades. Surveys in northeastern Washington would also be valuable. | Current insufficient | Both |
| 2 | Habitat loss or fragmentation | Barriers or impediments to movement across Interstate 90 in the central Washington Cascades may impede demographic support from north to south and may have prevented the establishment of a breeding population in the south Cascades. | Continue surveys specifically to detect wolverine passage, and continue development of passage structures and habitat corridors to facilitate successful crossings. | Current insufficient | Both |
| 3 | Climate change and severe weather | Loss of denning habitat and foraging habitat due to climate change. | Improve or maintain access to unoccupied denning and foraging habitat in the south Cascades (as identified in item 2 above). | Current insufficient | Both |

NOTE: Numbers are for reference only and do not reflect priority.

# MARINE MAMMALS

## BLUE WHALE (*Balaenoptera musculus*)

**Conservation Status and Concern**

The stock along the U.S. west coast, which includes Washington, is estimated at 1,647 whales and has a stable trend. Ship strikes and fisheries entanglements may negatively affect recovery.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| Endangered | Endangered | Yes | G3G4 | SNA | Critical/stable | Low-moderate |

**Biology and Life History**

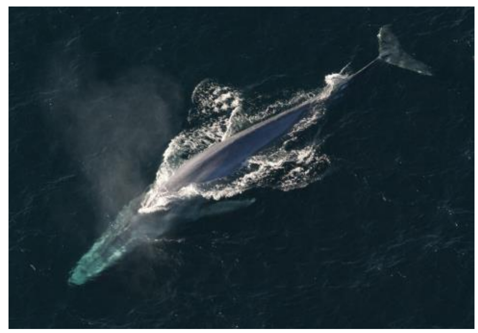


Photo: NOAA

The largest of the baleen whales, most Blue Whales migrate between summer and winter ranges, but some individuals appear to remain in certain areas year-round. Poleward movements in spring allow the whales to travel to areas with high summer and fall production of krill, their primary food. Up to 8,000 pounds of krill can be consumed in a day. Animals return to lower latitudes in winter, where most reproductive activity takes place, including births and mating. Average calving interval is probably two to three years. Age of sexual maturity is thought to be 5 to 15 years. Life span is estimated to be at least 80 years. Blue Whales do not form close social groups, but typically occur alone or in pairs.

**Distribution and Abundance**

Distribution covers the world's oceans from the tropics to higher latitudes. Total global population is estimated at perhaps only 5,000 whales. Individuals occurring off Washington belong to the Eastern North Pacific Stock, which feeds during summer and fall off the U. S. west coast (especially California) and to a lesser extent off British Columbia and in the Gulf of Alaska and central North Pacific. Wintering occurs off Mexico and Central America. The stock currently holds an estimated 1,647 whales, which is about one-third of its estimated pre-whaling size, and appears to have maintained a stable population trend since the 1990s. Blue Whales regularly occurred off the Washington coast prior to and during the whaling era. Sightings are rare now, with just three in the last 50 years, including six animals seen in December 2011. This species does not enter the state's inner waters.

**Habitat**

Blue Whales are more pelagic than most other whales, but also visit coastal waters. Occurrence is linked to areas of high zooplankton abundance.

**References**


Calambokidis, J. 2013. Updated abundance estimates of blue and humpback whales off the US west coast incorporating photo-identifications from 2010 and 2011. Document PSRG-2013-13 presented to the Pacific Scientific Review Group, April 2013.

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National Oceanic and Atmospheric Administration (NOAA) Fisheries Office of Protected Resources. http://www.nmfs.noaa.gov/pr/species/mammals/cetaceans/bluewhale.htm

**Blue Whale: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Overharvesting of biological resources | Ship strikes are a source of mortality and injury. | Identify areas of greatest concern for ship strikes and work with the shipping industry to reduce this threat. | Current insufficient | External |
| 2 | Overharvesting of biological resources | Entanglement in fisheries gear (netting, pots, and traps) is a cause of mortality and injury off the U.S. west coast. | Determine ongoing sources of bycatch and manage those fisheries to reduce bycatch. | Current insufficient | External |

NOTE: Numbers are for reference only and do not reflect priority.

## FIN WHALE (*Balaenoptera physalus*)

### Conservation Status and Concern

The stock along the U.S. west coast, which includes Washington, is estimated at about 3,000 whales and is either increasing or stable. Ship strikes and fisheries entanglements may hinder recovery.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| Endangered | Endangered | No | G3G4 | SNA | Low/increasing | Low-moderate |

### Biology and Life History


Photo: NOAA

Fin Whales are large baleen whales that usually occur alone or in groups of two to seven individuals. They regularly associate with other species of large whales and dolphins when feeding. This species commonly migrates between higher latitude waters during summer and lower latitude waters during winter, but animals in some areas (e.g., California) may be present year-round. Feeding occurs only in summer, when large amounts of krill are consumed. Small schooling forage fish and squid are also eaten. Mating and births of calves occur in winter. Adult females bear one young every two to three years. Sexual maturity is achieved at 6 to 12 years of age and life span can reach 80 to 90 years.

**Distribution and Abundance**

Distribution encompasses the world's oceans from the tropics to higher latitudes. Populations in the North Pacific are estimated to have once numbered 42,000 to 45,000 whales, but were reduced to estimated 13,000 to 18,700 animals during the whaling era. Fin Whales in Washington are part of the California/Oregon/Washington Stock, which was estimated to contain 3,044 whales in 2008. Stock trend is increasing or stable. Abundance off Washington and Oregon combined was estimated at 280 to 380 individuals from 1996 to 2001. Sightings and acoustic detections indicate this species is present off Oregon and Washington for most of the year. Observations of Fin Whales in the Salish Sea are very rare.

**Habitat**

This species usually inhabits deep offshore waters and the outer slopes of continental shelves. Temperate and subpolar regions are preferred.

**References**


Barlow, J. 2003. Preliminary estimates of the abundance of cetaceans along the U.S. west coast: 1991–2001. Administrative report LJ-03-03, Southwest Fisheries Science Center, La Jolla California.

Carretta, J. V., E. Oleson, D. W. Weller, A.R. Lang, K. A. Forney, J. Baker, B. Hanson, K. Martien, M. M. Muto, A. J. Orr, H. Huber, M. S. Lowry, J. Barlow, D. Lynch, L. Carswell, R.L. Brownell Jr., and D. K. Mattila. 2014. U.S. Pacific Marine Mammal Stock Assessments: 2013. NOAA Technical Memorandum, NOAA-TMNMFS-SWFSC-532. 406 p.

National Marine Fisheries Service (NMFS). 2010. Recovery plan for the fin whale (*Balaenoptera physalus*). National Marine Fisheries Service, Silver Spring, Maryland.

NOAA Fisheries Office of Protected Resources. http://www.nmfs.noaa.gov/pr/species/mammals/cetaceans/finwhale.htm


**Fin Whale: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Overharvesting of biological resources | Ship strikes are a relatively important source of mortality and injury off the U.S. west coast. | Identify areas of greatest concern for ship strikes and work with the shipping industry to reduce this threat. | Current insufficient | External |
| 2 | Overharvesting of biological resources | Entanglement in fisheries gear (netting, pots, and traps) is a cause of mortality and injury off the U.S. west coast. | Determine ongoing sources of bycatch and manage those fisheries to reduce bycatch. | Current insufficient | External |

NOTE: Numbers are for reference only and do not reflect priority.

## GRAY WHALE (*Eschrichtius robustus*)

**Conservation Status and Concern**

The eastern North Pacific stock of this whale has recovered from overharvest and has been stable for several decades. Status of a small group within this stock, the Pacific Coast Feeding Group, whose range includes Washington, requires further assessment.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| None | Sensitive | Yes | G4 | SNA | Medium/stable | Low-moderate |

**Biology and Life History**

The eastern North Pacific stock of this large baleen whale annually migrates 11,200 miles, roundtrip, between its summer range off Alaska and Siberia and its winter range in Mexico. Whales travel north from February to June and return south from October to January. Southward migration is more concentrated and closer to shore than is northward migration. Females are impregnated during southward migration or near the calving grounds. Gestation lasts about 13.5 months. A single calf is born in late December to early February. The calving interval is usually 2 years. Individuals become sexually mature at 5 to 11 years of age. Diet consists of small invertebrates obtained from the sea bottom in shallow waters.

Photo: R. LeValley

**Distribution and Abundance**

Year-round distribution of the Eastern North Pacific stock extends from the Bering and Chukchi seas southward to Baja California, Sonora, and Sinaloa in Mexico. A few individuals visit Puget Sound annually. Over the past several decades, stock numbers have recovered to levels near pre-whaling abundance. The most recent minimum population estimate is about 18,000 whales based on data from 2006 to 2007. Despite high levels of mortality in 1999 and 2000, the population has fluctuated around its average carrying capacity for the last 30 years. A small subpopulation, known as the Pacific Coast Feeding Group, numbers about 200 whales and summers between southeastern Alaska and northern California, including Washington. Recent genetic data suggest this group is somewhat distinct from the main stock, but that some interbreeding occurs between the two groups.

**Habitat**

Gray Whales forage and migrate mostly in continental shelf and coastal waters. Young are born in lagoons and bays.

**References**

Calambokidis, J., J.L. Laake and A. Klimek. 2012. Updated analysis of abundance and population structure of seasonal gray whales in the Pacific Northwest, 1998-2010. Paper SC/M12/AWMP2-IWC Scientific Committee.

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Frasier, T. R., S. M. Koroscil, B. N. White, and J. D. Darling. 2011. Assessment of population substructure in relation to summer feeding ground use in the eastern North Pacific gray whale. Endangered Species Research 14:39-48.

**Gray Whale: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Resource information collection needs | Better assessment of the status of the Pacific Coast Feeding Group is needed. | Determine the status of the Pacific Coast Feeding Group in Washington waters. | Current insufficient | External |
| 2 | Resource information collection needs | Gray Whales regularly strand in Washington. | Necropsies of stranded individuals should continue to monitor causes of death, animal condition, and physical health of the stock. | Current insufficient | Both |
| 4 | Energy development and distribution | Large oil spills could harm Gray Whale populations through negative impacts to health. | Minimize the risk of oil spills in Washington and elsewhere along the west coast of North America. | Current insufficient | Both |

NOTE: Numbers are for reference only and do not reflect priority.

## HUMPBACK WHALE (*Megaptera novaeangliae*)

**Conservation Status and Concern**

Abundance of this species along the U.S. west coast, including Washington, has steadily grown in recent decades. Entanglements in fishing gear and ship strikes are relatively minor sources of mortality and injury.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| Endangered | Endangered | Yes | G4 | SNA | Low/increasing | Low-moderate |

**Biology and Life History**

Photo: R. LeValley

This large baleen whale is highly migratory, with most populations moving long distances from tropical and subtropical wintering areas to higher latitudes in the summer. Individuals show strong site fidelity to summering and wintering areas. Animals from multiple summering areas converge on common wintering areas. Most of the summer is spent feeding and accumulating fat deposits. Prey mainly include small schooling fishes and krill, which are caught at the surface or while submerged. Humpback Whales bear young and mate at wintering grounds, but do not feed. Mating behavior includes aggressive displays and long vocalizations known as singing. Gestation lasts 11 to 12 months. Most adult females bear a calf every 2 to 3 years. Humpback whales travel alone or in small groups of up to 10 to 15 whales. Most humpbacks occur off Washington from July to September.

**Distribution and Abundance**

Distribution encompasses the world's oceans from the tropics to higher latitudes. Numbers in the North Pacific increased from about 1,200 to 1,400 whales in 1966 (following severe overharvest) to about 21,000 whales by 2004 to 2006. Humpback whales feeding along the U.S. west coast belong to the California/Oregon/Washington Stock, which is comprised of a California/Oregon feeding group and a Washington/southern British Columbia feeding group. This stock mainly winters in coastal areas off Mexico and Central America, although some members from the Washington/southern British Columbia feeding group winter in Hawaii. The stock has a long-term growth rate of about 7.5 percent per year and held an estimated 1,918 whales in 2007 to 2008, including about 189 whales in the Washington/southern British Columbia feeding group. Humpback Whales were common in the Salish Sea until the early 1900s, but were decimated by hunting and remain rare visitors.

**Habitat**

Habitat includes the open ocean and coastal waters, with inshore areas such as bays sometimes used. Feeding grounds are usually located in cold, productive coastal waters. Calving areas occur in shallow waters near coasts or islands.

**References**

Barlow, J., J. Calambokidis, E. A. Falcone, C. S. Baker, et al. 2011. Humpback whale abundance in the North Pacific estimated by photographic capture-recapture with bias correction from simulation studies. Marine Mammal Science 27:793−818.

Calambokidis, J., E. Falcone, A. Douglas, L. Schlender, and J. Huggins. 2009. Photographic identification of humpback and blue whales off the U.S. west coast: results and updated abundance estimates from 2008 field season. Final Report for Contract AB133F08SE2786 for the Southwest Fisheries Science Center, La Jolla, California.

**Humpback Whale: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Overharvesting of biological resources | Entanglement in fisheries gear (netting, pots, traps) remains a cause of mortality and injury to Humpback Whales off the U.S. west coast. | Determine ongoing sources of bycatch and manage those fisheries to reduce bycatch. | Current insufficient | External |
| 2 | Overharvesting of biological resources | Ship strikes are another source of mortality and injury. | Identify areas of greatest concern for ship strikes and work with the shipping industry to reduce this threat. | Current insufficient | External |

NOTE: Numbers are for reference only and do not reflect priority.

## KILLER WHALE (*Orcinus orca*)

**Conservation Status and Concern**

Of the three main populations occurring in Washington, southern resident Killer Whales have shown an overall decline since 1995, whereas transient and offshore populations are currently not of conservation concern. The reduced availability of depleted Chinook salmon populations has limited the population's productivity. High levels of chemical contaminants, noise and disturbance from vessels and other human activities, as well as large oil spills all have the potential to negatively impact the health and status of the population.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| Endangered (southern residents only) | Endangered | Yes | G4G5 | S1S2 | Low/declining (southern residents); Moderate/unknown (transients and offshores) | Southern residents: Moderate-high Transient/offshore Low-moderate |

**Biology and Life History**

Photo: NOAA

Three populations of Killer Whales, known as the southern residents, transients, and offshores, regularly occur in Washington. The southern resident population is comprised of three highly stable social groups (J, K, and L pods) and commonly inhabits waters around the San Juan Islands and the eastern Strait of Juan de Fuca from late spring to fall. Most of the rest of the year is spent along the outer coast. This population feeds primarily on Chinook salmon, chum salmon to a lesser extent, and occasionally other fish. Transient animals are part of a single population ranging from southeastern Alaska to California that feeds on seals and other marine mammals. Offshore Killer Whales are much less studied, but also form one population extending from southeastern Alaska to California. These whales usually occur more than 9 miles off the outer coast and feed primarily on sharks and other fish. All Killer Whales become sexually mature at about 12 to 16 years of age. Females become reproductively senescent when 35 to 45 years old. Estimated maximum lifespan is 80 to 90 years in females and 50 to 60 years in males. Calving interval is about 3 to 8 years.

**Distribution and Abundance**

Killer Whales are distributed nearly worldwide. In Washington, they occur in nearly all of the state's marine waters. The southern resident population has shown an overall declining trend since 1995, falling from 98 whales to 81 whales in March 2015. Minimum estimates of transient and offshore populations are 243 and 240 whales, respectively, but only small portions of both populations normally occur in Washington at any one time. Trend information does not exist for these populations.

**Habitat**

Pelagic and coastal waters are occupied. Southern resident and transient Killer Whales spend more time in coastal areas (including inland marine waters), where their preferred prey is typically found.

**References**

Allen, B. M., and R. P. Angliss. 2014. Alaska marine mammal stock assessments, 2013. NOAA Technical Memorandum NMFS-AFSC-277, Alaska Fisheries Science Center, Seattle, Washington.

Carretta, J. V., E. Oleson, D. W. Weller, A.R. Lang, K. A. Forney, J. Baker, B. Hanson, K. Martien, M. M. Muto, A. J. Orr, H. Huber, M. S. Lowry, J. Barlow, D. Lynch, L. Carswell, R.L. Brownell Jr., and D. K. Mattila. 2014. U.S. Pacific Marine Mammal Stock Assessments: 2013. NOAA Technical Memorandum, NOAA-TMNMFS-SWFSC-532. 406 p.

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Wiles, G. J. 2004. Washington state status report for the killer whale. Washington Department of Fish and Wildlife, Olympia, Washington.

## Killer Whale: Conservation Threats and Actions

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Overharvesting of biological resources | Depleted populations of Chinook salmon reduce prey availability for the southern residents, thereby limiting the population's productivity. | Rebuild depleted populations of Chinook salmon through multiple restoration activities, including management of habitat, harvest, hydropower, and hatcheries. | Current insufficient | Both |
| 2 | Outreach needs | Noise and disturbance from vessels and other human activities has the potential to disrupt foraging and other behavior by the southern resident population. | Minimize disturbance from vessels by continued evaluation and enforcement of regulations and guidelines protecting Killer Whales from vessel noise and disturbance. | Current insufficient | Both |
| 3 | Fish and wildlife habitat loss or degradation | High levels of chemical contaminants continue to exist in southern resident whales and may be causing health impacts. | Minimize pollution levels in aquatic habitats. | Current insufficient | External |
| 4 | Energy development and distribution | Large oil spills could harm Killer Whale populations through negative impacts to health. | Minimize the risk of oil spills in Washington and elsewhere along the west coast of North America. | Current insufficient | Both |

NOTE: Numbers are for reference only and do not reflect priority.

## MINKE WHALE (*Balaenoptera acutorostrata*)

### Conservation Status and Concern

The stock along the U.S. west coast, including Washington, is estimated at about 500 whales, with trend unknown. Ship strikes and fisheries entanglements may hinder population growth.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| None | None | No | G5 | SNA | Low/unknown | Low-moderate |

### Biology and Life History

Photo: NOAA

This small baleen whale is usually solitary or found in groups of two to three individuals, but occasionally forms larger loose aggregations with many animals at favored feeding locations. Some populations migrate between higher latitude waters in summer and lower latitude waters in winter, while others maintain home ranges and are not migratory. Adults tend to migrate farther than immatures. Gestation lasts 10 to 11 months. In the northern hemisphere, single calves are born from November-March. Young are weaned by 4 to 6 months of age; calving occurs every 1 to 4 years. Age of sexual maturity is usually 6 to 8 years. Lifespan is estimated to reach 50 years. Diet consists mainly of small schooling forage fishes and krill.

### Distribution and Abundance

Minke Whales are found throughout the world's oceans in tropical, temperate, and subpolar waters. Global population size is unknown, but the species is relatively common overall. Minke Whales are rare along the U.S. west coast and belong to the California/Oregon/Washington Stock. Although this stock was never commercially harvested, it is estimated to total only about 478 whales based on surveys conducted in 2005 and 2008. Stock trend is not known. The stock is non-migratory. A few members of the stock reside in Washington’s inner marine waters for part of the year.

### Habitat

Both coastal and pelagic waters are occupied. Important habitat features may include water temperature, depth, and underwater topography.

#### References


Anderwald, P., P. G. H. Evans, R. Dyer, A. Dale, P. J. Wright, and A. R. Hoelzel. 2012. Spatial scale and environmental determinants in minke whale habitat use and foraging. Marine Ecology Progress Series 450:259-274.

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Reilly, S. B., J. L. Bannister, P. B. Best, M. Brown. 2008. *Balaenoptera acutorostrata*. The IUCN Red List of Threatened Species. Version 2014.2. http://www.iucnredlist.org/details/full/2474/0

**Minke Whale: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| | Resource information collection needs | Improve assessment of occurrence and threats in Washington. | Expand efforts to document the species in Washington waters. | Current insufficient | External |

## NORTH PACIFIC RIGHT WHALE (*Eubalaena japonica*)

**Conservation Status and Concern**
The stock along western North America, including Washington, is critically endangered, with trend unknown. Threats to the stock are poorly known.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| Endangered | Endangered | No | G1 | SNA | Critical/unknown | Moderate |

**Biology and Life History**
A large slow-swimming baleen whale, North Pacific Right Whales migrate between higher latitudes during spring and summer and lower latitudes in winter. Females become sexually mature at 9 to 10 years of age. Calving occurs in coastal waters during winter and may occur every 3 to 5 years based on calving rates of similar species. Weaning takes place at about one year of age. The species feeds from spring to fall and also during parts of the winter. Diet consists of zooplankton, especially copepods. North Pacific Right Whales feed by swimming continuously with their mouths open and filtering prey against their baleen, a behavior known as skimming.


Photo: NOAA

**Distribution and Abundance**
Distribution is restricted to the Pacific Ocean between 20° and 60°N latitude, with most remaining individuals concentrating in the northwestern Pacific and Bering Sea. Winter distribution is poorly known. The species was severely depleted by whaling and it is now one of the rarest of all marine mammals, with a total population of perhaps only a few hundred animals. Trend in abundance is unknown, but the population has failed to increase significantly following protection. Individuals in the northeastern Pacific, including Washington, belong to the Eastern North Pacific Stock. Size of this stock probably numbers below 50 whales. Stock trend is unknown, but sightings of calves are rare. The last record of a North Pacific Right Whale off Washington was in 1992. At least seven confirmed records off British Columbia, Oregon, California, and Mexico since 1994 suggest that the species still rarely visits Washington.

**Habitat**
The species mainly inhabits coastal and continental shelf waters, but is sometimes found in deep waters. Occurrence is often strongly linked to areas of high prey abundance.

**References**

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NMFS. 2013. Final recovery plan for the North Pacific right whale (Eubalaena japonica). National Marine Fisheries Service, Silver Spring, Maryland.

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Thomas, P. 2014. 'Astonishing' North Pacific right whale sighting only in second in 62 years off British Columbia. http://www.grindtv.com/outdoor/nature/post/astonishing-north-pacific-right-whale-sighting-is-only-the-second-in-62-years-off-british-columbia/

**North Pacific Right Whale: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| | Resource information collection needs | Document sightings in Washington and identify potential threats in state waters. | Expand efforts to document the species in Washington waters. | Current insufficient | External |

## SEA OTTER (*Enhydra lutris kenyoni*)

**Conservation Status and Concern**

Washington's population of Sea Otters has shown steady growth to almost 1,600 animals since its reintroduction in 1969 and 1970. Oil spills are the greatest potential threat to the population.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| Species of Concern | Endangered | Yes | G4T2T3 | S2S3 | Low/increasing | Low-moderate |

**Biology and Life History**


Photo: R. LeValley

The Sea Otter is the smallest of the marine mammals and the largest member of the weasel family (Mustelidae). It is a carnivore and feeds on urchins, crabs, clams, mussels, snails, and chitons. It uses rocks to break the shells and exoskeletons of its prey and expose the edible interior of these species. Predation by Sea Otters on urchins has been found to maintain stability within marine invertebrate communities; the species is considered a keystone species because of this effect. The dense fur of the Sea Otter made its pelt extremely valuable to fur traders, which led to overexploitation of the species in the 1700s and 1800s. Otter mortality can result from oil spills and incidental capture in nets and traps set for fish, shell fish, and crabs.

**Distribution and Abundance**

The Sea Otter is found only in the northern Pacific Ocean. In Washington it is limited in distribution to the marine waters from just south of Destruction Island north to Cape Flattery, and east to Pillar Point in the Strait of Juan de Fuca. The Washington population had increased steadily from 59 individuals reintroduced in 1969 to 1970 to almost 1,600 otters in 2014.

**Habitat**

Sea Otters are commonly found in rocky marine habitats and kelp beds within 1.2 miles of the coast. Females tend to use habitats closer to the shore than males. In rough weather, otters take refuge among kelp, or in coves and inlets.

**References**

Bodkin, J. L. 2003. Sea otter. Pp 735-743 in G. A. Feldhamer, B. C. Thompson and J. A. Chapman, editors. Wild mammals of North America: biology, management and conservation, 2nd edition. Johns Hopkins University Press, Baltimore, Maryland.

Laidre, K. L., R. J. Jameson, E. Gurarie, S. J. Jeffries, and H. Allen. 2009. Spatial habitat use patterns of sea otters in coastal Washington. Journal of Mammalogy 90:906-917.

Lance, M. M., S. A. Richardson, and H. L. Allen. 2004. Washington state recovery plan for the sea otter. Washington Department of Fish and Wildlife, Olympia, Washington.

**Sea Otter: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Energy development and distribution | Oil spills are potentially a major source of mortality and habitat loss and degradation. | Prevention of oil spills and responses to spills should remain a management priority. | Current insufficient | External |
| 2 | Fish and wildlife habitat loss or degradation | The population is vulnerable because of its limited distribution and size. | Continue current surveys to assess population trends and range expansion. | Current sufficient | Both |

NOTE: Numbers are for reference only and do not reflect priority.

## SEI WHALE (*Balaenoptera borealis*)

### Conservation Status and Concern

The stock along the U.S. west coast, which includes Washington, is quite small at about 125 whales, with trend unknown. Threats to the stock are poorly understood.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| Endangered | Endangered | No | G3 | SNA | Critical/unknown | Low-moderate |

### Biology and Life History


Photo: NOAA

This large baleen whale is the fastest swimming whale. The species usually travels alone or in groups of two to five, but occasionally forms loose gatherings of 30 to 50 animals on productive feeding grounds. Movement patterns are not well known, but many animals are thought to migrate between lower latitude wintering grounds and higher latitude feeding grounds in the summer. A single calf is born in winter (from September to March) after a gestation period of 11 to 13 months. Calving interval among females is 2 to 3 years. The species reaches sexual maturity at 6 to 12 years. Sei Whales are flexible in their prey selection and feed on copepods, krill, squid, and small schooling fishes (e.g., anchovies, saury, and mackerel). Foraging methods include both skim feeding at the surface and gulp feeding below the surface.

### Distribution and Abundance

Subtropical, temperate, and subpolar water are occupied worldwide, although overall distribution is not well understood. The current global population is estimated at 80,000 animals. Sei Whales along the west coast of North America, including Washington, are part of the Eastern North Pacific Stock, which extends west to 180° longitude. No population estimates or trend data are available for the full stock. Animals are rarely recorded off the U.S. west coast, with only nine confirmed sightings made in California, Oregon, and Washington waters during extensive ship and aerial surveys from 1991 to 2008. The most recent estimate of abundance for California, Oregon, and Washington waters out to 300 nautical miles was 126 whales from 2005 to 2008. Population trend for this area is unknown.

### Habitat

This species generally occurs along the edges of continental shelves and in deeper oceans, especially where ocean fronts and eddies exist. Temperate waters may be preferred.

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**Sei Whale: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| | Resource information collection needs | Improve assessment of occurrence and threats in Washington. | Expand efforts to document the species in Washington's waters. | Current insufficient | External |

## SPERM WHALE (*Physeter macrocephalus*)

**Conservation Status and Concern**

The stock along the U.S. west coast, that includes Washington, numbers no more than several thousand whales, with trend probably stable. Fisheries entanglements are a relatively minor source of mortality and injury.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| Endangered | Endangered | Yes | G3G4 | SNA | Low/stable | Low-moderate |

**Biology and Life History**

Photo: Wikimedia Commons

Sperm Whales are large toothed whales. Adult females, calves, and juveniles form groups of usually 20 to 40 animals. As males grow older, they join bachelor schools that can hold up to 50 whales, but eventually become solitary. Sperm Whales do not undertake predictable seasonal migrations, although there is a general trend among animals at mid-latitudes to move poleward during summer and return during winter. Single calves are produced every 3 to 6 years. Births occur in warmer regions, with those in the northern hemisphere taking place in May to September. Females reach sexual maturity at 7 to 11 years, whereas males may not breed until age 25. The species can dive beyond depths of 5900 feet when foraging. Diet is primarily composed of medium to large squid, sharks, skates, and other fish.

**Distribution and Abundance**

Distribution encompasses the world's oceans from the tropics to higher latitudes. Females are generally found in warmer waters (greater than 60°F) at latitudes lower than 40°, but may occur to 50° latitude in the North Pacific. Adult males spend much of their time in colder waters near pack ice, but occasionally return to warmer regions to breed. Global population sizes are not accurately known. Most sperm whales in Washington belong to the California/Oregon/Washington Stock. The most recent estimate of stock size is 2,431 whales based on ship surveys made in 2008; trend was probably stable from 1991 to 2008. Sperm Whales are present in deeper waters off Washington in all seasons except winter. Members from another stock, the North Pacific Stock which inhabits Alaska, are also known to move through Washington's waters. Numbers for the entire eastern temperate North Pacific were last estimated at 26,300 to 32,100 whales in 1997.

**Habitat**

The species generally prefers deep water, but is sometimes found in shallower continental shelf waters. Densities are usually highest near productive waters, including near steep drop-offs or strong oceanographic features such as the edges of continental shelves, near offshore banks, and over submarine trenches and canyons.

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**Sperm Whale: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| | Overharvesting of biological resources | Entanglement in fisheries gear (netting, pots, and traps) is a cause of mortality and injury off the U.S. west coast. | Determine ongoing sources of bycatch and manage those fisheries to reduce bycatch. | Current insufficient | External |

# UNGULATES

## BIGHORN SHEEP (*Ovis canadensis*)

**Conservation Status and Concern**

Although a game species and sustainably hunted, Bighorn Sheep remain a conservation reliant species. Bighorns currently occupy approximately 15 to 20 percent of their historical habitat in Washington, and connectivity among individual herds is difficult to establish. Bighorns are susceptible to pneumonia caused by bacteria routinely carried by domestic sheep and goats.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| None | None | Yes | G4 | S2S3 | Low/variable | Moderate |

**Biology and Life History**

Photo: J. Cummins

This species is gregarious, but for most of the year adult males live apart from females and young. In the mating season, mature males generally dominate younger males and battle over access to females through vigorous head butting contests, but during most of the rest of the year they live amiably in small bands apart from the females. The timing of the mating season is generally November in Washington. Lambing generally peaks in April into May in Washington. Females typically bear one lamb. Females first breed usually in their third year. Diet is diverse and variable. Bighorn Sheep are primarily grazers of grass and forbs, but the diet can also include significant amounts of shrubs. Their diet changes seasonally. Access to mineral licks may be important for the Rocky Mountain Bighorn Sheep (subspecies *O. canadensis canadensis*), especially in spring.

**Distribution and Abundance**

Bighorn Sheep in Washington number approximately 1,330 individuals distributed in 17 identified herds, exclusive of those managed by tribal governments. The herds are distributed throughout eastern Washington except for the Columbia Plateau. As of early 2014, herds vary from as few as 21 to as many as 240 sheep. Populations are considered to be approximately stable in seven herds, increasing in four herds and declining in six herds.

**Habitat**

Bighorn Sheep occur in mesic to xeric, alpine to desert grasslands or shrub-steppe in mountains, foothills, or river canyons. Many of these grasslands are fire-maintained. Suitable escape terrain (cliffs, talus slopes, etc.) is an important feature of the habitat. Distribution is correlated with low precipitation levels, especially in winter and spring. Elevation varies considerably, both geographically and seasonally, in Washington from as low as 200 feet to over 6500 feet.

**References**


WDFW. 2014. Game management plan, July 2015-June 2021. Washington Department of Fish and Wildlife, Olympia, Washington.

**Bighorn Sheep: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Invasive and other problematic species | Introduction of pneumonia into wild Bighorn Sheep from domestic sheep and goats can eliminate Bighorn Sheep herds. | Reduce to the degree feasible the probability of contact between bighorn sheep and domestic sheep and goats in all bighorn herds as well as in areas identified for repatriation of bighorn sheep. | Current insufficient | Both |
| 2 | Resource information collection needs | Individual Bighorn Sheep herds are small and thus susceptible to deleterious effects of genetic drift and inbreeding. Exploratory movements that would normally provide Bighorn Sheep with opportunities for genetic exchange are limited now because human development, fire suppression, or natural lack of escape terrain renders these populations isolated. | Evaluate and prioritize the need for genetic rescue/augmentation of small isolated populations, find and procure source animals that are not closely related to target populations, and implement and monitor translocations. | Currently insufficient | Both |
| 3 | Management decision needs | Habitat succession and fire suppression. | On WDFW lands, continue prescribed burns where appropriate and feasible; encourage federal land managers to restore the natural role of fire where possible. | Currently insufficient | Both |
| 4 | Invasive and other problematic species | Predators, particularly Cougars, occasionally become specialists on Bighorn Sheep. Because Bighorn Sheep live in small, isolated, and predictable habitats, individual predators can occasionally cause declines and threaten persistence of entire herds. | Where excessive predation is suspected to be an important limiting factor, consider removing individual predators that specialize on Bighorn Sheep, or consider augmentations to allow imperiled herds to grow beyond the point where isolated predators are limiting. | Currently insufficient | Both |

NOTE: Numbers are for reference only and do not reflect priority.

# COLUMBIAN WHITE-TAILED DEER – COLUMBIA RIVER DPS (*Odocoileus virginianus leucurus*)

*See Appendix B for a potential range and habitat distribution map

**Conservation Status and Concern**

This subspecies exists in small, isolated populations, rendering it vulnerable to such factors as disease and stochastic events. Continued habitat degradation will impede recovery by further fragmentation of existing habitat and loss of areas for future range expansion. In addition, this species has the potential to be greatly affected by climate change due to sea level rise that will reduce island and lowland coastal habitats. Periodic major flood-events have already been shown to impact survival of all age classes. Coyote predation has been a significant cause of mortality among fawns in Washington. Vehicle collisions are another source of mortality, especially for newly translocated deer.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| Endangered | Endangered | Yes | G5T2Q | S1 | Low/stable | Moderate-high |

**Biology and Life History**

The Columbian White-tailed Deer is the westernmost subspecies of White-tailed Deer. Diet consists of grasses, forbs, and browse. The deer are sedentary year-round, with home ranges averaging 475 acres for males and 395 acres for females. Rutting activities peak in November. Fawns are born during the summer months, and peak in June.

Photo: J.V. Higbee

**Distribution and Abundance**

Historically, Columbian White-tailed Deer were distributed throughout the lowlands of southwestern Washington and western Oregon, but now remain in two geographically isolated populations: in Douglas County, Oregon, and along the lower Columbia River. The latter population, known as the Columbia River Distinct Population Segment (DPS), is found on islands in the Columbia River and adjacent areas of Clark, Cowlitz, and Wahkiakum Counties, Washington, and Clatsop, Columbia, and Multnomah Counties, Oregon. The DPS has experienced a roughly stable trend since the mid-1990s. Puget Island (Washington), Wallace Island (Oregon), and the Oregon mainland near Westport support two of the largest and more stable subpopulations (each about 150 to 200 deer in 2011). Deer were translocated to Ridgefield National Wildlife Refuge from 2013 to 2015 to establish a subpopulation there. As of January 2014, the entire Columbia River DPS totaled about 600 deer.

**Habitat**

Columbian White-tailed Deer are strongly associated with riparian habitat. They inhabit riparian forest, brushland, and pasture on islands and within the floodplain of the lower Columbia River. Forested swamps with tall shrubs and Sitka spruce, red-osier dogwood, red alder, black cottonwood, and willow characterize the native vegetation of this area.

**References**


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**Columbian White-tailed Deer: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Fish and wildlife habitat loss or degradation | Populations are isolated due to historical harvest and habitat loss and fragmentation. | Continue conducting translocations and population augmentations. | Current sufficient | Both |
| 2 | Management decision needs | Significant flooding events can and have had impacts on subpopulations. | Build and maintain water control structures on refuges, as needed, to manage water levels in sloughs and marshes. Consider construction of high-water refugia. | Current insufficient | External |
| 3 | Management decision needs | Suitable natural habitat is unstable and limited. | Manage vegetation to maintain/expand a mosaic of marshes, woodlands and grasslands. | Current insufficient | Both |
| 4 | Resource information collection needs | Suitable natural habitat is unstable and limited. There is a need to search for suitable habitat beyond what is currently occupied. | Identify high quality upland habitat in areas that might support deer populations regardless of land ownership. | Current insufficient | Both |
| 5 | Invasive and other problematic species | Coyote predation causes high fawn mortality and has a disproportionate effect on small subpopulations. | Continue efforts to control Coyotes. | Current sufficient | External |
| 6 | Invasive and other problematic species | Invasive plants erode utility of habitats. | Implement efforts to control invasive plants. | Current insufficient | Both |
| 7 | Resource information collection needs | Recovery goals for population size and distribution may no longer be adequate to achieve recovery. | Conduct a population and habitat viability analysis (PHVA) of the DPS to address adequacy of current recovery priorities and activities. | Current insufficient | Both |

NOTE: Numbers are for reference only and do not reflect priority.

## WOODLAND CARIBOU (*Rangifer tarandus*)

*See Appendix B for a range and potential habitat distribution map

### Conservation Status and Concern

The South Selkirk Woodland Caribou population has been adversely affected by predation and habitat change. The core range for this population, which overlaps into Washington, is in British Columbia. The population is at a perilously low level with recent annual calf mortality recorded at 40 to 70 percent mainly due to predation, severe weather, and malnutrition.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| Endangered | Endangered | Yes | G5T4 | S1 | Critical/declining | High |

### Biology and Life History


Photo: J. Adams

The Woodland Caribou that overlap into Washington belong to the South Selkirk population and are a unique ecotype of caribou distinguished from other Woodland Caribou by a diet of almost exclusively arboreal lichens during the coldest six months of the year. This trait allows them to inhabit the deep snow areas in the Selkirk Mountains above 4,000 feet, and these are often referred to as "mountain caribou." At other times of the year, diet consists largely of dried grasses, sedges, huckleberry leaves, willow and dwarf birch tips, and arboreal lichens. Woodland Caribou form relatively small groups. Herd size ranges from single females during calving up to about 25 animals during late winter; small groups of two to five animals are typical during spring and summer. Most Woodland Caribou move to lower elevations in early winter and re-ascend in late winter. In spring, they again descend to lower elevations, and then in summer move back up to the mountains as the snowpack disappears.

### Distribution and Abundance

The South Selkirk population is restricted to southeastern British Columbia, northern Idaho, and northeastern Washington. The population has declined from an estimated 46 caribou in 2009 to 18 animals in 2014. Woodland Caribou were observed only in British Columbia during the March 2014 survey. In December 2014, a radio-collared individual was detected in the far northern Selkirk Mountains in Washington.

### Habitat

South Selkirk Woodland Caribou inhabit rugged mountainous regions with old-growth forests of Engelmann spruce/subalpine fir and western red cedar/western hemlock that are generally more than 100 to 150 years old. These forests support abundant arboreal lichens on which caribou forage. Tracts of old-growth spruce and western red-cedar/western hemlock on moderate slopes are critical early-winter habitats. Young are born typically in severe isolated sites on high ridges.

**References**
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### Woodland Caribou: Conservation Threats and Actions

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Small population size | Genetic and demographic effects of small population size. | Consider measures to increase population size, including translocations, captive breeding, and shepherding. | Current insufficient | External |
| 2 | Management decisions | Predation by Cougars and Gray Wolves may result in mortality levels that are unsustainable for the very small population. | Removal of individual Cougars and Gray Wolves may be needed to reduce predation levels. | Current sufficient | Both |
| 3 | Fish and wildlife habitat loss or degradation | Highway mortality, especially in British Columbia. | Take steps to reduce highway collisions with vehicles, including increased signage to warn motorists, speed limit restrictions, and possible construction of highway underpasses. | Current insufficient | External |
| 4 | Fish and wildlife habitat loss or degradation | Human disturbance, including snowmobiles. | Maintain road closures and restrictions on snowmobile use in areas inhabited by Woodland Caribou. | Current insufficient | External |
| 5 | Fish and wildlife habitat loss or degradation | Loss and degradation of mature forest eliminates Woodland Caribou habitat. | Protect mature forest from harvest and road building, especially those areas important for calving. Presence of mature forest may also help reduce predation by Cougars and Gray Wolves and competition with White-tailed Deer and Elk. | Current insufficient | External |

NOTE: Numbers are for reference only and do not reflect priority.

# REFERENCES

## SECTION A: Alphabetical list of species

## SECTION B: Explanation of Terms

### Conservation Status Table

Federal Status
Refers to legal designations under the Federal ESA (listed as Endangered or Threatened or recognized as a Candidate species for listing), or designated as a Sensitive species.

State Status
The Washington Fish and Wildlife Commission has classified 46 species as Endangered, Threatened or Sensitive, under WAC 232-12-014 and WAC 232-12-011. Species can also be designated Candidate Species for state listing by WDFW policy.

PHS (Priority Habitats and Species Program)
A species listed under the PHS program is considered to be a priority for conservation and management and requires protective measures for survival due to population status, sensitivity to habitat alteration and/or tribal, recreational or commercial importance. Management recommendations have been developed for PHS species and habitats, and can assist landowners, managers and others in conducting land use activities in a manner that incorporates the needs of fish and wildlife.

- **Global (G) and State (S) Rankings:** Refers to NatureServe status rankings provided by the Natural Heritage Program. These conservation status ranks complement legal status designations and are based on a one to five scale, ranging from critically imperiled (1) to demonstrably secure (5). The global (G) and state (S) geographic scales were used for the SGCN species fact sheets. For more on the methodology used for these assessments, please see: Methodology for Assigning Ranks - NatureServe.

**State Rank:** characterizes the relative rarity or endangerment within the state of Washington.
**S1** = Critically imperiled
**S2** = Imperiled
**S3** = Rare or uncommon in the state – vulnerable
**S4** = Widespread, abundant, and apparently secure i
**S5** = Demonstrably widespread, abundant, and secure in the State
**SA** = Accidental in the state.
**SE** = An exotic species that has become established in the state.
**SH** = Historical occurrences only are known, perhaps not verified in the past 20 years, but the taxon is suspected to still exist in the state.
**SNR** or **S?** = Not yet ranked. Sufficient time and effort have not yet been devoted to ranking of this taxon.
**SP** = Potential for occurrence of the taxon in the state but no occurrences have been documented.
**SR** = Reported in the state but without persuasive documentation which would provide a basis for either accepting or rejecting the report (e.g., misidentified specimen).
**SRF** = Reported falsely in the state but the error persists in the literature.
**SU**= Unrankable. Possibly in peril in the state, but status is uncertain. More information is need.
**SX** = Believed to be extirpated from the state with little likelihood that it will be rediscovered.
**SZ** = Not of conservation concern in the state.

Qualifiers are sometimes used in conjunction with the State Ranks described above:
**B** - Rank of the breeding population in the state.
**N** - Rank of the non-breeding population in the state.

**Global Rank:** characterizes the relative rarity or endangerment of the element world-wide.
**G1** = Critically imperiled globally
**G2** = Imperiled globally
**G3** = Either very rare and local throughout its range or found locally (even abundantly at some of its locations) in a restricted range - vulnerable
**G4** = Widespread, abundant, and apparently secure globally
**G5** = Demonstrably widespread, abundant, and secure globally, though it may be quite rare in parts of its range
**GH** = Historical occurrences only are known, perhaps not verified in the past 20 years, but the taxon is suspected to still exist somewhere in its former range.
**GNR** or **G?** = Not yet ranked. Sufficient time and effort have not yet been devoted to ranking of this taxon.
**GU** = Unrankable. Possibly in peril range-wide but status uncertain. More information is needed.
**GX** = Believed to be extinct and there is little likelihood that it will be rediscovered.

Qualifiers are used in conjunction with the Global Ranks described above:
**Tn** Where n is a number or letter similar to those for Gn ranks, above, but indicating subspecies or variety rank. For example, G3TH indicates a species that is ranked G3 with this subspecies ranked as historic.

1. Key Conservation Threats (Stressor) and Actions Table

The **"Level of Investment"** column is meant to be a coarse assessment of whether the action referenced is sufficient (stay the course), insufficient (invest more resources when available), or "new action needed" (nothing is currently underway and new action needs to be initiated).

The **"Lead"** column refers to whether WDFW has the lead for that particular action (WDFW), or whether external conservation partners have the lead (external), or whether WDFW shares the lead with one or more organizations (Both).

## SECTION C: Full List of References


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State Wildlife Action Plan Update

# Appendix A-2

## Species of Greatest Conservation Need

## Fact Sheets

# BIRDS

**Conservation Status and Concern**

**Biology and Life History**

**Distribution and Abundance**

**Habitat Needs**

**Stressors**

**Conservation Actions Needed**

Washington Department of Fish and Wildlife
2015

# Appendix A-2

## SGCN Birds – Fact Sheets

# Table of Contents

# What is Included in Appendix A-2

**Introduction**
Appendix A-2 is one component of the State Wildlife Action Plan (SWAP) Update, and contains information about birds included in our Species of Greatest Conservation Need (SGCN) list for 2015. Included are fact sheets for each of the birds identified as Species of Greatest Conservation Need in the 2015 SWAP. The information provided includes a summary of the conservation concern and conservation status, description distribution and habitat, climate change sensitivity and an overview of key threats and conservation actions needed.

**What it means to be an SGCN**
The SGCN list includes both birds that have some form of legal protection status and those which may be in decline, but are not yet listed as part of either the Federal or State Endangered Species program. One of the purposes of the SWAP is to direct conservation attention to species and habitats *before* they become imperiled and recovery becomes more difficult and costly. Presence on this list does not necessarily mean that conservation attention will be directed towards these species; rather, that conservation actions for the species are *eligible* for State Wildlife Grants funding, and may be more competitive for other grant programs. It also raises the profile of a species to a wide audience of conservation partners and may encourage other organizations to initiate projects that may benefit the species.

**Climate Vulnerability**
Please see Chapter 5 for an explanation of the methodology used to assess climate vulnerability. For a full list of all the SGCN ranks, including a narrative description of sensitivity and references, please see Appendix C.

**Explanation of terms used in the document**
Please see Section B (page 117) for a description of terms and abbreviations used in this document.

**Alphabetical List of Species**
For an alphabetical list of all the birds included, please see Section A (page 116).

**References**
References are provided separately with each fact sheet, and also collectively for all SGCN birds in the REFERENCES section at the end of this document.

# WATERFOWL

## BARROW'S GOLDENEYE (*Bucephala islandica*)

**Conservation Status and Concern**

This sea duck species breeds in Washington, has low population numbers and has been declining in Puget Sound. Sources of impacts have not been clearly identified. Increasing development in the Puget Sound region has led to more disturbance, pollution, and degradation of foraging areas used by sea ducks. Some aquaculture practices may impact foraging areas through exclusion of sea ducks. Forest management activities may remove older trees and snags that provide most nest cavities and may increase predation at remaining cavities.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| None | None | Yes | G5 | S3B,S4N | Low/declining | Moderate-high |

**Biology and Life History**


Photo: R. LeValley

Like other sea ducks, Barrow's Goldeneye adults are more site-faithful to use areas, breed at an older age, and have lower recruitment compared to other waterfowl. WDFW surveys in 2010 on Puget Sound recorded only 9.7 percent juveniles in the population. Both male and female Barrow's Goldeneyes are territorial during the breeding season. Females nest in tree cavities, including those excavated by Pileated Woodpeckers, or in artificial nest boxes. Availability of suitable cavity nest sites may affect population size. Animal matter can comprise over 75 percent of the diets of breeding Barrow's Goldeneyes, including aquatic insects, mollusks, crustaceans, and small fish. During winter they feed in shallow water, primarily on mussels but also clams, crustaceans, and fish eggs. Most wintering birds depart for breeding areas from mid-March to early April.

**Distribution and Abundance**

The breeding population of Barrow's Goldeneye is thought to be widespread within the Cascades and between Okanogan and Pend Oreille Counties. A unique population nests in cavities within the talus slopes and basalt cliffs surrounding Lake Lenore and Alkali Lake in central Washington. Approximately 22 percent of goldeneyes on Puget Sound are Barrow's. The average population of Barrow's Goldeneye on Puget Sound was estimated at 5,297 during 2012 to 2014. Winter 2012 to 2014 counts of both goldeneye species (combined) on Puget Sound declined 44 percent to 24,077 from the 1994 to 1996 counts. The statewide breeding population of goldeneye (both species) averaged 858 in 2012 to 2014.

**Habitat**

Barrow's Goldeneyes nest primarily in mature and late successional forests and riparian areas adjacent to low gradient rivers, sloughs, lakes, and beaver ponds. Most Barrow's Goldeneyes wintering in Washington occur on Puget Sound bays, inlets, harbors, and rocky shores, and some use ice-free inland lakes, ponds, and rivers.

**References**

Sea Duck Joint Venture Species Fact Sheet – Barrow's Goldeneye http://seaduckjv.org/meetseaduck/bge.html
Washington Department of Fish and Wildlife (WDFW) Sea Duck Management Strategies:
http://wdfw.wa.gov/publications/pub.php?id=01007

### Barrow's Goldeneye: Conservation Threats and Actions

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Resource information collection needs | Lack of information on status and distribution | Conduct annual winter inventory | Current insufficient | Both |
| 2 | Resource information collection needs | Lack of information on population demography | Conduct periodic recruitment and species composition surveys | Current insufficient | Both |
| 3 | Resource information collection needs | Rangewide delineation of Puget Sound winter population | Develop satellite telemetry study to document use areas | Current insufficient | Both |
| 4 | Fish and wildlife habitat loss or degradation | Development impacts on breeding and wintering habitat | Document and address limiting factors | Current insufficient | Both |

NOTE: Numbers are for reference only and do not reflect priority.

## BLACK SCOTER (*Melanitta nigra*)

**Conservation Status and Concern**

This species has undergone significant population declines on Puget Sound. Increasing development in the Puget Sound region has led to more disturbance, pollution, and degradation of foraging areas used by sea ducks. Reduction of marine foraging areas may be reducing populations in some areas. Some aquaculture practices can impact foraging areas through exclusion of sea ducks.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| None | None | Yes | G5 | S3N | Moderate/declining | Moderate |

**Biology and Life History**


Photo: P. Massas

Like other sea ducks, Black Scoters are believed to reach sexual maturity when they are two or three years old. Courting begins in spring, and they arrive paired on the breeding grounds. Black Scoters are long-lived, nest later than most ducks, and on average have low reproductive output. Birds depart coastal molting areas from late August through November and then spend most of their annual cycle on wintering areas in Puget Sound. The diet of Black Scoters in Washington is predominantly mollusks (e.g., mussels and clams), but also crustaceans (e.g., snails, periwinkles), limpets, barnacles, and vegetation. Ducks usually feed in depths less than 33 feet, diving to take prey which they then swallow whole; powerful muscles of the gizzard crush the prey, shell and all.

**Distribution and Abundance**

The western population of Black Scoters breeds on tundra of north-central Alaska Peninsula, Alaska's Bristol Bay lowlands, Yukon-Kuskokwim Delta, and to a lesser extent in Kotzebue Sound and the Alaska North Slope. Currently, there are believed to be about 200,000 Black Scoters in Alaska. Their population in western Alaska has declined by about 50 percent since aerial surveys were begun in the 1950s, although recent trends appear to be stable. In winter, Black Scoters are found as far south as Baja California and west into the Aleutian Islands. The Black Scoter is the least numerous scoter species on Puget Sound. Wintering numbers of all scoters on Puget Sound total approximately 50,000, and only about 1 percent are Black Scoters. The total scoter population index (3-year average) for Puget Sound has declined over 50 percent since 1994 to 1996, and may have declined as much as 78 percent since 1978 to 1979. WDFW has implemented progressively restrictive hunting regulations for scoters since 1998 in response to population declines.

**Habitat**

Black Scoters breed near shallow tundra lakes in Alaska. In Washington, they frequent marine nearshore waters.

**References**

Sea Duck Joint Venture Species Fact Sheet - Black Scoter: http://seaduckjv.org/meetseaduck/bs.html
WDFW Sea Duck Management Strategies: http://wdfw.wa.gov/publications/pub.php?id=01007

**Black Scoter: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Fish and wildlife habitat loss or degradation | Puget Sound development impacts on marine environment | Document and address limiting factors | Current insufficient | Both |
| 2 | Resource information collection needs | Lack of information on status and distribution | Conduct annual winter inventory | Current insufficient | Both |
| 3 | Resource information collection needs | Lack of information on population demography | Conduct periodic recruitment and species composition surveys | Current insufficient | Both |
| 4 | Resource information collection needs | Rangewide delineation of Puget Sound winter population | Develop satellite telemetry study to document use areas | Current insufficient | Both |

NOTE: Numbers are for reference only and do not reflect priority.

## CINNAMON TEAL (*Anas cyanoptera septentrionalum*)

### Conservation Status and Concern

Cinnamon Teal is a once fairly common breeding species in Washington that has declined significantly in the past 40 years. Breeding areas in eastern Washington have been affected by wetland succession, exotic and invasive vegetation such as loosestrife and *Phragmites*, development, hydroelectric dam impacts to freshwater wetlands, and intensive grazing in some areas.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| None | None | No | G5 | S5B | Moderate/declining | Moderate |

### Biology and Life History

Cinnamon Teal are primarily found in Washington during the breeding season, and one of the last dabbling ducks to arrive on the breeding areas in early May. The peak of nesting occurs in mid-May to mid-June. Food habits of adults during the nesting season appear to be equally comprised of plant and animal food items. As the season progresses and fall migration grows closer, their food preference shifts toward plants. Cinnamon Teal depart Washington breeding areas for southern wintering areas in late summer, usually before most other dabbling duck species.

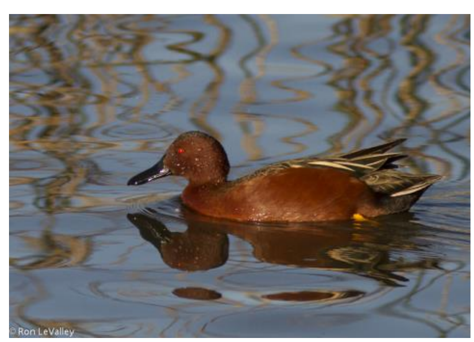
Photo: R. LeValley

**Distribution and Abundance**
Of the three North American teal species, Cinnamon Teal are the least widely distributed, and much less is known of their population dynamics than Blue- or Green-winged Teal. Cinnamon Teal occur in Washington during the breeding season mainly in eastern Washington, in the Columbia Basin and channeled scablands. Cinnamon Teal are rarely encountered in Washington during winter, and migrate south as far as northern South America. Recent WDFW aerial surveys indicate an average breeding population of approximately 7,000 in Washington during 2009 to 2014. Breeding Bird Survey estimates for Cinnamon Teal in Washington have declined significantly from 1968 to 2012 (-3.3 percent annually), and causes are unknown.

**Habitat**
Cinnamon Teal breeding areas typically contain dense upland vegetation near freshwater ponds and lakes, usually with dense aquatic vegetation. Where preferred upland plant cover is poor, they are known to nest over water in emergent vegetation.

**References**
Gammonley, J. H. 2012. Cinnamon Teal (*Anas cyanoptera*), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America Online: http://bna.birds.cornell.edu/bna/species/209

**Cinnamon Teal: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Agriculture and aquaculture side effects | Wetland losses and degradation due to irrigation management | Restore freshwater wetlands | Current insufficient | Both |
| 2 | Agriculture and aquaculture side effects | Intensive grazing impacts on freshwater wetlands | Mitigate grazing impacts on nesting and brood cover | Current insufficient | Both |
| 3 | Fish and wildlife habitat loss or degradation | Wetland losses and degradation due to hydrologic impacts from development | Acquire important breeding habitat and manage nesting cover through prescribed grazing and other methods | Current insufficient | Both |

NOTE: Numbers are for reference only and do not reflect priority.

## DUSKY CANADA GOOSE (*Branta canadensis occidentalis*)

### Conservation Status and Concern

Habitat changes on the Dusky Canada Goose breeding grounds on the Copper River Delta, Alaska have led to high predation pressure; combined with losses of wintering habitat in western Washington, these factors are responsible for a long-term population decline for this subspecies.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| None | None | No | G5T3 | SNR | Low/stable | N/A |

### Biology and Life History


Photo: WDFW

The primary nesting area for Dusky Canada Geese is the Copper River Delta, near Cordova, Alaska, although a small part of the population nests on Middleton Island in the Gulf of Alaska. The 1964 earthquake uplifted the Copper River Delta by 2 to 6 feet, drastically altering the frequency of tidal inundation and promoting drying of slough banks and meadows. As a result, the number and species composition of predators on the delta changed, and nest predation increased from less than six percent in 1959 to an average of over 60 percent from the 1990s to present. Recent work suggested that Bald Eagles might account for as much as 80 percent of nest predation, with another 15 percent attributable to Brown Bears.

### Distribution and Abundance

Most Dusky Canada Geese in Washington occur in Clark, Cowlitz, Pacific, and Wahkiakum Counties, where they use agricultural areas (mostly pasture and grain crops). Wintering numbers rangewide were relatively high between 1975 and 1981, from 23,000 to 26,500. Since that time, numbers decreased to 6,700 in 2009, and were estimated at approximately 14,000 birds in 2014 (3-year average) due to good production beginning in 2010. Due to an extensive hunter training program and restrictive hunting seasons since 1984, winter survival of this species is very high (approximately 80 percent) compared to other most other goose populations.

### Habitat

Changes in nesting habitat caused by the Alaska earthquake resulted in drier conditions and invasion of alder, willow, cottonwood, and Sitka spruce. Between 1974 and 1984, shrub cover increased nine-fold on the coastal delta. Since 1983, a total of 861 artificial nest islands of six different designs have been installed on the Copper River Delta by the US Forest Service to deter nest predation. Several National Wildlife Refuges were created in the Pacific Northwest during the 1960s to conserve habitat for Dusky Canada Geese.

### References

Pacific Flyway Council. 2014. Draft Pacific Flyway management plan for the dusky Canada goose. Dusky Canada Goose Subcommittee, Pacific Flyway Study Comm. [c/o USFWS], Portland, OR. Unpublished report.

**Dusky Canada Goose: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Agriculture and aquaculture side effects | Loss of foraging habitat on public lands | Maintain adequate foraging habitat on public lands | Current insufficient | Both |
| 2 | Agriculture and aquaculture side effects | Conversion of agricultural use areas to crops not utilized for forage | Acquire fee-title or easements to conserve adequate winter habitat | Current insufficient | Both |
| 3 | Fish and wildlife habitat loss or degradation | Loss of wintering habitat to residential development | Acquire fee-title or easements to conserve adequate winter habitat | Current insufficient | Both |
| 4 | Resource information collection needs | Lack of information on status and distribution | Conduct annual distribution surveys | Current insufficient | Both |

NOTE: Numbers are for reference only and do not reflect priority.

## HARLEQUIN DUCK (*Histrionicus histrionicus*)

**Conservation Status and Concern**

Declines in wintering numbers of Harlequin Ducks have occurred on Puget Sound. Conservation concerns include the effects of human disturbance, degradation of coastal habitats, pollutant discharge and reduction of marine forage.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| None | None | Yes | G4 | S2B,S3N | Low/declining | Moderate-high |

**Biology and Life History**


Photo: S. Fitkin

Similar to other sea duck species, annual recruitment is low due to delayed maturity, variable breeding propensity, small clutch size, relatively low numbers of successful breeders, and other factors related to productivity and brood survival. Natural events, particularly flooding, have the potential to negatively impact prey populations (e.g. caddisfly larvae), which have been associated with decreased reproductive efforts for Harlequin Ducks. WDFW surveys documented an average of approximately 10 percent young in the winter population during 2008 to 2010. Breeding males and subadults move to the coast to molt during June and July, with females and broods arriving during August-September. These same molting areas are important wintering areas for Harlequin Ducks from several western states and provinces. Adult Harlequin Ducks exhibit a substantial degree of faithfulness to wintering areas.

**Distribution and Abundance**

Surveys in 1996 documented approximately 400 breeding pairs on Washington streams, primarily in the Cascade and Olympic mountain ranges. An average of approximately 3,000 harlequins wintered on Puget Sound during 2012 to 2014, a reduction of 15 percent since 1994 to 1996. Hunting seasons have been restricted for harlequin ducks since 1998, and the current bag limit is one per hunter each season.

**Habitat**

The species is found on fast-flowing streams in riparian, subalpine, and coastal habitats during the breeding season.

**References**

Pacific Harlequin Duck Management: Recommendations for Rocky Mountain-Northwest Coast Segment. July 23, 2004. Pacific Flyway Study Comm. [c/o USFWS], Portland, OR.

WDFW Sea Duck Management Strategies: http://wdfw.wa.gov/publications/pub.php?id=01007

**Harlequin Duck: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Resource information collection needs | Lack of information on population demography | Conduct periodic recruitment surveys | Current insufficient | Both |
| 2 | Resource information collection needs | Rangewide delineation of Puget Sound winter population | Develop satellite telemetry study to document use areas | Current insufficient | Both |
| 3 | Fish and wildlife habitat loss or degradation | Puget Sound development impacts | Research/surveys to document and address limiting factors | Current insufficient | Both |

NOTE: Numbers are for reference only and do not reflect priority.

## LONG-TAILED DUCK (*Clangula hyemalis*)

### Conservation Status and Concern

This species has undergone significant population declines on Puget Sound. Increasing development in the Puget Sound region has led to more disturbance, pollution, and degradation of foraging areas used by sea ducks. Reduction of marine forage (primarily herring spawn) may be reducing populations in some areas.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| None | None | No | G5 | S3S4N | Moderate/declining | Low-moderate |

### Biology and Life History

Photo: T. Bowman

Like other sea ducks, Long-tailed Ducks are believed to reach sexual maturity when they are 2 or 3 years old, are long-lived, nest later than most ducks, and on average have low reproductive output. Birds depart coastal molting areas from late August through November and then spend most of their annual cycle on wintering areas in the Puget Sound area. Their winter diet is varied but chiefly animal matter, including bottom-dwelling crustaceans, clams, mussels, small fish, and snails. Most feeding is in water less than 30 feet deep, but the Long-tailed Duck has been documented to dive more than 200 feet, deeper than any other duck.

### Distribution and Abundance

Long-tailed Ducks breed in arctic and subarctic wetlands from the west coast of Alaska across most of northern Canada. Approximately 200,000 Long-tailed Ducks are thought to breed in Alaska. Population numbers have declined about 80 percent in Alaska since surveys began in 1957, although numbers have recently stabilized. Long-tailed Ducks winter along the Pacific coast from the Bering Sea to California. Some birds from Alaska may winter in the northern Bering Sea and across to Russia. The current Puget Sound population is estimated at approximately 5,200 Long-tailed Ducks. Puget Sound populations have declined 39 percent since 1994 to 1996, and as much as 94 percent since 1978 to 1979. WDFW implemented restrictive hunting regulations for Long-tailed Ducks in 2010 in response to population declines.

### Habitat

The Long-tailed Duck spends most of the year (approximately 9 months) primarily in coastal marine waters. Only during the breeding season does it frequent shallow wetlands of low-lying tundra, ranging southward to the northern edge of the boreal forest. Non-breeding and molting birds tend to use deeper ponds and lakes and nearshore marine areas.

#### References

Sea Duck Joint Venture Species Fact Sheet – Long-tailed Duck: http://seaduckjv.org/meetseaduck/ltd.html
WDFW Sea Duck Management Strategies: http://wdfw.wa.gov/publications/pub.php?id=0100

**Long-Tailed Duck: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Resource information collection needs | Lack of information on status and distribution | Conduct annual winter inventory | Current insufficient | Both |
| 2 | Resource information collection needs | Lack of information on population demography | Conduct periodic recruitment and species composition surveys | Current insufficient | Both |
| 3 | Fish and wildlife habitat loss or degradation | Puget Sound development impacts on marine environment | Document and address limiting factors | Current insufficient | Both |

NOTE: Numbers are for reference only and do not reflect priority.

## SURF SCOTER (*Melanitta perspicillata*)

**Conservation Status and Concern**

This species has undergone significant population declines on Puget Sound. Increasing development in the Puget Sound region has led to more disturbance, pollution, and degradation of foraging areas used by sea ducks. Reduction of marine forage may be reducing populations in some areas. Some aquaculture practices can impact foraging areas through exclusion of sea ducks.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| None | None | Yes | G5 | S3N | Moderate/declining | Moderate-high |

**Biology and Life History**

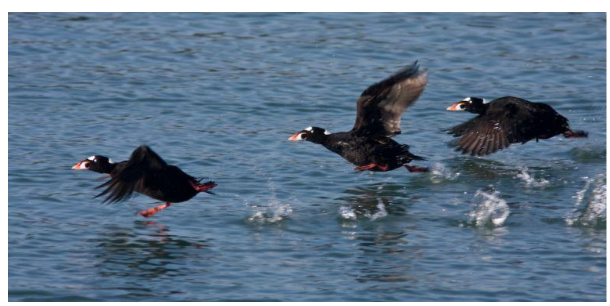
Photo: R. LeValley

The Surf Scoter is one of the least studied ducks in North America. Surf Scoters do not breed until 2 to 3 years old, and are believed to be long-lived but on average have low reproductive output (e.g. an average of approximately eight percent young in Puget Sound wintering flocks during 2008 to 2010). Nests are well concealed and the few that have been found are typically near shallow lakes within the boreal forest of Northwest Territories and Nunavut, an area threatened by energy development and climate change effects. Males and nonbreeding females often undertake extensive molt migrations to coastal areas (e.g. Padilla Bay) that are hundreds of miles from breeding areas. Molting flocks may number in the hundreds to thousands, although the location and characteristics of molting areas has not been well documented. Birds depart coastal molting areas from late August through November and move to wintering areas, primarily in Puget Sound. Adults are site-faithful to wintering sites.

**Distribution and Abundance**

Although Surf Scoters are found in many marine coastal areas, they are most numerous on Puget Sound. Wintering numbers of all scoters on Puget Sound total approximately 50,000, and most (80 percent) are Surf Scoters. The total scoter population index (three-year average) for Puget Sound has declined over 50 percent since 1994 to 1996, and may have declined as much as 78 percent since 1978 to 1979. WDFW has implemented progressively restrictive hunting regulations for scoters since 1998 in response to population declines.

**Habitat**

Wintering Surf Scoters feed mostly on mussels and clams at up to 66 feet in depth, before switching to herring eggs or other seasonally abundant prey during spring migration.

**References**

WDFW Sea Duck Management Strategies: http://wdfw.wa.gov/publications/pub.php?id=01007

**Surf Scoter: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Resource information collection needs | Lack of information on status and distribution | Conduct annual winter inventory | Current insufficient | Both |
| 2 | Resource information collection needs | Lack of information on population demography | Conduct periodic recruitment and species composition surveys | Current insufficient | Both |
| 3 | Agriculture and aquaculture side effects | Some aquaculture practices may exclude sea ducks | Develop best management practices; identify and protect important foraging areas | Current insufficient | Both |
| 4 | Fish and wildlife habitat loss or degradation | Puget Sound development impacts on marine environment | Document and address limiting factors | Current insufficient | Both |

NOTE: Numbers are for reference only and do not reflect priority.

## WHITE-WINGED SCOTER (*Melanitta fusca)*

**Conservation Status and Concern**

This species has undergone significant population declines on Puget Sound. Increasing development in the Puget Sound has led to more disturbance, pollution, and degradation of foraging areas used by sea ducks. Reduction of marine forage (primarily herring spawn) may be reducing populations in some areas. Some aquaculture practices can impact foraging areas through exclusion of sea ducks.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| None | None | Yes | G5 | S3N | Low/declining | Moderate |

**Biology and Life History**


Photo: R. Gilbert

The White-winged Scoter is the largest scoter species in Washington. White-winged Scoters first breed at two to three years old, and are believed to be long-lived and have low recruitment in most years. In spring, White-winged Scoters move from saltwater wintering habitats to inland breeding areas in the boreal forests of northern Alberta and Northwest Territories. Many of their breeding areas are threatened by resource extraction and climate change effects. In some areas, White-winged Scoters nest predominantly on islands, although gulls, Common Ravens, and American Crows often destroy 10 to 30 percent of nests and a large number of ducklings. Birds depart coastal molting areas from late August through November. In Washington, White-winged Scoters spend most of their annual cycle on wintering areas in the Puget Sound area. Based on satellite telemetry studies by WDFW, adults have a high degree of site-fidelity to wintering sites.

**Distribution and Abundance**

White-winged Scoters have virtually disappeared from the more southern reaches of their breeding range in the prairie/parkland region of Canada and the U.S. Most White-winged Scoters in Washington are found on Puget Sound during winter. Wintering numbers of all scoters on Puget Sound total approximately 50,000 and approximately 20 percent are White-winged Scoters. The total scoter population index (3-year average) for Puget Sound has declined over 50 percent since 1994 to 1996, and may have declined as much as 78 percent since 1978 to 1979. WDFW has implemented progressively restrictive hunting regulations for scoters since 1998 in response to population declines.

**Habitat**

Wintering White-winged Scoters feed mostly on bottom-dwelling animals such as mollusks (clams, mussels, snails) and crustaceans (crabs, shrimp) at up to 66 feet in depth, before switching to herring eggs or other seasonally abundant prey during spring migration.

**References**

Sea Duck Joint Venture Species Fact Sheet – White-winged Scoter: http://seaduckjv.org/meetseaduck/wws.html
WDFW Sea Duck Management Strategies: http://wdfw.wa.gov/publications/pub.php?id=01007

**White-winged Scoter: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Resource information collection needs | Lack of information on status and distribution | Conduct annual winter inventory | Current insufficient | Both |
| 2 | Resource information collection needs | Lack of information on population demography | Conduct periodic recruitment and species composition surveys | Current insufficient | Both |
| 3 | Agriculture and aquaculture side effects | Some aquaculture practices can exclude sea ducks | Develop best management practices; identify and protect important foraging areas | Current insufficient | Both |
| 4 | Fish and wildlife habitat loss or degradation | Puget Sound development impacts on marine environment | Document and address limiting factors | Current insufficient | Both |

NOTE: Numbers are for reference only and do not reflect priority.

## WESTERN HIGH ARCTIC BRANT (*Branta bernicla*)

**Conservation Status and Concern**

Western High Arctic Brant include a small population which has experienced a long-term decline in numbers. Factors affecting population status and distribution are currently unknown. Potential disturbance factors include increased water-based recreation, commercial and residential development, shellfish harvest, and fishing.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| None | None | Yes | G5 | S3N | Low/stable | Moderate |

**Biology and Life History**

This is one of two stocks of Brant that occur in Washington during winter, and is not currently recognized as a distinct subspecies separate from Black Brant. They breed in Canada on the Parry Islands, located in Northwest Territories and Nunavut. These Brant exhibit breast color plumage characteristics closer to the pale gray of Brant on the Atlantic coast, in contrast to typical Black Brant with dark breast plumage in the Pacific Flyway. In their high latitude nesting area, extreme weather conditions during summer can lead to total breeding failures in some years.

Photo: M. Axelson

**Distribution and Abundance**

Status and trends of this Brant are less clear than those for Black Brant. In 1993, there were 500 nesting birds on Prince Patrick Island and 1,500 on Melville Island. Only two percent of the area of Mellville, Prince Patrick, and Eglinton Islands, and associated smaller islands in the Parry group are suitable for nesting, and the scarcity of vegetation likely limits abundance and distribution. Following the breeding season, these Brant migrate to the Izembek National Wildlife Refuge area in Alaska and stage for up to 6 weeks in the fall. Marking information indicates the north Puget Sound area is the major wintering area for this stock, although Brant populations wintering in Alaska have been growing recently and may contain Brant from this same population. The percentage of these Brant in north Puget Sound during winter averaged 48 percent (4,248) in 2007 to 2013.

**Habitat**

On breeding areas in the Parry Islands, Brant nest as widely dispersed solitary pairs, often well away from water. Some nesting and much available feeding habitat is susceptible to inundation by storm tides, and is susceptible to spills by petroleum exploration and development. Brant utilizing north Puget Sound use coastal estuaries with sufficient quantities of eelgrass and sea lettuce, as well as adequate haul-out and grit access sites. Numbers of Brant utilizing migration and wintering habitats in Washington have been related to trends in the size of eelgrass beds that have been reduced in some areas. Several major oil refineries in north Puget Sound are located in key wintering areas, including Padilla Bay.

**References**

Pacific Flyway Council. 2014. Draft Pacific Flyway Management Plan for Pacific Brant. USFWS, Portland, Oregon.

**Western High Arctic Brant: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Resource information collection needs | Lack of information on status and distribution | Conduct annual winter inventory | Current insufficient | Both |
| 2 | Resource information collection needs | Lack of information on population demography | Conduct annual recruitment and stock assessments | Current insufficient | Both |
| 3 | Fish and wildlife habitat loss or degradation | Puget Sound development impacts on marine environment | Acquire or facilitate protection of critical shoreline use areas | Current insufficient | Both |
| 4 | Fish and wildlife habitat loss or degradation | Disturbance and direct habitat impacts at important use areas on Padilla, Samish, and Fidalgo Bays | Acquire and enhance critical shoreline use areas | Current insufficient | Both |

NOTE: Numbers are for reference only and do not reflect priority.

# UPLAND GAME BIRDS

## COLUMBIAN SHARP-TAILED GROUSE (*Tympanuchus phasianellus columbianus*)

**Conservation Status and Concern**

The statewide population of Columbian Sharp-tailed Grouse is distributed in seven subpopulations that are not sustainable at current levels. Maintaining the species in Washington will require restoring habitat and increasing populations.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| Species of Concern | Threatened | Yes | G5 | S1S2 | Low/declining | Moderate |

**Biology and Life History**


Photo: B. Griffith

Sharp-tailed Grouse inhabit grassland and shrublands, and feed on plant material and insects. Males gather at traditional sites in spring to perform elaborate dances on leks to attract females for mating. Females nest under a grass clump or shrub and incubate a clutch of approximately 10 to 14 eggs. The precocial chicks feed on insects, gradually shifting to more plant material. Young chicks are particularly vulnerable to predators. Maturing broods aggregate into flocks in late summer. During late fall and winter, particularly after snow covers the ground, Sharp-tailed Grouse will move to areas with riparian deciduous cover where they often eat buds and fruits of deciduous trees and shrubs, such as water birch, serviceberry, hawthorn, and aspen. Annual adult survival of non-hunted populations ranges from 30 to 60 percent; maximum life span reported is 7.5 years.

**Distribution and Abundance**

The subspecies in Washington is the Columbian (*T. p. columbianus*), the rarest subspecies. Seven remnant populations remain in Douglas, Lincoln, and Okanogan Counties. Washington populations may have once numbered in the hundreds of thousands. The total population now numbers fewer than 1,000 birds, and they occupy less than five percent of their historical range.

**Habitat**

Sharp-tailed Grouse are a grassland and steppe species, and the Palouse prairie probably once supported the highest numbers in Washington. Diverse native grassland with sparse shrubs provides the best nesting habitat, but deciduous riparian habitat must be available in the area for overwintering. Sharp-tailed Grouse will also use cropland near native habitat, such as wheat stubble and alfalfa, and have benefitted from the Conservation Reserve Program.

**References**

Stinson, D. W., and M. A. Schroeder. 2012. Washington State recovery plan for the Columbian sharp-tailed grouse. Washington Department of Fish and Wildlife, Olympia, Washington.

**Columbian Sharp-Tailed Grouse: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Agriculture and aquaculture side effects | Habitat converted to cropland (loss and fragmentation); lack of connectivity | Protect and restore key habitats using a variety of conservation tools; translocations may be needed in some cases | Current insufficient | WDFW |
| 2 | Agriculture and aquaculture side effects | Habitat converted to cropland | Sage and Sharp-tailed Grouse SAFE contracts | Current insufficient | Both |
| 3 | Fish and wildlife habitat loss or degradation | Small populations, potential declining genetic health | Population augmentation | Current insufficient | Both |

NOTE: Numbers are for reference only and do not reflect priority.

## GREATER SAGE-GROUSE (*Centrocercus urophasianus*)

### Conservation Status and Concern

Greater Sage-grouse require landscapes of sagebrush steppe, much of which has been converted to cropland or degraded. Remaining populations are small and unlikely to persist at their current size. The USFWS found in 2001 that listing of the Columbia Basin Distinct Population Segment under the Endangered Species Act was "warranted but precluded" by higher priority listing actions.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| Candidate | Threatened | Yes | G3G4 | S1 | Low/stable | Moderate-high |

### Biology and Life History

Greater Sage-grouse are closely tied to sagebrush. Mating occurs at leks where males display to attract females. Females incubate a clutch of six to nine eggs in a nest on the ground. Males and females gather into flocks in winter, as do broodless hens in early summer. During the winter, Greater Sage-grouse feed almost exclusively on sagebrush; at other times they also feed on forbs. They also eat insects including ants and grasshoppers, which are essential in the diet of growing chicks. Birds generally move between winter and summer ranges returning to traditional lek sites in February. Annual adult survival averages 50 to 75 percent, and females may live 8 years or more.

Photo: WDFW

**Distribution and Abundance**

The Washington population in 2014 totaled less than 1,000 birds. There are two remnant populations: one in Douglas and Grant Counties, and one on the Yakima Training Center in Yakima and Kittitas Counties; small reintroduced populations also exist in Lincoln County and on the Yakama Indian Reservation.

**Habitat**

This species requires large areas of shrub-steppe habitat dominated by sagebrush. Productive breeding habitat is sagebrush steppe with a diverse herbaceous understory, and springs or wet areas that retain green vegetation in late summer. Nest predation rates are affected by habitat quality, because residual grasses help conceal hide nests. Some degraded habitat that lacks the grass and forb understory needed for nesting and brood rearing is nonetheless suitable for wintering grouse. Greater Sage-grouse will also use edges of wheat and alfalfa fields near shrub-steppe habitat.

**References**

Stinson, D. W., D. W. Hays, and M. A. Schroeder. 2004. Washington State recovery plan for the greater sage-grouse. Washington Department of Fish and Wildlife, Olympia, Washington.

US Fish and Wildlife Service (USFWS). 2001. 12-month finding for a petition to list the Washington population of western sage grouse (*Centrocercus urophasianus phaios*). Federal Register 66:22984-22994.

**Greater Sage-grouse: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Agriculture and aquaculture side effects | Habitat converted to cropland | Protect and restore key habitats using a variety of conservation tools | Current insufficient | Both |
| 2 | Agriculture and aquaculture side effects | Habitat converted to cropland | Sage and Sharp-tailed Grouse SAFE contracts | Current insufficient | Both |
| 3 | Habitat loss or degradation | Wildfire impacts to sagebrush | Sagebrush replanting | Current insufficient | Both |
| 4 | Fish and wildlife habitat loss or degradation | Small populations, potential declining genetic health | Population reintroductions, augmentations | Current insufficient | Both |
| 5 | Agriculture and aquaculture side effects | Wire fences pose collision hazard | Attach markers to improve visibility to fences in breeding habitat | Current insufficient | External |

NOTE: Numbers are for reference only and do not reflect priority.

## MOUNTAIN QUAIL (*Oreortyx pictus*)

**Conservation Status and Concern**

Mountain Quail populations have declined to very low levels within their native range in Washington and were (or continue to be) absent in some areas. The decline is thought to be due to loss or degradation of dense shrub communities resulting from intensive cattle grazing practices and hydroelectric and other development in riparian zones.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| None | None | Yes | G5 | S1 | Low/unknown | Moderate |

**Biology and Life History**

Photo: K. Chou

Mountain Quail nest on the ground in dense cover, usually sheltered by a shrub, log, or clump of grass. Like other quail, their nests are shallow depressions lined with grass, needles, leaves, and feathers. Diet varies with the season but consists primarily of seeds, bulbs, leaves, berries, and some insects. One of the most important foods is sumac. Insect and other animal matter are a minor source of food, comprising less than five percent of the diet overall. Females lay nine to 10 eggs, which both parents incubate. Shortly after hatching, the young leave the nest. Both parents incubate their own nest and then tend and actively defend the young and lead them to food sources, where they feed themselves.

**Distribution and Abundance**

Although the species has been introduced to parts of western Washington, where it is somewhat common, Asotin, Garfield, and Columbia Counties are the Mountain Quail's native range. The species was once abundant in Klickitat County and may have been native there historically. After being extirpated from portions of the historical distribution, 309 mountain quail were released in the Asotin Creek watershed between 2005 and 2013. Survival of released birds to 6 months post-release has ranged between 18 to 34 percent. It is not clear whether these attempts have established populations that will become self-sustaining. While incidental observations of Mountain Quail continue to occur in the area, deriving a population estimate for this small, widely dispersed population in remote habitat is not currently practical.

**Habitat**

This species requires dense shrub cover, brushy, riparian habitat in dry areas, and brushy slopes. They are found in dense cover with scattered open areas on slopes in foothills and mountains. They use dense thickets resulting from fires or clearcuts, and they are seldom found far from this cover. In summer, the quail require a source of water, which may limit their nesting range.

**References**

WDFW. 2015. Game Management Plan July 2015 - June 2021. Washington Department of Fish and Wildlife, Olympia, Washington.

WDFW. 2014. 2014 Game status and trend report. Washington Department of Fish and Wildlife, Olympia, Washington.

## Mountain Quail: Conservation Threats and Actions

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Energy development and distribution | Hydroelectric development along the Snake River has resulted in the loss of key riparian habitat | Protect as-yet undeveloped habitat along tributaries | Nothing current - new action needed | Both |
| 2 | Agriculture and aquaculture side effects | Mountain Quail require dense shrub cover and brushy areas. Use of herbicides kills shrubs and plants required for cover and forage, particularly sumac | Work with landowners to use best management practices | Current insufficient | WDFW |
| 3 | Agriculture and aquaculture side effects | Mountain Quail require dense shrub cover and brushy areas. Intensive grazing practices have damaged habitat required for cover and forage | Protect as-yet undeveloped habitat along tributaries | Current insufficient | Both |
| 4 | Resource information collection needs | Success of translocation efforts is not clear and trend data are lacking | Evaluate results from translocations to assess effectiveness of release strategies | Current insufficient | WDFW |

NOTE: Numbers are for reference only and do not reflect priority.

## SPRUCE GROUSE (*Falcipennis canadensis*)

### Conservation Status and Concern

Although a gamebird, the indirect effects of climate change including disease of trees and wildfire, the direct effects of certain timber harvest practices, and the uncertainty about taxonomy mean that Spruce Grouse conservation status is unclear.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| None | None | No | G5 | S4 | Declining | High |

### Biology and Life History


Photo: M. Schroeder

Spruce Grouse dwell mostly in trees from late autumn through early spring and on the ground from late spring through early autumn. Both males and females are territorial during the spring. Females generally produce a clutch of five to six eggs. Nest and brood success are usually not very high, but are compensated for with relatively high adult survival.

### Distribution and Abundance

These grouse are distributed throughout the boreal forest of Canada and Alaska and small portions of other northern states. Most evidence suggests that this grouse consists of types that are genetically, phenotypically, and behaviorally distinct, and taxonomic reclassification may occur at some point in the future. In Washington, they are primarily found on the east slope of the Cascades from the U.S.-Canada border south to Yakima County and in Okanogan, Ferry, Stevens, and Pend Oreille Counties. Cascade populations are believed to be relatively sparse and discontinuous while populations in the Okanogan highlands have historically been abundant and continuous. Spruce Grouse have declined in many portions of northern Washington due to wildfires between 1994 and 2014. The Washington population is approximately 5,000 individuals.

### Habitat

Spruce Grouse depend on conifer forests, especially fire-adapted lodgepole pine, but also spruce and fir. Greatest densities appear to be in young successional stands of dense lodgepole pine, with a well-developed middle and understory of spruce, fir, and/or deciduous shrubs. Populations close to the crest of the Cascades live in habitats with greater tree diversity, but these populations are poorly understood. Grouse forage in winter primarily on lodgepole pine needles, and secondarily on spruce needles. Nesting and brood-rearing females often use small riparian meadows and forest openings. Spruce Grouse living in fragmented habitats have lower survival.

### References


Boag, D. A., and M. A. Schroeder. 1991. Spruce grouse (Falcipennis canadensis). Birds of North America 5: 1-28.

Boag, D. A., and M. A. Schroeder. 1987. Population fluctuations in spruce grouse: what determines their numbers in spring? Canadian Journal of Zoology 65:2430-2435.

**Spruce Grouse: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Invasive and other problematic species and genes | Increased fire size resulting from beetle infestations | Fire management | Current insufficient | Both |
| 2 | Agriculture and aquaculture side effects | Salvage harvest in areas impacted by beetle infestations | Develop and implement best management practices | Current insufficient | Both |
| 3 | Climate change and severe weather | Beetle infestations due to climate temperature change killing lodgepole pine, spruce and fir | Forest management | Current insufficient | External |
| 4 | Resource information collection needs | Lack of population data poses risk of over-harvesting | Monitor annual harvest | Current insufficient | WDFW |

NOTE: Numbers are for reference only and do not reflect priority.

## WHITE-TAILED PTARMIGAN (*Lagopus leucura*)

**Conservation Status and Concern**

The greatest threat to the long-term survival of White-tailed Ptarmigan populations appears to be climate change, which may lead to a gradual loss of alpine habitats as the tree line moves upward. Consequently, they have been petitioned for listing under the Endangered Species Act and the USFWS decided that the petition was valid and worthy of consideration.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| Petitioned | None | No | G5 | S3 | Low/unknown | High |

**Biology and Life History**

White-tailed Ptarmigan dwell mostly on the ground in alpine tundra habitats. They are generally resident in the same general habitats throughout the year but some birds may migrate more than 6 miles. They are monogamous and the breeding pair defends a territory during the breeding and nesting seasons. Females generally produce a clutch of five to seven eggs. Nest and brood success are usually not very high, but are compensated for with relatively high survival.

Photo: M. Schroeder

**Distribution and Abundance**

White-tailed Ptarmigan are distributed in alpine tundra habitats of western North America. In Washington they are found in the Cascades from Mt. Adams north to the U.S.-Canada border. There has been little work done with White-Tailed Ptarmigan, but birds are believed to be relatively rare on Mt. Adams, uncommon on Mt. Rainier, and common in areas further north, such as the Pasayten Wilderness. There is an apparent gap of about 31 miles in occupancy between Mt. Rainier and the Alpine Lakes Wilderness to the north. The Washington population may be about 1,000 individuals.

**Habitat**

White-tailed Ptarmigan depend on alpine tundra habitats that are forb-rich with occasional shrubs such as willow. During winter they may spend time feeding on vegetation in wind-exposed areas, avalanche chutes, and riparian areas with exposed shrubs.

**References**

Braun, C. E., K. Martin, and L. A. Robb. 1993. White-tailed Ptarmigan (*Lagopus leucurus*). Birds of North America 68: 1-24.

USFWS. 2012. Endangered and threatened wildlife and plants; 90-day finding on a petition to list the southern white-tailed ptarmigan and the Mt. Rainier white-tailed ptarmigan as threatened with critical habitat. Federal Register 77:33143–33155.

**White-Tailed Ptarmigan: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Climate change and severe weather | Low elevation habitats influenced by indirect impacts of climate change due to drier conditions, longer growing seasons, and encroachment by trees | Continue to minimize human disturbance (direct and indirect) in White-tailed Ptarmigan habitats | Current insufficient | WDFW |
| 2 | Education needs | Outreach for the general public to educate them about White-tailed Ptarmigan and the risks they face | Improved outreach | Current insufficient | WDFW |
| 3 | Resource information collection needs | Little known about abundance, distribution, and connectivity in Washington | Surveys needed to make management effective | Current insufficient | WDFW |

NOTE: Numbers are for reference only and do not reflect priority.

## AMERICAN WHITE PELICAN (*Pelecanus erythrorhynchos*)

*See Appendix B for a range and potential habitat distribution map

### Conservation Status and Concern

American White Pelicans nest in only one location in Washington.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| None | Endangered | Yes | G4 | S1B | Low/increasing | Low-moderate |

### Biology and Life History

Photo: R. LeValley

American White Pelicans are large, highly gregarious, migratory birds that nest in colonies. Breeding sites include isolated islands in freshwater lakes and rivers. Females typically breed at age three and lay an average of two eggs; most pairs fledge only one young. Nesting pelicans are highly susceptible to disturbance and females rarely lay a second clutch if the first clutch is lost. Young are cared for by both parents for 3 to 4 weeks, then join other young within the colony and fledge at 9 to 10 weeks of age. Adult life span is 12 to 14 years. Natural predators of eggs and chicks include gulls, Coyotes, large corvids and other mammals. Foraging areas may be 30 miles or more from breeding sites and include the shallows of lakes, rivers and marshes; prey includes fish (including, in some areas, commercially important species), amphibians and crustaceans.

### Distribution and Abundance

American White Pelicans breed in the western and central Canadian provinces and in the north-central and western United States. They overwinter from central California to southern Arizona, Mexico and northern Central America, as well as Texas to Florida. In Washington, they are a locally uncommon to common visitor and migrant, a very local breeder in the eastern part of state and a rare visitor in western Washington. American White Pelicans did not breed in Washington from about 1930 to 1995. The only known breeding colony of around 1,000 pairs occurs at Badger Island in the Columbia River in Walla Walla County.

### Habitat

American White Pelicans nest on isolated islands in freshwater systems. These islands can be permanent or ephemeral. Most American White Pelicans spend the winter along coastal areas in bays, inlets and estuaries that contain exposed places, such as sand islands, for loafing and roosting, with nearby foraging sites, and on inland freshwater reservoirs, lakes, or rivers.

#### References


Evans, R. M., and F. L. Knopf. 1993. American white pelican (Pelecanus erythrorhynchos). Birds of North America 57: 1-24.

WDFW. 2013. Threatened and Endangered Wildlife in Washington: 2012 Annual Report. Listing and Recovery Section, Wildlife Program, Washington Department of Fish and Wildlife, Olympia.

**American White Pelican: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Fish and wildlife habitat loss or degradation | Dredging and deposition of dredged materials may impact nesting and roosting sites | Work with US Army Corps of Engineers on Columbia River to avoid impacts to potential nest sites | Current insufficient | Both |
| 2 | Resource information collection needs | Monitor for impacts from contaminants and prey resource declines | Monitor local breeding sites | Nothing current - new action needed | Both |

NOTE: Numbers are for reference only and do not reflect priority.

## BROWN PELICAN (*Pelecanus occidentalis*)

**Conservation Status and Concern**

This species has recovered from its previous population decline and has been delisted by the USFWS.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| Species of Concern | Endangered | Yes | G4 | S3N | Stable/increasing | Moderate |

**Biology and Life History**

The Brown Pelican does not breed in Washington, although a few nests have recently been found along the lower Columbia River. They breed in colonies on small offshore islands. Nesting can occur from December to August, and in the Gulf of California generally occurs from November to May. Brown Pelicans are slow to mature and reach sexual maturity at 3 to 5 years of age. The oldest individual lived 43 years. Reproductive success varies with level of disturbance by humans, starvation of young, and/or flooding of nests, but typically the number of young fledged per nest averages one or less. Brown Pelicans feed primarily on small marine fishes such as Northern Anchovy, Pacific Sardine, and Pacific Mackerel.


Photo: R. LeValley

**Distribution and Abundance**

Brown Pelicans are common to abundant in Washington's outer coastal waters from spring through autumn. Up to 16,000 have been reported roosting at East Sand Island in the Columbia River estuary.

Brown Pelicans in Washington belong to the subspecies *P. o. californicus*. These birds nest in the Gulf of California and along the coast of Baja California in Mexico north to Channel Islands in southern California. After breeding, California Brown Pelicans disperse north along the coast as far as southern British Columbia. The origin of birds that occur in Washington is uncertain.

**Habitat**
Brown Pelicans inhabit mainly coastal waters and are rarely seen inland or far out at sea. They feed mostly in shallow estuarine waters, and occasionally up to 40 miles from shore. They use sand spits, offshore sand bars, and islets for nocturnal roosting and daily loafing, especially non-breeders and during the non-nesting season. Dry roosting sites are essential. Brown Pelicans that roost on beaches can be disturbed by humans, including pedestrians and motorists.

**References**
Shields, M. 2002. Brown Pelican (*Pelecanus occidentalis*). Birds of North America 609: 1-36.
Stinson, D. W. 2015. Periodic status review for the Brown Pelican. Washington Department of Fish and Wildlife, Olympia, Washington.
USFWS. 2009. Removal of the Brown Pelican (*Pelecanus occidentalis*) from the federal list of endangered and threatened wildlife: Final Rule. Federal Register 74:59444-59472.

**Brown Pelican: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Fish and wildlife habitat loss or degradation | Potential oil spills | Plan to minimize risks during oil and other toxic spills | Current sufficient | Both |
| 2 | Invasive and other problematic species and genes | Harmful algae blooms, fluctuations in prey populations-natural oscillations | Monitor; particularly the roost sites. | Current sufficient | Both |

NOTE: Numbers are for reference only and do not reflect priority.

## CLARK'S GREBE (*Aechmophorus clarkii*)

*See Appendix B for a range and potential habitat distribution map

### Conservation Status and Concern

The small breeding population of this species in Washington, which occurs at a small number of Columbia Basin lakes and reservoirs, is strongly impacted by various threats relating to water drawdowns and recreational boating activity.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| None | Candidate | Yes | G5 | S2B | Low/declining | Low-moderate |

### Biology and Life History

This species is gregarious and nests in colonies. Clutch size usually numbers two to four eggs and brood size is usually one to three chicks which depart nests soon after hatching. Nesting and brood rearing extend from early June to late August. Spring migration is mainly from late April to early May; fall migration extends from mid-September to November. Clark's Grebes will flock with Western Grebes. Wintering birds can occur in daytime flocks, but disperse at night to forage. Diet is mainly fishes, and aquatic invertebrates are also consumed; considered opportunistic as to the species eaten. Prey are caught underwater by diving.

Photo: R. LeValley

### Distribution and Abundance

Clark's Grebes are a rare nester in Washington and the size of the state's breeding population is not well known, but may number only 75 to 150 birds. All known nesting localities are in Grant County except for one site in Adams County. The species occurs more widely in the state during migration, including rarely in western Washington; it is rare during winter.

### Habitat

Large freshwater lakes, reservoirs, and marshes are used during the summer breeding season. These habitats as well as sheltered coastal marine areas are occupied during migration and winter. Nesting sites usually contain at least a few square miles of open water and areas of emergent vegetation. Nests are built in emergent vegetation.

### References

Storer, R. W. and G. L. Nuechterlein. 1992. Western and Clark's Grebes. Birds of North America 26: 1-24.
Wahl, T. R. 2005. Clark's Grebe. Page 83 *In* T. R. Wahl, B. Tweit, and S. G. Mlodinow (eds.). Birds of Washington: Status and Distribution. Oregon State University Press, Corvallis, Oregon.

**Clark's Grebe: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Agriculture and aquaculture side effects | Major water drawdowns at reservoirs used by nesting colonies | Devise effective floating nest platforms; work with irrigation authorities to manage water levels to reduce impacts to grebes | Current insufficient | Both |
| 2 | Fish and wildlife habitat loss or degradation | Boater activity and boat wakes at nesting colonies can destroy nests, spill eggs, or cause gull predation | Identify wake-free zones near breeding colonies | Current insufficient | Both |

NOTE: Numbers are for reference only and do not reflect priority.

## COMMON LOON (*Gavia immer*)

*See Appendix B for a range and potential habitat distribution map

**Conservation Status and Concern**

The Common Loon's life history characteristics and small breeding population in Washington render it highly vulnerable to impacts unless monitored and managed appropriately.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| None | Sensitive | Yes | G5 | S2B,S4N | Low/stable | Low-moderate |

**Biology and Life History**

Nests are built at the water's edge and egg-laying generally begins between mid-May and mid-July. Chicks leave the nest within 24 hours of hatching and are soon moved to nursery areas. Chicks may be carried on their parents' backs until they reach 3 weeks of age. Most juveniles are capable of flight at 11 to 12 weeks, and some leave their small, natal lakes or parental territories shortly afterward. Non-breeders aggregate in marine waters, but also inland freshwater bodies.

Photo: J. Picken

**Distribution and Abundance**

Common Loons breed in freshwater habitats of northern North America including much of Canada, Alaska, northern portions of the contiguous United States, and southern Greenland. It also breeds in Iceland. The southern portion of its historical breeding range has contracted. These birds spend winters on inland larger freshwater bodies and marine environments from Alaska to northern Mexico in the American west. In Washington, breeding areas are freshwater lakes and reservoirs, mainly in remote areas of northeastern and northwestern parts of the state. Common Loons spend the winter in almost all nearshore marine and larger freshwater bodies of western Washington. They are uncommon and irregular in winter in eastern Washington where they are found in large water bodies and Columbia Basin impoundments. The size of Washington's breeding population is unknown.

**Habitat**
In winter and during migration, Common Loons use inland lakes and rivers and marine and estuarine coastal waters. Breeding habitat includes usually clear lakes containing both shallow and deep water areas. Nest sites are on small islands, quiet backwaters, or mainland shores. Loons have been found nesting in marshy portions of lakes in water depths no greater than 1.6 feet. Optimal nest sites include overhead cover to conceal eggs from predators, protection from wind and waves, good visibility by incubating adults, and a steep slope adjacent to the nest for adequate underwater approaches and exits. Brood-rearing areas are typically located in shallow coves of fairly uniform depth, sheltered from prevailing winds and wave action, and are independent of nest site location.

**References**
Evers, D. C., J. D. Paruk, J.W. Mcintyre and J. F. Barr. 2010. Common loon (*Gavia immer*). Birds of North America 313: 1-32.

Wahl , T. R. and S. Richardson. 2005. Common Loon (*Gavia immer*). Pp 76 – 77 in T. R. Wahl, B. Tweit, and S. G. Mlodinow (eds.) Birds of Washington: Status and Distribution. Oregon State University Press, Corvallis, OR, USA. 436 pp.

**Common Loon: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Fish and wildlife habitat loss or degradation | Shoreline and adjacent upland development, use and degradation by various land use change actions (e.g. development, timber harvest, stormwater runoff impacts increase pollutant exposure) | Work with private and public landowners to support and sustain habitat and support health ecosystem processes | Current sufficient | Both |
| 2 | Fish and wildlife habitat loss or degradation | Human consumptive and non-consumptive recreational intrusion on breeding lakes; lead tackle impacts; direct disturbance of nesting and brooding by recreation activities | Provide outreach to educate constituents regarding curbing recreation impacts | Current insufficient | Both |
| 3 | Outreach Needs | Lead tackle use, gear entanglement, oil spill, commercial fish bycatch impacts require more outreach and management attention | Provide outreach to educate constituents regarding curbing recreation impacts | Current sufficient | Both |
| 4 | Coordination-Administration Needs | Maintain and increase collaboration with landowners and constituents to manage hydroelectric sites used for breeding by providing platforms | Emphasize need for platforms on managed waters that have flux and resident loons | Current sufficient | Both |

NOTE: Numbers are for reference only and do not reflect priority.

## MARBLED MURRELET (*Brachyramphus marmoratus*)

### Conservation Status and Concern
Because of its breeding association with old forests, Marbled Murrelet populations have been severely affected by loss of mature and old forest habitat.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| Threatened | Threatened | Yes | G3G4 | S2 | Low/declining | Moderate |

### Biology and Life History
Marbled Murrelets forage in marine waters and nest inland in mature and old-growth conifer forests. Small schooling fish (e.g. Pacific Anchovy, Pacific Herring, Candlefish) and Pacific Sand Lance make up most of the diet, which may include small crustaceans when fish are not abundant. Marbled Murrelets appear to establish long-term pair bonds and fidelity to nesting areas and nest trees.


Photo: USFWS

### Distribution and Abundance
This species is an uncommon resident in marine waters in general proximity to nesting habitat; it is most abundant in northern Puget Sound and the Strait of Juan de Fuca, and least abundant along the coast of southwestern Washington. Surveys indicate highest nesting presence on the Olympic Peninsula, the northern Cascades and in limited remaining habitat in southwest Washington. Population estimate for 2013 in Puget Sound and Strait of Juan de Fuca was 4,395 birds, and on the Washington coast was 1,257 birds. The overall estimate of rate of annual decline in Marbled Murrelet density for Washington was -4.65 percent for the period from 2001 through 2013.

### Habitat
In Washington, Marbled Murrelets nest in mature and old-growth conifer forests, and sometimes in comparatively younger forests with residual old-growth trees. The nest is located in a depression on a mat of moss, lichen or debris accumulations on large branches. The primary factor influencing breeding distribution is likely the availability of suitable nesting platforms within close proximity to marine water foraging areas. Marine foraging areas are usually within 1.2 to 3 miles of shore, typically in waters less than 100 feet deep.

#### References
Ralph, C. J., G. L. Hunt, M. G. Raphael, and J. F. Piatt (technical editors). 1995. Ecology and conservation of the Marbled Murrelet. Gen. Tech. Rep. PSW-GTR-152. Albany, California.

Raphael, M. G., A. Shirk, G. A. Falxa, S. F. Pearson. 2014 Habitat associations of marbled murrelets during the nesting season in nearshore waters along the Washington to California coast. Journal of Marine Systems. DOI: 10.1016/j.jmarsys.2014.06.010

**Marbled Murrelet: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Fish and wildlife habitat loss or degradation | Conversion of old forest nesting habitat to commercial forestry. Fragmentation of nesting habitat isolates remaining breeding areas, increases hard edge (attracting predators), and decreases nest success | Use land acquisitions, conservation easements and landowner agreements to protect nesting habitat and create larger contiguous forest blocks | Current insufficient | Both |
| 2 | Management decision needs | Conversion of old forest nesting habitat to commercial forestry. Fragmentation of nesting habitat isolates remaining breeding areas, increases hard edge (attracting predators), and decreases nest success | Identify and retain future potential recruitment habitat near and adjacent to currently occupied sites. Block and connect forests to reduce edge with "security forest" goal of more than 40 years old adjacent to nesting habitat. Increase nearshore terrestrial habitat | Current insufficient | Both |
| 3 | Resource information collection needs | Chronic low juvenile recruitment in a declining population | Collect data needed for comprehensive understanding of demography | Current insufficient | Both |
| 4 | Fish and wildlife habitat loss or degradation | Campgrounds/recreation sites in and near habitat can attract avian predators (corvids) and human disturbance to nesting birds | Outreach and education to to enhance refuse management at campgrounds; develop visitor management guidelines for murrelet breeding areas | Current insufficient | Both |
| 5 | Energy development and distribution | Environmental contamination in marine habitat; very vulnerable to periodic and chronic spills that may have lethal and sub-lethal effects that affect populations | Control, monitor, and timely response to contaminant (oil) spills. Identify important nearshore foraging areas and include in spill response team's maps/databases | Current insufficient | Both |

NOTE: Numbers are for reference only and do not reflect priority.

## RED-NECKED GREBE (*Podiceps grisegena)*

*See Appendix B for a potential range and habitat distribution map

### Conservation Status and Concern

Status of this species is not clear. Wintering populations in Washington exhibit ecological traits identified as risk factors for marine birds that occur in the Salish Sea and are declining.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| None | Monitor | Yes | G5 | S3B,S5N | Unknown/unknown | Low-moderate |

### Biology and Life History

Red-necked Grebes nest on freshwater lakes, reservoirs and sloughs where marsh vegetation is present and overwinter in marine bays, estuaries and protected shorelines. By May, they have usually arrived at their breeding sites where they remain until fall. By mid-November, most have returned to their wintering areas. Breeding pairs typically nest solitarily and both members of the pair incubate one brood/year. Red-necked Grebes dive for their prey and feed on fish and insects, as well as crustaceans, mollusks, amphibian eggs and larvae, and some vegetation.

Photo: R. LeValley

### Distribution and Abundance

The Red-necked Grebe overwinters along the Pacific coast from Alaska to southern California. In western Washington, it is a fairly common to common migrant and winter visitor; it rarely occurs in summer in marine waters and on freshwater lakes west of the Cascades. East of the Cascades, the Red-necked Grebe is a local, fairly common breeder in northeastern Washington, but is a rare to uncommon winter visitor. The size of Washington's breeding population is unknown.

### Habitat

Winter habitats include saltwater bays and estuaries and other protected locations. In migration, they are found on lakes, ponds, and rivers. Nesting occurs on shallow, freshwater lakes, as well as shallow protected marsh areas and secluded bays of larger lakes. Nests are constructed in reeds along lake margins and are raised slightly above the surface of the water. Nest sites are selected based on a combination of attributes including shelter from wind and waves, availability of nest materials and anchorage, easy swimming access, proximity to open water, and distance from terrestrial predators.

#### References


Stout, B. E., and G. L Nuechterlein. 1999. Red-necked Grebe (*Podiceps grisegena*). Birds of North America 465: 1-32.

Vischis, L. I., C. K. Johnson, J. R. Evenson, S. F. Pearson, K. L. Barry, P. D. Davidson, M. G. Raphael and J. K. Gaydos. 2014. Assessing ecological correlates of marine bird declines to inform marine conservation. Conservation Biology: doi: 10.1111/cobi.12378.

Wahl , T. R. 2005. Red-necked grebe (*Podiceps grisegena*). Pp 79 – 80 in T. R. Wahl, B. Tweit, and S. G. Mlodinow (eds.) Birds of Washington: Status and Distribution. Oregon State University Press, Corvallis, OR, USA. 436 pp.

**Red-Necked Grebe: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| | Resource information collection needs | Determine population trend for both winter and breeding populations | Conduct surveys to understand species trend and distribution | Current insufficient | Both |

## SHORT-TAILED ALBATROSS (*Phoebastria albatrus)*

**Conservation Status and Concern**

The Short-tailed Albatross main population is vulnerable to extreme reduction and breeding capacity due to about 90 percent of nesting pairs located in one colony (Torishima Island, Japan). Fishing vessels and fishing tactics are a mortality threat.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| Endangered | Candidate | Yes | G1 | SNA | Rare/increasing | Low |

**Biology and Life History**

The Short-tailed Albatross is the largest pelagic seabird in the North Pacific Ocean with a wingspan of 7 to 7.5 feet. It first breeds at 5 to 9 years of age with most beginning at 6 years; pairs mate for life and lifespan is about 45 years. They are ocean surface feeders, relying primarily on squid, Flying Fish and fish eggs and crustaceans; they also follow fishing vessels for bait lines and processing scraps.

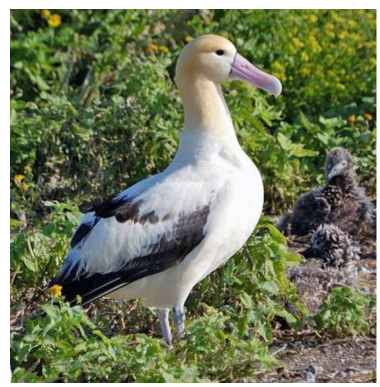

Photo: J.L. Place

**Distribution and Abundance**

Once thought to be the most abundant albatross species in the North Pacific, this species was hunted to near-extinction by 1949. Exact populations were not known; between 1885 and 1903 it is estimated that more than 5 million birds were harvested from one island colony alone (Torishima, Japan). The 2014 estimate is 661 breeding pairs among all locales and the total population estimate is 4,354 individuals, of which 1,928 are estimated to be of breeding age. Recolonization efforts began in the late 1970s, and the population is now growing at an average rate of 7.5 percent per year. However, they are still vulnerable to extreme population reduction and breeding capacity because the main breeding colony which supports about 90 percent of nesting pairs is located on an unstable volcanic island. This species was known to have occurred offshore of Washington and British Columbia, where they were considered common, in the mid-19th to early 20th century.

**Habitat**

During breeding, adults forage primarily in the upwelling zones off northern Japan. During northern summers, mostly adult birds follow trade winds to the edges of the continental shelves from China north to the Aleutian Islands and Bering Strait. Immature birds (less than 3 years) largely occur at the eastern Pacific continental shelf from the Alaskan gulf south to southern California.

**References**

Campbell R. W., N. K. Dawe, I. McTaggart-Cowan, J. M. Cooper, G. Kaiser, A. C. Stewart, and M. C. E. McNall. 1990. Birds of British Columbia, Vol. 1. University of British Columbia Press, Vancouver, British Columbia.

Jewett S. G., W. P. Taylor, W. T. Shaw, and J. W. Aldrich. 1953. Pp 67-68 *in* Birds of Washington. University of Washington Press, Seattle, Washington. 767 pp.

USFWS. 2014. Short-tailed Albatross 5-year review: summary and evaluation. Region 7, Anchorage, Alaska.

USFWS. 2008. Short-tailed Albatross recovery plan. Region 7, Anchorage, Alaska.

**Short-Tailed Albatross: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Habitat loss or degradation | Natural volcanic disturbance on main breeding island could decimate recovering populations. Eroding soils at site cause nest failure | Use land acquisitions, conservation easements and landowner agreements to protect significant colonies; reintroduce on former breeding sites; translocation of chicks | Current sufficient | External |
| 2 | Overharvesting of biological resources | Bycatch from commercial longline fisheries; wire/cable strikes from trawlers | Enforce North Pacific protective fishing equipment regulations. Increase on-board vessel observer efforts | Current sufficient | External |
| 3 | Habitat degradation | Chronic pelagic pollution: plastic debris, chemical and petroleum contaminants and toxic metals | Monitor and conduct research of short/long-term effects on chicks and adults | Current sufficient | External |

NOTE: Numbers are for reference only and do not reflect priority.

## TUFTED PUFFIN (*Fratercula cirrhata*)

### Conservation Status and Concern

In Washington, this species has experienced an order-of-magnitude population decline in recent decades and has disappeared from more than half of its historical breeding sites.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| Species of Concern | Endangered | Yes | G5 | S34B,S4N | Low/declining | Moderate |

### Biology and Life History


Photo: R. LeValley

Tufted Puffins gather in colonies on islands and headlands during spring and summer to breed and rear young. Breeding extends from mid-April to early September in Washington. Nesting occurs in burrows, where a single egg is laid. Incubation is by both members of the breeding pair and usually lasts 43 to 46 days. Rates of chick growth and survival depend on prey availability and quality. Nesting adults forage up to 38 miles from their colonies to catch prey for nestlings. Chicks are fully independent upon fledging. The species feeds on fishes, crustaceans, and cephalopods, which are caught underwater. Tufted Puffins at colonies experience predation by Bald Eagles and other predators, and kleptoparasitism by gulls. Birds winter alone or in small groups at sea.

### Distribution and Abundance

In Washington, breeding occurs on islands along the northern outer coast and in the Strait of Juan de Fuca. The population has been declining since at least the 1980s, with minimum population estimates falling from 23,342 birds in 1978 to 1982 to 2,958 birds in 2009, and only 19 of 44 historical breeding sites remaining occupied. Nearly all breeding now occurs along the outer coast. The species is very rare during winter.

### Habitat

Nesting takes place on isolated offshore islands and inaccessible headlands. Preferred nesting habitat includes grassy slopes, bluffs, and plateaus with soil deep enough for burrowing in locations free of introduced predators and human disturbance. Rocky areas and thickets are sometimes used for nesting. Foraging occurs from nearshore waters to open sea during the breeding season. The species is pelagic during the non-breeding season.

#### References


Piatt, J. F., and A. S. Kitaysky. 2002. Tufted Puffin (*Fratercula cirrhata*). Birds of North America 708: 1-31.

Hanson, T. and G. J. Wiles. 2015. Washington state status report for the Tufted Puffin. Washington Department of Fish and Wildlife, Olympia, Washington.

**Tufted Puffin: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Resource information collection needs | The cause(s) of population declines in Washington are unknown | Conduct research to determine causes of population declines | Current insufficient | Both |
| 2 | Climate change and severe weather | Reduced prey availability can result from changing ocean conditions (including climate change), overharvest, shoreline habitat loss, and other factors | Determine causes of declining prey availability; manage causes of forage fish decline to enhance prey populations | Current insufficient | Both |
| 3 | Overharvesting of biological resources | Entrapment in fishing nets | Determine ongoing sources of bycatch and manage those fisheries to reduce bycatch | Current insufficient | Both |
| 4 | Energy development and distribution | Mortality from oil spills | Expand safeguards to prevent oil spills | Current insufficient | Both |

NOTE: Numbers are for reference only and do not reflect priority.

## WESTERN GREBE (*Aechmophorus occidentalis*)

*See Appendix B for a range and potential habitat distribution map

**Conservation Status and Concern**

Western Grebe breeding populations occur in freshwater and wintering populations occur in marine waters. Each of these populations and their habitats are strongly impacted by unique threats.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| None | Candidate | Yes | G5 | S3B,S3N | Low/declining | Low-moderate |

**Biology and Life History**

Western Grebes are gregarious throughout the year. They nest in colonies that usually contain tens or hundreds of nests. Nesting and brood rearing extend from early June to late August. Brood size is usually one to three young. Chicks depart nests soon after hatching. Spring migration is mainly from late April to early May; fall migration extends from mid-September to November. Wintering birds occur in daytime flocks of up to hundreds or thousands of birds. Diet is mainly fishes and is opportunistic as to the species eaten. Aquatic invertebrates are also eaten. Prey are captured underwater by diving.

Photo: R. Gilbert

**Distribution and Abundance**

Nesting in Washington mainly occurs at several locations in Grant County, with single sites also known from Adams, Spokane, Okanogan, Lincoln, and possibly Ferry Counties. Overwintering birds are distributed throughout the Salish Sea, along the outer coast, and in nearby freshwater lakes. Size of the state's nesting population is not well known, but may number 1,000-2,000 adults, with most nesting at Potholes Reservoir. The wintering population in the state's inner marine waters has declined 99 percent since 1978 to 1979, with the population index from the 2014 annual winter survey being the lowest (9,100 ± 4,343 birds) since surveys began.

**Habitat**

Large freshwater lakes, reservoirs, and marshes are inhabited during the summer breeding season, whereas primarily coastal marine areas with relatively sheltered waters are used in winter. Both types of habitats are occupied during spring and fall migration. Nesting sites usually contain at least a few square miles of open water and areas of emergent vegetation. Nests are built in emergent vegetation.

**References**


Storer, R. W. and G. L. Nuechterlein. 1992. Western and Clark's Grebes. Birds of North America 26: 1-24.

Wahl, T. R. 2005. Western Grebe (*Aechmophorus occidentalis*). Pp 81-82 *in* T. R. Wahl, B. Tweit, and S. G. Mlodinow (eds.). Birds of Washington: status and distribution. Oregon State University Press, Corvallis, OR. 436 pp.

**Western Grebe: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Agriculture and aquaculture side effects | Major water drawdowns at reservoirs used by nesting colonies | Devise effective floating nest platforms; work with irrigation authorities to manage water levels to reduce impacts to grebes | Current insufficient | Both |
| 2 | Fish and wildlife habitat loss or degradation | Boater activity and boat wakes at nesting colonies can destroy nests, spill eggs, or cause gull predation | Identify wake-free zones near breeding colonies | Current insufficient | Both |
| 3 | Resource information collection needs | Prey base appears to have declined in the Salish Sea | Determine causes of declining forage fish availability; manage causes of forage fish decline to enhance prey populations | Current insufficient | Both |
| 4 | Energy development and distribution | Oil spills in the wintering range | Expand safeguards to prevent oil spills | Current insufficient | External |
| 5 | Overharvesting of biological resources | Bycatch in gillnet fisheries in the wintering range | Determine ongoing sources of bycatch and manage those fisheries to reduce bycatch | Current insufficient | Both |

NOTE: Numbers are for reference only and do not reflect priority.

# FALCONS, HAWKS, EAGLES

## BALD EAGLE (*Haliaeetus leucocephalus*)

*See Appendix B for a range and potential habitat distribution map

**Conservation Status and Concern**

This species has experienced recovery as a result of removal of DDT from most of its range. This species is protected under the Bald and Golden Eagle Protection Act.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| Species of Concern | Sensitive | Yes | G5 | S4B,S4N | Medium/increasing | Low-moderate |

**Biology and Life History**

Bald Eagles nest in large trees, usually near marine shorelines, large lakes or rivers. They prey on fish, waterfowl, and small mammals, or scavenge. Many birds that nest in Canada and Alaska migrate south to overwinter in Washington concentrating on rivers with spawned-out salmon, especially chum. Bald Eagles generally first breed at about 5 to 6 years of age, and adults may not lay eggs every year. They commonly roost communally, especially in winter. Bald Eagles return to their breeding territories year after year and may repair and use the same nest for many successive years or may construct alternate nests within the territory. Territories also typically contain large perch trees.

Photo: R. LeValley

**Distribution and Abundance**

The resident population was about 1,500 breeding pairs as of the last comprehensive census conducted in 2005; up to 4,000 individuals overwinter in Washington. Bald Eagles nest primarily along marine shorelines and major rivers of western and northeastern Washington. Nests are rare or absent from the Columbia Basin and southeastern Washington, but overwintering birds can be locally common.

**Habitat**

Breeding habitat most commonly includes areas close to coastal areas, bays, rivers, lakes, reservoirs, or other bodies of water that reflect the general availability of primary food sources including fish, waterfowl, or seabirds. Nests are usually constructed in large trees. Tree species used for nesting vary and may include conifers and hardwoods. Winter roosts are usually located in uneven-aged patches of trees in locations that are protected from wind and inclement weather.

**References**

Seavey, J. R. 2005. Bald Eagle (*Haliaeetus leucocephalus*). Pp 111-112 *in* T.R. Wahl, B. Tweit, and S.G. Mlodinow (eds.). Birds of Washington: status and distribution. Oregon State University Press, Corvallis, OR. 436 pp.

Stinson, D. W., J. W. Watson, and K. R. McAllister. 2007. Washington State Status Report for the Bald Eagle. Washington Department of Fish and Wildlife, Olympia. 86 + viii pp.

**Bald Eagle: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Management decision needs | Retention of trees in various size and age classes within Bald Eagle habitat | Provide landowners with incentives to maintain trees on their property | Current insufficient | External |
| 2 | Management decision needs | Population has recovered and appears to be robust | Conduct status review | Nothing current – new action needed | WDFW |
| 3 | Resource information collection needs | Location and site status data are not current | Participate in development of strategy to update information for management purposes | Nothing current - new action needed | Both |

NOTE: Numbers are for reference only and do not reflect priority.

## FERRUGINOUS HAWK *(Buteo regalis)*

*See Appendix B for a range and potential habitat distribution map

**Conservation Status and Concern**

This species is impacted by the loss and fragmentation of shrub-steppe and grasslands from agriculture and residential development and associated declines in distribution and abundance of its primary prey, jackrabbits and ground squirrels. Integrity of shrub-steppe and grassland ecosystems in supporting abundant and diverse populations of prey species is critical to the recovery of this hawk. In addition, direct sources of mortality include illegal shooting, electrocution, and collision with wind turbines.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| Species of Concern | Threatened | Yes | G4 | S2B | Low/declining | Low-moderate |

**Biology and Life History**

This species is migratory and arrives on the breeding areas from late April through July. Prey species include primarily jackrabbits and ground squirrels historically, with a recent shift to pocket gophers, reptiles, and insects. Following nesting, Ferruginous Hawks typically migrate to the eastern front of the Rocky Mountains to exploit abundant ground squirrels, followed by a subsequent migration to central California.


Photo: Bureau of Land Management

**Distribution and Abundance**

Washington State is on the northwestern edge of the species' breeding range. Over 200 territories have been documented in Washington; Franklin and Benton Counties together host about 60 percent of the Ferruginous Hawk territories, and Grant, Walla Walla, Adams, and Yakima Counties have had 13 or more territories each. In 2002, only 20 percent of historical Ferruginous Hawk nesting territories in Washington were occupied, with many vacant for years. The current population size is unknown, but likely is very small.

**Habitat**

Ferruginous Hawks occur in arid grasslands and shrub-steppe habitats. Nests occur on small rock outcrops on the slope of steep hillsides or canyons or in isolated trees, such as junipers.

**References**


Bechard, M. J. and J. K. Schmutz. 1995. Ferruginous Hawk (*Buteo regalis*). Birds of North America. 172: 1-20.

Richardson, S. A., A. E. Potter, K. L. Lehmkuhl, R. Mazaika, M. E. McFadzen, and R. Estes. 2001. Prey of ferruginous hawks breeding in Washington. Northwestern Naturalist 82:58–64.

Watson, J. W. 2003. Migration and winter ranges of ferruginous hawks from Washington. Final Report. WDFW, Olympia, Washington, USA. http://wdfw.wa.gov/publications/00131/


**Ferruginous Hawk: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Agriculture and aquaculture side effects | Loss, degradation, and fragmentation of shrub-steppe foraging habitat and associated declines in distribution and abundance of major prey species, especially jackrabbits and ground squirrels | Protect and restore shrub-steppe habitat | Current insufficient | Both |
| 2 | Fish and wildlife habitat loss or degradation | Human disturbance may cause nesting failure and nest abandonment | Protect nest sites from disturbance | Current insufficient | Both |
| 3 | Overharvesting of biological resources | Poisoning of ground squirrels, low prey abundance negatively influences reproduction | Consider reclassifying some ground squirrels as protected wildlife; public outreach | Current insufficient | Both |

NOTE: Numbers are for reference only and do not reflect priority.

## GOLDEN EAGLE (*Aquila chrysaetos*)

*See Appendix B for a range and potential habitat distribution map

**Conservation Status and Concern**

This species is of concern due to declines in the distribution and abundance of its primary prey species, jackrabbits and ground squirrels; additional mortality factors include continued exposure to lead in the environment and collisions at wind energy facilities. Foraging habitat in shrub-steppe and grasslands has declined due to loss and degradation of these habitats from agriculture, human development, and overgrazing. This species is protected under the Bald and Golden Eagle Protection Act.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| None | Candidate | Yes | G5 | S3 | Low/unknown | Moderate |

**Biology and Life History**

The same nest sites are typically used year after year and the pair maintains one or more alternate nests. Preferred prey include medium to large-sized mammals and birds, including hares, rabbits, ground squirrels, and marmots with Mountain Beaver being an important prey source in western Washington. Nesting success varies by year and region.

Photo: J. Watson

**Distribution and Abundance**

Golden Eagles have a broad distribution throughout the mountainous areas of the state, especially in eastern Washington. Breeding is limited primarily to the Okanogan highlands, rainshadows of the Olympics and Cascades, the Blue Mountains along the Snake and Grande Ronde rivers, and the San Juan Islands. The resident population occurs at low densities in areas where suitable nest sites (cliffs and trees) are found in proximity to abundant prey. There are over 300 documented breeding territories in Washington, of which over 80 percent are in eastern Washington. Occupancy of these sites is not well understood and information on the number of sites occupied in a given year, as well as an estimate of abundance, are currently lacking.

**Habitat**

This species is found mostly in dry open forests of eastern Washington, shrub-steppe, canyonlands, in high-elevation alpine zones of all regions, and sparingly in clearcut areas in western Washington. It is associated with steep terrain, which often includes cliffs where nests occur. Nests are situated on cliff ledges, rocky outcrops, large trees, or human made structures, such as power poles and transmission towers. Most eastside nests are on cliffs; westside nests are above timberline or in very large trees that border on extensive clearcuts. Shrublands and grasslands, open meadows, avalanche chutes, talus fields and rock outcrops, balds, bogs, recently burned areas, and clearcuts are used as hunting sites.

**References**

Bosakowski, T. 2005. Golden eagle (*Aquila chrysaetos)*. Pp 121 – 122 *in* T. R. Wahl, B. Tweit, and S. G. Mlodinow (eds.) Birds of Washington: Status and Distribution. Oregon State University Press, Corvallis, OR, USA. 436 pp.

Kochert, M. N., K. Steenhof, C. L. McIntyre, and E. H. Craig. 2002. Golden eagle (*Aquila chrysaetos*). Birds of North America 684: 1-44.

**Golden Eagle: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Agriculture and aquaculture side effects | Loss, degradation, and fragmentation of shrub-steppe foraging habitat and associated declines in distribution and abundance of major prey species, especially jackrabbits and ground squirrels | Protect and restore habitat; conservation of prey populations | Current insufficient | Both |
| 2 | Energy development and distribution | Collisions at wind energy facilities | Implement measures to minimize mortality risks at wind energy facilities | Current insufficient | Both |

NOTE: Numbers are for reference only and do not reflect priority.

## PEREGRINE FALCON (*Falco peregrinus*)

*See Appendix B for a range and potential habitat distribution map

**Conservation Status and Concern**

This species has experienced a remarkable recovery and the population continues to increase across Washington.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| Species of Concern | Sensitive | Yes | G4 | S2B,S3N | Low/increasing | N/A |

**Biology and Life History**

Peregrine Falcons are predators of other birds ranging in size up to waterfowl and gulls. Peregrine Falcons are generally monogamous, and may form long-term pair bonds. They usually nest on a cliff near water, but as the species recovers and its range expands, they can also be found nesting on human-built structures (e.g. tall buildings, bridges).

Photo: R. LeValley

**Distribution and Abundance**

Breeds up to about 3000 feet in elevation (sometimes higher) in nearly all parts of the state; highest densities are along the northern outer coast and San Juan Islands. Also found in Cascade Range foothills, along the Columbia River and associated with other water bodies in the Columbia Basin. Over 170 breeding territories have been documented as of 2014. This is an uncommon resident, migrant, and wintering species in western lowlands, and rare to uncommon summer resident and migrant in the mountains and eastern lowlands.

### Habitat

Peregrine Falcons breed on cliffs, and occasionally tall buildings, bridges and other locations that offer security and a vantage point above surrounding terrain. They hunt primarily in areas of open cover types that include estuaries, agricultural fields, coastal beaches, water bodies, and in some urban areas.

#### References

Anderson, C. M. and S. G. Herman. 2005. Peregrine Falcon (*Falco peregrinus*). Pp 126-127 *in* Wahl, T.R., B. Tweit, and S.G. Mlodinow (Eds.), Birds of Washington: status and distribution. Oregon State University, Corvallis, OR, USA. 436 pp.

White, C. M., N. J. Clum, T. J. Cade, and G. Hunt. 2002. Peregrine Falcon (*Falco peregrinus*). The Birds of North America 660: 1-48.

### Peregrine Falcon: Conservation Threats and Actions

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| | Management decision needs | Population has recovered and appears to be robust | Conduct status review | Nothing current - new action needed | WDFW |

# CRANES

## SANDHILL CRANE (GREATER) (*Grus canadensis tabida*)

*See Appendix B for a range and potential habitat distribution map

**Conservation Status and Concern**

The Washington population of Greater Sandhill Cranes numbers about 80 adult and sub-adult birds, with about 30 breeding pairs. Sandhill Cranes are long-lived, but have a low reproductive rate, and nests are vulnerable to predators, disturbance, and fluctuating water levels.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| None | Endangered | Yes | G5T4 | S1B,S3N | Critical/increasing | Moderate |

**Biology and Life History**

Sandhill Cranes eat insects, rodents, snails, small reptiles and amphibians, nestling birds, the roots of aquatic plants, tubers, berries, seeds, and grains. The courtship of cranes includes elaborate rituals. Pairs return to the same nesting territories year after year and sometimes use the same nest repeatedly. Nests, which are built in emergent vegetation in shallow water or close to water, are a mound of plant material pulled up from around the site and anchored to surrounding vegetation. The young learn migratory routes from adults, and Washington birds migrate to the Central Valley of California. Reproductive rates are low and birds often mate for life.

Photo: R. LeValley

**Distribution and Abundance**

This species formerly nested at numerous sites throughout eastern Washington, and was extirpated for about 30 years; they currently breed at about six locations in Klickitat and Yakima Counties. The breeding population in Washington numbers only about 30 pairs, but has been slowly increasing.

**Habitat**

Sandhill Cranes live in wet meadows and grasslands, and they feed in grain fields and pastures. Breeding territories contain wetlands, grassy uplands, partially forested uplands, and wet meadows, and are sometimes surrounded by forest. Emergent vegetation is a key component of their preferred nesting areas. During migration and in winter they live in more open grassland, agricultural fields, and river valleys. Sandhill Cranes typically use habitats where they have clear views of their surroundings.

**References**


Littlefield, C. D., and G. L. Ivey. 2002. Washington State Recovery Plan for the Sandhill Crane. Washington Department of Fish and Wildlife, Olympia, Washington.

Tacha, T. C., S. A. Nesbitt, and P. A. Vohs. 1992. Sandhill crane (*Grus canadensis tabida*). Birds of North America 31: 1-24.

**Sandhill Crane (Greater): Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Resource information collection needs | Inadequate information needed to manage small population | Aerial surveys of nesting territories | Current insufficient | Both |
| 2 | Resource information collection needs | Assess survival, recruitment | Analysis of banding data to assess recruitment/survival | Current insufficient | External |
| 3 | Agriculture and aquaculture side effects | Nests vulnerable to water-level changes | Enhance effectiveness of water management | Current insufficient | External |

NOTE: Numbers are for reference only and do not reflect priority.

# SHOREBIRDS

## MARBLED GODWIT (*Limosa fedoa*)

**Conservation Status and Concern**

Due to the extremely small size of the *beringiae* subspecies population and the localized area of foraging and roosting in coastal Washington, the Marbled Godwit is vulnerable to oil spills or other actions that would degrade or impact its habitat. Human disturbance currently does not appear to be a concern.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| None | None | Yes | G5 | S3N | Low/increasing | Moderate |

**Biology and Life History**

The Marbled Godwit is one of the largest shorebirds in the world. In coastal areas, they use a variety of intertidal invertebrates that are extracted from mudflats. They nest in native prairie grasslands, wet meadows and similar cover types.

Photo: R. LeValley

**Distribution and Abundance**

Three separate breeding regions are known in North America and both *fedoa* and *beringiae* subspecies likely occur in Washington. The *beringiae* subspecies breeds in a small area of the Alaska Peninsula. The estimated global population is 140,000 to 200,000, and this includes the *beringiae* population of about 2,000. The latter subspecies is thought to overwinter between Washington and California, whereas the *fedoa* population from the northern Great Plains overwinters between central California and coastal Mexico. Marbled Godwits occur primarily at Willapa Bay and Grays Harbor. The primary area for the species is northern Willapa Bay (they roost at the Tokeland Marina) and southern Grays Harbor (they roost at Westport). Considered a very rare visitor several decades ago, Marbled Godwit abundance in Washington has increased steadily and some recent counts have exceeded 1500 birds.

### Habitat

Typically associated with tidal mudflats and sandflats, but small numbers at times also use coastal beaches. In the Columbia Basin, where it is very uncommon, short grass areas and shorelines are used.

#### References

Buchanan, J. B. 2005. Marbled Godwit (*Limosa fedoa*). Page 149 *in* T. R.Wahl, B. Tweit, and S.G. Mlodinow (Eds.), Birds of Washington: status and distribution. Oregon State University, Corvallis, OR, USA. 436 pp.
Gratto-Trevor, C. L. 2000. Marbled Godwit (*Limosa fedoa*). The Birds of North America 492: 1-24.

### Marbled Godwit: Conservation Threats and Actions

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Fish and wildlife habitat loss or degradation | Oil spill that impacts foraging area and fouls foraging birds | Maintain spill response effectiveness | | Both |
| 2 | Resource information collection needs | Small population size | Clarify subspecies occurrence in Washington | Current insufficient | Both |

NOTE: Numbers are for reference only and do not reflect priority.

## RED KNOT (*Calidris canutus roselaari*)

### Conservation Status and Concern

Limited information suggests the population has declined; its localized use of food resources in tidal areas along the flyway suggests it will be sensitive to climate change effects.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| None | None | Yes | G4 | S3N | Low/declining | Moderate |

### Biology and Life History

Red Knots of the subspecies *roselaari* are found in Washington, chiefly during spring migration. Spring migration occurs primarily in May. Red Knots are known to consume a variety of invertebrates, but they are considered bivalve specialists. Red Knots nest in Arctic and sub-arctic tundra where nests are situated on the ground.

Photo: J. Buchanan

### Distribution and Abundance

The species is very local in its distribution, both in Washington and elsewhere along the flyway. It is found on the outer coast, almost exclusively in Willapa Bay and Grays Harbor; these sites are major stopovers along the Pacific Flyway and likely support a large proportion of the population. The population estimate in coastal Washington is about 17,000, making *roselaari* the least common of six global subspecies and one of the least common sandpipers to use the Pacific Flyway as its primary flyway. This subspecies breeds in northwestern Alaska and Wrangel Island, Russia and overwinters primarily at coastal locations in northwestern Mexico. Limited information suggests a decline in abundance in the last 35 years. Most autumn migrants bypass Washington; very rare in summer and winter, and in any season away from the outer coast.

### Habitat

Primary foraging habitats include estuarine intertidal mud and sand flats; they will occasionally forage in pastures adjacent to estuaries during high tide. Red Knots roost primarily on sand islands and low marsh shorelines, but they also use sand spits, and rarely sandy beaches or pastures in or near estuaries.

#### References

Chappell, C. B. 2005. Red Knot (*Calidris canutus*). Pp 152-153 in Wahl, T. R., B. Tweit, and S. G. Mlodinow (Eds.), Birds of Washington: status and distribution. Oregon State University, Corvallis, OR, USA. 436 pp.

Harrington, B. A. 2001. Red Knot (*Calidris canutus*). The Birds of North America 563:1-32.

**Red Knot: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Resource information collection needs | Population appears to have declined; more information needed to assess risks, vulnerability, population status | Collect information to address threats | Current insufficient | Both |
| 2 | Fish and wildlife habitat loss or degradation | Oil spill that impacts foraging area and fouls foraging birds | Spill response effectiveness | | Both |
| 3 | Invasive and other problematic species and genes | Spartina removal has been successful, but tideflat elevation has increased due to trapped sediments. This may have altered food resources | Investigate food habits and prey availability; conduct experiments to restore tideflats to former elevation | Current insufficient | Both |

NOTE: Numbers are for reference only and do not reflect priority.

## ROCK SANDPIPER (*Calidris ptilocnemis*)

**Conservation Status and Concern**

Studies predicting vulnerabilities of Rock Sandpipers to climate change indicate no change in risk associated with wintering and migration habitats; all breeding habitat exists outside Washington State, and does have expected increased risk associated with climate change.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| None | None | Yes | G5 | S3N | Low/unknown | Low-moderate |

**Biology and Life History**

Washington has migratory and wintering populations of Rock Sandpipers. Rock Sandpipers in Washington migrate to breeding sites on Pribilof and St. Matthew islands. In Washington, Rock Sandpipers usually aggregate in small flocks (or as singles), although in Alaska they aggregate in flocks of hundreds or even thousands. As might be indicated by the size and shape of their bill, Rock Sandpipers probe into rocky crevices and do not chip or pry prey from the surface of the rocks.


Photo: A.D. Wilson

**Distribution and Abundance**

Most Rock Sandpipers spend the winter in Alaska and British Columbia, and comparatively small numbers migrate as far south as California. The species is almost completely limited to outer coastal areas. Perhaps fewer than 100 to 200 birds overwinter in Washington, although survey efforts along coastal areas are impractical in many areas, so this estimate is uncertain. The abundance of Rock Sandpipers at Christmas Bird Count locations south of southern British Columbia declined beginning in the early 1980s, and this coincided with increases in abundance in Alaska, which suggested a range contraction.

**Habitat**

The Rock Sandpiper is almost exclusively associated with rocky shoreline habitats. These areas include rock shorelines and rock jetties. They are sometimes found on sand beaches in very small numbers. Large numbers of Rock Sandpipers use mudflats in Alaska and also roost on floating ice there.

**References**


Andres, B. A., P. A. Smith, R. I. G. Morrison, C. L. Gratto-Trevor, S. C. Brown, and C. A. Friis. 2012. Population estimates of North American shorebirds, 2012. Wader Study Group Bull. 119: 178-194.

Galbraith, H., D. W. DesRochers, S. Brown, J. M. Reed. 2014. Predicting vulnerabilities of North American shorebirds to climate change. PLoS ONE 9(9):e108899. Doi:10.1371/journal.pone.0108899

Ruthrauff, D. R. 2014. On the frozen edge: environmental and physiological constraints in the life history of a northerly-wintering shorebird. PhD Thesis, University of Groningen, Groningen, The Netherlands.


**Rock Sandpiper: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Resource information collection needs | Lack of information about abundance in Washington | Work with partners on surveys to understand species distribution and abundance | Current insufficient | Both |
| 2 | Resource information collection needs | Trends in populations are unknown | Conduct monitoring and demographic studies on the breeding grounds to understand population trend | Unknown | External |

NOTE: Numbers are for reference only and do not reflect priority.

## UPLAND SANDPIPER (*Bartramia longicauda*)

### Conservation Status and Concern

Habitat loss most likely contributed to population decline of this species in Washington. Incomplete information on distribution prevents meaningful protection should there be breeding birds in the state. Scarcity of records suggests it may no longer breed in Washington.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| None | Endangered | Yes | G5 | SHB | Critical/unknown | Moderate |

### Biology and Life History

Photo: G. Lasley

Nests are situated on the ground in wet meadow vegetation where the loosely woven cup of grasses is well concealed. This species is inconspicuous, and is typically detected when giving courtship calls in flight or while on a perch such as a wooden fence post. Upland Sandpipers feed almost exclusively on insects, especially grasshoppers and crickets, weevils, and other small invertebrates gathered from or close to the ground. Occasional seeds of weeds, grasses and waste grains, including wheat, are also consumed.

### Distribution and Abundance

This species may be extirpated as a breeder in the state, although comprehensive surveys in potential habitat away from documented historical breeding areas have not been conducted. As a breeder in eastern Washington, the Upland Sandpiper's known distribution in the state has always been very limited. Breeding was documented at Turnbull NWR and in the Spokane Valley. Regular observations were made in this area from the mid-1950s into the late-1980s. Virtually all habitat in the Spokane Valley has been converted. Migrants are rare in Washington.

### Habitat

This species nests in wet meadows with relatively tall grasses. During migration, it is found in a variety of open habitats with relatively short or sparse vegetation such as plowed fields, airports, golf courses, beach dunes, and sod farms.

#### References


Houston, C. S. and D. E. Bowen, Jr. 2001. Upland Sandpiper (*Bartramia longicauda*). The Birds of North America 580:1-32.

Mlodinow, S. G. 2005. Upland Sandpiper (*Bartramia longicauda*). Page 145 *in* T. R. Wahl, B. Tweit, and S. G. Mlodinow (eds.) Birds of Washington: Status and Distribution. Oregon State University Press, Corvallis, OR, USA. 436 pp.

**Upland Sandpiper: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Resource information collection needs | Need to assess current distribution and abundance of species | Identify areas of habitat within likely range; conduct breeding season surveys | Current insufficient | Both |
| 2 | Resource information collection needs | Protection status of habitat | Need to assess current distribution and protection status of habitat | Current insufficient | Both |

NOTE: Numbers are for reference only and do not reflect priority.

## WESTERN SNOWY PLOVER (*Charadrius alexandrinus nivosus*)

**Conservation Status and Concern**
Washington's population is very small and vulnerable to a variety of impacts such as predation, adverse weather, shoreline modification, dune stabilization, and recreational activities.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| Threatened | Endangered | Yes | G3 | S1 | Low/increasing | Moderate-high |

**Biology and Life History**
Snowy Plovers nest on the ground and leave the n s (or male only), and the female often then abandons its first mate and brood within a few days to renest with a new mate. Predation by gulls, Common Ravens, Red Foxes, skunks, Raccoons, and/or Coyotes may result in a high rate of clutch loss in some areas.

**Distribution and Abundance**
The Pacific coast breeding population extends from Washington to northwestern Mexico; some are found farther south during winter. In Washington, Snowy Plovers are found only in Pacific and Grays Harbor Counties. The Washington population consists of less than 50 adult birds, and is dependent on immigration from Oregon. Populations are responding to intensive conservation efforts, but viability analysis indicates that the Pacific coast population is unlikely to reach the federal recovery objective of 3,000 birds.

**Habitat**

In Washington, Snowy Plovers are found (in any season) primarily above the high tide line on coastal beaches, sand spits, dune-backed beaches, and sparsely vegetated dunes. Nests are on the ground on broad open beaches or salt or dry mud flats, where vegetation is sparse or absent (small clumps of vegetation are used for cover by chicks).

**References**


Pearson, S. F., C. Sundstrom, B. Hoenes, and W. Ritchie. 2014. Washington State Snowy Plover Population Monitoring, Research, and Management: 2013 Nesting Season Research Progress Report. Washington Department of Fish and Wildlife, Olympia, Washington.

USFWS. 2007. Recovery plan for the Pacific coast population of the western snowy plover(*Charadrius alexandrinus nivosus)*. USFWS, Sacramento, California.

WDFW. 1995. Washington State recovery plan for the Snowy Plover. Olympia, Washington.


**Western Snowy Plover: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Fish and wildlife habitat loss or degradation | Human disturbance; beach walkers, pets, cars | Expand efforts to reduce disturbance to areas used by plovers | Current insufficient | Both |
| 2 | Invasive and other problematic species and genes | Nest predation by corvids | Control nest predation; continue ongoing program that uses nest exclosures and other measures | Current sufficient | Both |
| 3 | Fish and wildlife habitat loss or degradation | Degradation of habitat | Continue programs to enhance nesting habitat by removing beach grass in key areas | Current insufficient | Both |
| 4 | Resource information collection needs | Ongoing surveys and nesting protection measures | Continue annual surveys conducted during breeding and winter periods | Current sufficient | Both |

NOTE: Numbers are for reference only and do not reflect priority.

# PIGEONS

## BAND-TAILED PIGEON (*Patagioenas fasciata)*

**Conservation Status and Concern**

The Band-tailed Pigeon population, which is reliant on upland forests and limited mineral sources in western Washington, has declined due to a combination of factors.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| None | None | Yes | G4 | S34B,S4N | Low/declining | Low-moderate |

**Biology and Life History**

Band-tailed Pigeons in Washington are presumably monogamous, and most clutches have one egg; however, some pairs may nest up to three times a year depending on weather conditions. In some years, the protozoan *Trichomoniasis gallinae* contributes to increased mortality of Band-tailed Pigeons, and is passed directly from one bird to another through food, water, and other means. Band-tailed Pigeons seek a mineral supplement to their diet of berries, which contains few minerals. Mineral sites are important for Band-tailed Pigeons; they provide needed sodium (and possibly calcium) during the nesting season. The species is site-faithful to breeding areas, which are usually in proximity to mineral sources, but flocks can be nomadic depending on food availability.


Photo: R. LeValley

**Distribution and Abundance**

Band-tailed Pigeons in Washington are found primarily west of the Cascades during spring and summer. Direct population estimates of Pacific coast Band-tailed Pigeons are extremely difficult to obtain because of poor visibility and inaccessibility at use sites. Breeding Bird Survey results indicate that the trend since 1968 has decreased two percent per year; results of a mineral site survey since 2003 have been inconclusive. Population declines have led to very restrictive hunting regulations since 1990 in the Pacific coast states, and the season was closed in Washington from 1991 to 2001. The size of Washington’s breeding population is unknown.

**Habitat**

Band-tailed Pigeons nest primarily in conifers, occasionally in hardwoods and shrubs, within closed canopy conifer, or mixed hardwood and conifer forests. Food resources include berry- and nut-producing trees and shrubs such as cascara, elderberry, wild cherry, huckleberry, and madrone. Habitats for Band-tailed Pigeons have been influenced by timber harvest and management of clearcuts to reduce forage species. Less than 40 mineral sites used by Band-tailed Pigeons have been identified in Washington, and many are in private ownership without protection from loss or degradation.

**References**

Pacific Flyway Council 2010. Pacific Flyway management plan for the Pacific Coast population of band-tailed pigeons. Pacific Coast Band-tailed Pigeon Subcommittee, Pacific Flyway Study Committee [c/o USFWS], Portland, Oregon.

**Band-Tailed Pigeon: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Management decision needs | Effects of timber management practices | Promote use of best management practices (PHS) by timber companies | Current insufficient | Both |
| 2 | Resource information collection needs | Unknown use of alternate mineral sites | Conduct telemetry study to document new mineral sites and understand spatial context of site use | Current insufficient | Both |
| 3 | Agriculture and aquaculture side effects | Loss of foraging habitat due to broadleaf / shrub suppression in managed forests | Research to quantify forage distribution, abundance, and trends | Current insufficient | Both |
| 4 | Fish and wildlife habitat loss or degradation | Loss of mineral sites due to development | Protect existing mineral sites using a variety of strategies | Current insufficient | Both |

NOTE: Numbers are for reference only and do not reflect priority.

# CUCKOOS

## YELLOW-BILLED CUCKOO *(Coccyzus americanus)*

*See Appendix B for a range and potential habitat distribution map

**Conservation Status and Concern**

This species is not known to have bred in Washington since about 1940 and has been a very rare migrant and summer resident since then. Recovery efforts are probably best directed at remnant nesting habitats still occupied in the southwest U.S.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| Candidate | Candidate | Yes | G5 | SH | Extirpated/declining | Moderate |

**Biology and Life History**

A migratory species, Yellow-billed Cuckoos begin arriving in western North America in mid- to late May. Most nesting occurs between June and early August, but can extend from late May until late September. This species usually builds its own nests and cares for its own young. In the west, nests are often placed in willows, cottonwoods, and shrubs. Two clutches may be laid in years of good food supply. Females occasionally lay their eggs in the nests of other birds. Diet consists mainly of large insects such as caterpillars, grasshoppers, katydids, beetles, and crickets, with small vertebrate prey also taken.

Photo: US Forest Service

**Distribution and Abundance**

Yellow-billed Cuckoos nest across much of the eastern and central U.S. and parts of Canada, Mexico, and the Caribbean, and overwinter in the northern three-quarters of South America. Breeding also once occurred over much of the western U.S., but is now largely restricted to a few areas of the Southwest after major population declines. The species formerly bred uncommonly in parts of western Washington, but is now a very rare migrant statewide, with single records in 4 years between 2000 and 2014. Breeding probably ended in the state by about 1940.

**Habitat**

Yellow-billed Cuckoos display a strong preference for large, continuous riparian zones with cottonwoods and willows. In Washington, nesting also took place in fir woodlands and open brushy hillsides.

**References**


Tweit, B. 2005. Yellow-billed cuckoo *(Coccyzus americanus)*. Page 210 *in* T. R. Wahl, B. Tweit, and S. G. Mlodinow(eds.). Birds of Washington: status and distribution. Oregon State University Press, Corvallis, OR, USA. 436 pp.

USFWS. 2013. Endangered and threatened wildlife and plants; proposed threatened status for the western distinct population segment of the yellow-billed cuckoo (*Coccyzus americanus*). Federal Register 78:61622-61666.

**Yellow-Billed Cuckoo: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Resource information collection needs | Document records of Yellow-billed Cuckoo occurrence in Washington | Continue working with the birdwatching community to continue documenting sightings of cuckoos in Washington | Current insufficient | Both |
| 2 | Fish and wildlife habitat loss or degradation | Loss and degradation of riparian forests are a broad problem across the west | No management activities targeting this species are currently conducted due to its scarcity in the state, although broader efforts to protect and restore riparian forests would perhaps be beneficial | Nothing current - new action needed | Both |

NOTE: Numbers are for reference only and do not reflect priority.

# OWLS

## BURROWING OWL (*Athene cunicularia*)

**Conservation Status and Concern**

This species is associated with shrub-steppe and grassland habitats and has experienced a contraction of its range and possible decline in numbers due to loss of native grassland and shrub-steppe and eradication of burrowing mammals such as ground squirrels, Yellow-bellied Marmots, and American Badgers.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| Species of Concern | Candidate | Yes | G4 | S2B | Low/declining | Low-moderate |

**Biology and Life History**

Burrowing Owls are migratory, although some regularly overwinter in Washington. It is an uncommon breeder in eastern Washington and is extremely rare during migration in western Washington. Burrowing Owls are dependent upon abandoned burrows created by mammals for nesting, food caching and roosting in shrub-steppe and grasslands. Each spring, pairs return to the same burrows they inhabited previously, if still available, and defend the immediate area

Photo: R. LeValley

around the burrow entrance from other Burrowing Owls. Perches are important for the early detection of predators and potential prey. Diet includes small mammals and insects.

### Distribution and Abundance

Burrowing Owls may be declining in Washington (based on Breeding Bird Survey data). The size of Washington's breeding population is unknown.

### Habitat

Burrowing Owls are inhabitants of shrub-steppe and steppe and use abandoned mammal burrows for nesting. Habitats include open grasslands, especially prairie, plains, and savanna, sometimes other open areas such as vacant lots near human habitation or airports. This owl spends much time on the ground or on low perches such as fence posts or dirt mounds.

#### References


Haug, E. A., B. A. Millsap, and M. S. Martell. 1993. Burrowing owl (*Speotyto cunicularia*). Birds of North America 61: 1-20.

WDFW. 2013. Threatened and Endangered Wildlife in Washington: 2012 Annual Report. Washington Department of Fish and Wildlife, Olympia.


### Burrowing Owl: Conservation Threats and Actions

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Fish and wildlife habitat loss or degradation | Conversion of grasslands destroys nesting burrows and foraging habitat, degrades habitat quality, and may increase vulnerability to predators | Work with land owners to restore native vegetation and conserve local populations of burrowing mammals around breeding colonies of owls. Implement voluntary agreements and conservation easements to conserve habitat | Current insufficient | Both |
| 2 | Overharvesting of biological resources | Decline in burrowing mammals due to poisoning, trapping, shooting | Reduce persecution of burrowing mammals through regulation, outreach and education | Current insufficient | Both |
| 3 | Resource information collection needs | Unknown abundance and population trend | Conduct surveys to assess status and trends | Current insufficient | Both |

NOTE: Numbers are for reference only and do not reflect priority.

## FLAMMULATED OWL (*Otus flammeolus*)

*See Appendix B for a range and potential habitat distribution map

### Conservation Status and Concern

Flammulated Owls are probably impacted by habitat loss (and degradation) and fire suppression in dry forest landscapes.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| None | Candidate | Yes | G4 | S3B | Low/unknown | Moderate-high |

### Biology and Life History

The Flammulated Owl is the only Neotropical migrant owl in North America. It breeds in western North America and migrates to Mexico and Guatemala. In Washington, it is found in dry forests where pairs occupy small territories. Prey items are generally dominated by insects, including moths. The maximum recorded longevity of a Flammulated Owl in the wild is about 7 to 8 years. Rates of nest success and productivity in Washington are not known.

Photo: J. Patterson

### Distribution and Abundance

This species appears to be uncommon and is found in ponderosa pine and other dry forest regions on the eastern slope of the Cascade Range, the Kettle Range, Selkirk Mountains, and Blue Mountains. Surveys conducted in Washington found the species most often in ponderosa pine and dry Douglas-fir forests, but also in other forest types. Studies from other parts of the species' range have concluded the species may be somewhat more common than originally thought. The size of Washington's breeding population is unknown.

### Habitat

Most strongly associated with mid- and late-seral ponderosa pine forests with an open canopy cover, a presence of cavity trees or snags, and at least some areas of dense foliage (perhaps used as protective cover) within an otherwise generally open understory.

#### References


Buchanan, J. B. 2005. Flammulated Owl (*Otus flammeolus*). Pp 211-212 *in* T. R. Wahl, B. Tweit, and S. G. Mlodinow (eds.) Birds of Washington: Status and Distribution. Oregon State University Press, Corvallis, OR, USA. 436 pp.

McCallum, D. A. 1994. Flammulated Owl (*Otus flammeolus*). The Birds of North America 93:1-24.

**Flammulated Owl: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Fish and wildlife habitat loss or degradation | Effects of fire suppression | Develop and implement dry forest management and restoration programs | Current insufficient | Both |
| 2 | Agriculture and aquaculture side effects | Loss of ponderosa pine forest (and other dry forests) | Promote protection and effective management of dry forests using a variety of tools | Current insufficient | Both |

NOTE: Numbers are for reference only and do not reflect priority.

## GREAT GRAY OWL (*Strix nebulosa*)

*See Appendix B for a potential range and habitat distribution map

**Conservation Status and Concern**

Little is known about this species, and although impacts and range contraction may have occurred over the last century, current threats and impacts are not understood.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| None | Monitor | No | G5 | S2B | Low/unknown | Moderate-high |

**Biology and Life History**

This is one of the least-studied owl species in Washington. Research in other regions indicates that the diet of this forest-dwelling owl is dominated by voles and pocket gophers. Most Great Gray Owls breed by 3 years of age, although some pairs may not breed in years of low prey abundance.

Photo: A. List

**Distribution and Abundance**

This is a rare local breeder in parts of northern Washington such as the Okanogan Highlands (and perhaps other locations), and a rare winter visitor elsewhere in the state, occasionally including lowland areas. Records from a century ago suggest the species formerly nested at low elevations in western Washington. The population in Washington is very small (likely fewer than 20 to 40 territories) and is thought to be stable.

**Habitat**

Mature conifer forests of Douglas-fir, western larch, ponderosa pine, Engelmann spruce, subalpine fir, and lodgepole pine adjacent to foraging areas in openings and wet meadows, sometimes in association with quaking aspen, are cover types used by this species.  Great Gray Owls nest in broken-topped snags, clusters of mistletoe-infected branches, and nests built by other species (for example, Northern Goshawk).

**References**


Anderson, C. M. and K. Woodruff. 2005.  Great Gray Owl (*Strix nebulosa*). Pp 219-220 *in* T. R. Wahl, B. Tweit, and S. G. Mlodinow (eds.) Birds of Washington: Status and Distribution. Oregon State University Press, Corvallis, OR, USA. 436 pp.

Bull, E. L. and J. R. Duncan. 1993. Great Gray Owl (*Strix nebulosa*). The Birds of North America 41:1-16.


**Great Gray Owl:  Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| | Resource information collection needs | Recent threats not clear | Conduct surveys of habitat and owls to increase knowledge | Current insufficient | External |

## NORTHERN SPOTTED OWL  (*Strix occidentalis caurina*)

**Conservation Status and Concern**

Impacts from habitat loss of mature forest are now exacerbated by effects of competition with Barred Owls for prey and habitat. As the population declines and becomes even smaller, other threat factors may become more relevant.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| Threatened | Endangered | Yes | G3T3 | S1 | Low/declining | High |

**Biology and Life History**

The Northern Spotted Owl is relatively long-lived, has a long reproductive life span, invests significantly in parental care, and exhibits high adult survivorship.  The majority of pairs do not breed every year.  Courtship usually begins in February or March, and females typically lay eggs in late March or April.  Northern Spotted Owls have large home ranges and in those areas use a number of prey species, chief among them the Northern Flying Squirrel, but also Bushy-tailed Woodrats, Snowshoe Hares and other small mammals.  Spotted Owls are at a competitive disadvantage to the more generalist Barred Owl which has expanded its range to now include the entire distribution of the Northern Spotted Owl.

Photo:  R. LeValley

## Distribution and Abundance

Formerly a widespread and uncommon resident of coniferous forests in western Washington and the east slope of the Cascade Range, the Northern Spotted Owl is now rare throughout Washington. It has been very rare in southwestern Washington for several decades and no longer breeds in the Puget Lowlands. The population of Northern Spotted Owls in Washington continues to decline, and some landscapes where long-term monitoring has been conducted now support several or fewer pairs. About 1,200 territories have been documented in Washington; trend data suggest that perhaps 25 percent or less of these remain occupied.

## Habitat

The Northern Spotted Owl inhabits mid- and late-seral coniferous forests. Typical habitat characteristics include: generally high canopy closure; complex canopy structure involving trees of multiple age or size classes; large decaying trees and/or snags; and, in most forest areas, a high volume of downed wood. The presence of mistletoe infection is important in the eastern Cascade Range. The species occurs up to about 5,000 feet in elevation.

### References

Buchanan, J. B. 2005. Spotted Owl (*Strix occidentalis*). Pp 217-218 *in* T. R. Wahl, B. Tweit, and S. G. Mlodinow (eds.) Birds of Washington: Status and Distribution. Oregon State University Press, Corvallis, OR, USA. 436 pp.

Gutiérrez, R. J., A. B. Franklin, and W. S. LaHaye. 1995. Spotted Owl (*Strix occidentalis*). The Birds of North America 179:1-28.

## Northern Spotted Owl: Conservation Threats and Actions

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Invasive and other problematic species and genes | Competition with Barred Owls | Management of Barred Owl population to reduce competition | Current insufficient | External |
| 2 | Fish and wildlife habitat loss or degradation | Loss of habitat | Continue existing habitat protection measures and develop incentives to protect habitat on private lands | Current insufficient | Both |

NOTE: Numbers are for reference only and do not reflect priority.

## SHORT-EARED OWL *(Asio flammeus)*

**Conservation Status and Concern**

This species is thought to be experiencing a range-wide, long-term decline in North America. The primary threats are the loss, fragmentation and degradation of habitat.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| None | None | Yes | G5 | S23B,S3N | Low/unknown | N/A |

**Biology and Life History**

These are probably the most diurnal of owls and may be active from late afternoon until nightfall, or at dawn, also hunting at night. When Short-eared Owls find areas of especially abundant resources they may breed in large numbers and produce super-normal clutches.

Photo by S. Garvie

**Distribution and Abundance**

This is an uncommon winter visitor, migrant, and summer resident in open lowland habitats in eastern Washington, with a much more restricted distribution in western Washington where breeding is considered rare. In western Washington, they are now scarce or absent in many areas where formerly encountered (e.g. estuaries, prairies, coastal dunes). Similarly, in eastern Washington they are uncommon, although comprehensive trend data are lacking. Populations of Short-eared Owls are naturally irruptive and nomadic, compounding the difficulty in detecting population changes. There is no population estimate for this species in Washington.

**Habitat**

Short-eared Owls breed in landscapes with extensive areas of open land with low vegetation. Cover types used include fresh and saltwater marshes, dunes, prairies, grassy plains, old fields, and meadows. Breeding habitat may also be occupied by wintering birds. Short-eared Owls tend to congregate and roost communally in the winter, often in sheltered sites near hunting areas.

**References**


Booms, T. L., G. L. Holroyd, M. A. Gahbauer, H. E. Trefry, D. A. Wiggins, D. W. Holt, J. A. Johnson, S. B. Lewis, M. D. Larson, K. L. Keyes, and S. Swengel. 2014. Assessing the status and conservation priorities of the short-eared owl in North America. Journal of Wildlife Management 78: 772-778.

Wahl, T. R. 2005. Short-eared Owl (*Asio flammeus*). Pp 221-222 *in* T. R. Wahl, B. Tweit, and S. G. Mlodinow (eds.) Birds of Washington: Status and Distribution. Oregon State University Press, Corvallis, OR, USA. 436 pp.

**Short-Eared Owl: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Fish and wildlife habitat loss or degradation | Habitat is converted, degraded or fragmented | Evaluate and determine the need to actively manage for Short-eared Owls | Current insufficient | WDFW |
| 2 | Resource information collection needs | Need for rigorous inventory and monitoring of species | Implement monitoring program, potentially in conjunction with other states | Current insufficient | WDFW |

NOTE: Numbers are for reference only and do not reflect priority.

## WESTERN SCREECH OWL (*Otus kennicottii macfarlanei*)

*See Appendix B for a potential range and habitat distribution map

**Conservation Status and Concern**

This species appears to have been impacted by the presence of Barred Owls in western Washington. More information is needed to assess whether its population has declined or if suspected changes reflect only a behavioral response to Barred Owls.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| None | None | No | G5 | S4 | Unknown/unknown | Low-moderate |

**Biology and Life History**

This small resident owl is strongly associated with coniferous forests although other forest types are also used. It preys mainly on small mammals (mice and shrews), birds and insects. Clutch size averages three to four eggs. Incubation is about 26 days.

Photo: R. Magnuson

**Distribution and Abundance**

This owl was formerly a fairly common resident statewide except in the Columbia Basin. There are no population estimates, but this species' population likely ranged in the tens of thousands as recently as the 1980s. Recent surveys in southwestern Washington and published information from Bainbridge Island and British Columbia indicate it has either experienced a substantial population decline or has changed its vocalization behavior (i.e., reducing its detectability), likely due to increased predation risk by Barred Owls. Other information regarding the abundance or distribution of this species is lacking and population status is unknown.

## Habitat

This species is found in many forest types, from urban to rural and including riparian zones and forests dominated by Douglas-fir, western hemlock, Sitka spruce and grand fir. They are virtually absent from the Columbia Basin but should be expected to occur there if suitable conditions develop along riparian zones or in small woodlots near human dwellings.

### References


Buchanan, J. B. 2005. Western Screech Owl *(Otus kennicottii).* Pp 212-213 *in* T. R. Wahl, B. Tweit, and S. G. Mlodinow (eds.) Birds of Washington: Status and Distribution. Oregon State University Press, Corvallis, OR, USA. 436 pp.

Cannings, R. J. and T. Angell. 2001. Western Screech Owl (*Otus kennicottii*). The Birds of North America 597:1-20.

Elliott, K. 2006. Declining numbers of Western Screech-owl in the lower mainland of British Columbia. British Columbia Birds 14: 2-11.


## Western Screech Owl: Conservation Threats and Actions

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Invasive and other problematic species and genes | Potential impacts from Barred Owls | Management of Barred Owl population to reduce predation risk | Nothing current - new action needed | External |
| 2 | Invasive and other problematic species and genes | Potential impacts from Barred Owls | Conduct surveys to evaluate species response to Barred Owl presence or removal | Nothing current - new action needed | Both |

NOTE: Numbers are for reference only and do not reflect priority.

# WOODPECKERS

## LEWIS' WOODPECKER *(Melanerpes lewis)*

*See Appendix B for a range and potential habitat distribution map

**Conservation Status and Concern**

This species may be impacted by habitat loss and effects of fire suppression practices. Intensive salvage harvest of trees in recently-burned forest may preclude or limit breeding in such areas. Historically, breeding records included many areas in western Washington, but there have been no breeding records in that region for decades.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| None | Candidate | Yes | G4 | S2S3 | Low/declining | Low-moderate |

**Biology and Life History**

Lewis' Woodpecker prefers snags of advanced decay and softer woods (e.g., cottonwood, aspen) for nesting. This species rarely drills bark, as it lacks the physical structural integrity to excavate or forage in harder woods. Its main diet is insects in spring and summer, fruit and berries in late summer/fall, and conifer seeds and acorns in winter. They are strongly site-faithful, and a life-long pair bond is suspected.

Photo: Wikimedia Commons

**Distribution and Abundance**

This species is uncommon in summer and generally rare in winter in eastern Washington. It is rare in western Washington. Many individuals from Washington appear to move southward for the winter. Breeding Bird Survey data indicate only a slight decline between 1999 and 2009. Breeding season territories reported to vary between 2.5 to 15 acres in the Blue Mountains. Foraging ranges broadly overlap and large numbers may forage together where there is a local abundance of food. The size of Washington's breeding population is unknown.

**Habitat**

Lewis' Woodpecker is typically restricted to lower elevation forests. It breeds in tree cavities in ponderosa pine forests and oak woodlands with open canopy (e.g. less than 30 percent canopy cover), as well as riparian cottonwood with a brushy undergrowth (e.g., sage brush, bitterbrush) and larger (greater than 20 inches diameter at breast height) snags of late decay stages. In addition, it often nests in burned forest. Birds that overwinter in eastern Washington are often associated with oak woodlands and commercial orchards. During winter, food supply is the most important aspect of habitat selection, and is dependent on conifer seed, mast and nut production.

**References**
Lewis, J. C., M. Whalen, and E. A. Rodrick. 2002. Lewis' Woodpecker. Priority Habitats and Species, Vol. IV: Birds. Washington Dept. of Fish and Wildlife, Olympia, Washington.
Tobalske, B. W. 1997. Lewis' Woodpecker. Birds of North America 284: 1-28.
Zhu, X., D. S. Srivastava, J. N. M. Smith, and K. Martin. 2012. Habitat selection and reproductive success of Lewis' woodpecker (*Melanerpes lewis*) at its northern limit. PloS ONE 7(9): e44346. DOI: 10.1371/journal.pone.0044346

### Lewis' Woodpecker: Conservation Threats and Actions

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Fish and wildlife habitat loss or degradation | Conversion to agriculture and development. Habitat fragmentation may isolate remaining populations. Urban-wildland interface and clearing of forest habitats (cottonwood, low elevation ponderosa pine) in/near human habitation | Use land acquisitions, conservation easements and landowner agreements to protect habitat. Work with county planners to establish buffers for habitat. Work with landowners to reduce the density of younger trees in ponderosa pine forests; in some areas this will enhance oak development | Nothing current - new action needed | Both |
| 2 | Fish and wildlife habitat loss or degradation | Unknown population size and extent | Understand and map forest burned areas, low elevation open pine stands and cottonwoods to determine source habitats and landscapes | Current insufficient | Both |
| 3 | Agriculture and aquaculture side effects | Loss of mature and old trees with cavities harvested and snag habitat felled for safety reasons | Restore open ponderosa pine conditions that mimic natural fire regimes; maintain and recruit large-diameter snags; retain large live cottonwoods | Current insufficient | Both |

NOTE: Numbers are for reference only and do not reflect priority.

## WHITE-HEADED WOODPECKER (*Picoides albolarvatus*)

*See Appendix B for a range and potential habitat distribution map

**Conservation Status and Concern**

White-headed Woodpeckers are probably impacted by habitat loss (and degradation) and fire suppression in dry forest landscapes.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| None | Candidate | Yes | G4 | S2S3 | Low/declining | Low-moderate |

**Biology and Life History**

This species has been considered by some to be an obligate of ponderosa pine (or other long-needle pine) forests, but in some cases it has been associated with other forest types. Pine seeds are a major part of its diet, especially in fall and winter. They also consume a variety of insects and other invertebrates. White-headed Woodpeckers use both live and dead trees for foraging and nesting. In some areas, individuals may descend to lower elevations during winter, and this is reflected in annual home range estimates some of which exceed several hundred acres.

Photo: R. Gilbert

**Distribution and Abundance**

White-headed Woodpeckers occupy dry forests in the eastern Cascade Range; also found east of the Okanogan River and in the Blue Mountains. Except for a small area in southern British Columbia, northern Washington represents the northwestern extent of the species' range. It is uncommon, and a population estimate is not available.

**Habitat**

This species uses conifer forests dominated by ponderosa pine, Douglas-fir, and occasionally other tree species such as aspen. Most areas are characterized by wide tree spacing, which produces an open canopy. The species was associated with large-diameter trees and snags in some studies, but recent work also indicates use (including nesting) of smaller trees and snags retained in clearcut harvest units.

**References**

Garrett, K. L., M. G. Raphael, and R. D. Dixon. 1996. White-headed Woodpecker (*Picoides albolarvatus*). Birds of North America 252:1-24.

Leach, R. H. 2005. White-headed Woodpecker (*Picoides albolarvatus*). Pp 239-240 *in* T. R. Wahl, B. Tweit, and S. G. Mlodinow (eds.) Birds of Washington: Status and Distribution. Oregon State University Press, Corvallis, OR, USA. 436 pp.

**White-Headed Woodpecker: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Agriculture and aquaculture side effects | Effects of fire suppression | Develop and implement dry forest management and restoration programs | Current insufficient | Both |
| 2 | Resource information collection needs | Dry forest management and restoration needs | Evaluate response of species to dry forest management and restoration efforts | Current insufficient | Both |
| 3 | Agriculture and aquaculture side effects | Loss of ponderosa pine forest (and other dry forests) | Promote protection and effective management of dry forests using a variety of tools | Current insufficient | Both |

NOTE: Numbers are for reference only and do not reflect priority.

# PERCHING BIRDS

## LOGGERHEAD SHRIKE (*Lanius ludovicianus)*

*See Appendix B for a range and potential habitat distribution map

**Conservation Status and Concern**
This species is strongly associated with shrub-steppe in Washington and has likely experienced a population decline in accordance with loss and conversion of shrub-steppe habitat.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| Species of Concern | Candidate | Yes | G4 | S3B | Low/stable | Low-moderate |

**Biology and Life History**
The Loggerhead Shrike is a predator of lizards, small mammals, small birds, and insects. It impales prey on thorns and barbed wire fences; prey may be left at such sites for later consumption. Loggerhead Shrikes have small territories, but are generally found in low densities. They hunt by watching from high perches, then flying swiftly down after prey.

Photo: R. LeValley

**Distribution and Abundance**
This species is a local summer resident in eastern Washington; it is rare there during winter. There are no population estimates for

the species in Washington. The size of Washington's breeding population is unknown. Breeding Bird Survey data indicate a slight but non-significant downward trend in Washington for the period 1966 to 2012.

### Habitat

The species breeds in open country, including shrub-steppe and grasslands where there are scattered tall shrubs, fence posts, utility wires, or other lookout posts. Loggerhead Shrikes generally nest in dense, thorny trees or shrubs.

#### References

Wahl, T. R. 2005. Loggerhead Shrike (*Lanius ludovicianus*). Pp 254-255 *in* T. R. Wahl, B. Tweit, and S. G. Mlodinow (eds.) Birds of Washington: Status and Distribution. Oregon State University Press, Corvallis, OR, USA. 436 pp.

Yosef, R. 1996. Loggerhead Shrike (*Lanius ludovicianus*). The Birds of North America 231:1-28.

### Loggerhead Shrike: Conservation Threats and Actions

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Fish and wildlife habitat loss or degradation | Conversion of shrub-steppe habitat; most of impact has already occurred; amount of continuing impact uncertain | Restoration of degraded or lost habitat; protection of existing habitat | Current insufficient | Both |
| 2 | Fish and wildlife habitat loss or degradation | Loss of sagebrush from wildfire | Reduce wildfire risk and prevent establishment of exotic plant species after fires | Current insufficient | Both |
| 3 | Resource Information needs | Unknown if Breeding Bird Surveys results accurately reflect actual Washington population trend | Conduct comprehensive surveys | Current insufficient | WDFW |

NOTE: Numbers are for reference only and do not reflect priority.

## OREGON VESPER SPARROW (Pooecetes gramineus affinis)

*See Appendix B for a range and potential habitat distribution map

**Conservation Status and Concern**

Due to loss and degradation of habitat this subspecies is now in danger of extirpation in Washington.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| Species of Concern | Candidate | Yes | G5T3 | S1B | Low/declining | Low-moderate |

**Biology and Life History**

Oregon Vesper Sparrows breed in dry grassland and open habitats (e.g., lowland prairies, some airfields) in western Washington. They build a bulky, loose, cup-like nest of grasses and rootlets on the ground in a small depression, often near the base of a grass clump, weed, or shrub. The female typically lays three to five eggs in mid-May, and incubates them for 11 to 13 days. The young fledge in 7 to 12 days, and pairs commonly raise two broods per season. They are often seen in loose flocks before fall migration.

Photo: ODFW

**Distribution and Abundance**

The Oregon Vesper Sparrow subspecies (*P. g. affinis*) has a restricted breeding range that includes southwestern British Columbia, western Washington, western Oregon, and northwestern California. It is migratory and overwinters from central California west of the Sierra Nevadas to northwestern Baja California, Mexico. It is now limited in Washington to remnant prairies and grasslands in Pierce, Thurston, and Skagit Counties, with smaller numbers on islands in the lower Columbia River and grasslands on San Juan Island; a few may still breed in eastern Clallam County and near Shelton (Mason County). The size of Washington's breeding population is probably less than 500 individuals.

**Habitat**

Breeding territories at Joint Base Lewis-McChord were in areas of high-quality prairie supporting intact Idaho fescue near prairie edges. Prairie size appears to be an important factor in site selection, with only large prairies occupied now. In western Oregon, they use areas with extensive grass and weed cover, or in lightly grazed pastures with scattered shrubs and grass heights of less than 1 to 2 feet tall.

**References**


Altman, B. 2011. Historical and current distribution and populations of bird species in Prairie-Oak habitats in the Pacific Northwest. Northwest Science 85:194-222.

Mlodinow, S. G. 2005. Vesper Sparrow *Pooecetes gramineus.* Pp 326-327 *in* T. R. Wahl, B. Tweit, and S. G. Mlodinow (eds.) Birds of Washington: Status and Distribution. Oregon State University Press, Corvallis, OR, USA. 436 pp.

Smith, M. R., P. W. Mattocks, Jr., and K. M. Cassidy. 1997. Breeding birds of Washington state: location data and predicted distribution. *In* Cassidy, K. M., C. E. Grue, M. R. Smith, and K. M. Dvornich (eds.). Washington state GAP analysis- final report. Vol. 4 Seattle Audubon Society Publications in Zoology No. 1, Seattle, Washington.

**Oregon Vesper Sparrow: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Fish and wildlife habitat loss or degradation | Conversion to agriculture and development. Habitat loss isolates remaining populations | Use land acquisitions, conservation easements and landowner agreements to protect habitat | Current insufficient | Both |
| 2 | Invasive and other problematic species and genes | Invasive Scot's broom and native conifer forest succession (due to alteration of prairie fire regime) | Restore and manage degraded habitat at prairies; use prescribed fire where possible; coordinate with airport vegetation management | Current insufficient | Both |
| 3 | War, civil unrest and military exercises | Military training exercises disturb nesting and degrades habitat | Work with Joint Base Lewis-McChord to develop management plan for known breeding habitat | Current insufficient | Both |
| 4 | Outreach and education | Recreational use of prairies; vegetation management (e.g. mowing airports) | Public outreach/education and coordination | Current insufficient | Both |
| 5 | Invasive and other problematic species and genes | Increased predation pressure from encroaching urbanization (domestic and feral cats) | Assess impacts of predation by cats, and assess need for, and approach to, effectively address this risk factor | Current insufficient | Both |
| 6 | Agriculture and aquaculture side effects | Potential herbicide and pesticide effects | Education/outreach | Current insufficient | Both |

NOTE: Numbers are for reference only and do not reflect priority.

## PURPLE MARTIN *(Progne subis)*

*See Appendix B for a range and potential habitat distribution map

**Conservation Status and Concern**

The population of Purple Martins in Washington is very small and is essentially dependent on humans to provide nest structures, a relationship that likely has not changed since European settlement. Consequently, persistence of the population likely requires ongoing human intervention (e.g. erecting and maintaining nest structures).

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| None | Candidate | Yes | G5 | S3B | Low/stable | Low-moderate |

**Biology and Life History**

Purple Martins are aerial insectivores and nest in cavities. They nest almost exclusively in human-made nest structures (e.g. nest boxes and gourds). Females lay four to five eggs and incubation lasts for 15 to 18 days. The young leave the nest at 28 to 29 days, and are fed by the parents for several more days.


Photo: Wikimedia Commons

**Distribution and Abundance**

Purple Martins are found throughout much of eastern North America and along the Pacific coast. In Washington, they are found in much of the Puget Trough, Grays Harbor, Willapa Bay and the lower Columbia River; they are rare elsewhere. They migrate to the Neotropics for the winter. It is thought that their presence and abundance in Washington was facilitated by availability of nests associated with humans. The population is estimated at about 600, with 400 in the Puget Trough and 200 along the Columbia River; comprehensive monitoring is required to refine this population estimate.

**Habitat**

Purple Martins are secondary cavity users; they do not create their own. Most nests are situated in the marine environment (e.g. nest cavities in pilings or nest structures attached to pilings), and they nest less commonly at lakes and marshes. They rarely nest in snags or in uplands.

**References**

Brown, C. R. 1997. Purple Martin (*Progne subis*). The Birds of North America 287: 1-32.

Kostka, S. and K. McAllister. 2005. Purple Martin (*Progne subis*). Pp 269-270 *in* T. R. Wahl, B. Tweit, and S. G. Mlodinow (eds.) Birds of Washington: Status and Distribution. Oregon State University Press, Corvallis, OR, USA. 436 pp.

**Purple Martin: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| | Resource information collection needs | Reliable information on population size and trend | Develop a comprehensive monitoring program to monitor the population | Current insufficient | Both |

## PYGMY NUTHATCH *(Sitta pygmaea)*

*See Appendix B for a potential range and habitat distribution map

**Conservation Status and Concern**

The Pygmy Nuthatch is a species of concern because of its dependence on old ponderosa pine forests to provide suitable nesting cavities in dead and decadent trees and a year-round food source of pine seed. Certain timber management practices and fire suppression have altered the structure and species composition of ponderosa pine forests.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| None | Monitor | Yes | G5 | S3S4 | Low/unknown | Moderate-high |

**Biology and Life History**

Pygmy Nuthatches are one of only a few cooperatively breeding songbirds in North America. During the breeding season, about a third of the pairs have up to three helpers at the nest. These helpers are usually related males, often offspring from the previous year, and help defend the nest site and raise the young. Pairs form long-term bonds and remain paired year round. Pygmy Nuthatches are cavity nesters. They nest and roost in natural cavities and woodpecker holes. Winter flocks roost together in cavities. Both members of the pair dig the nest hole in a dead branch or snag of a ponderosa pine or aspen. The nest hole is lined with bark strips, plant down, moss, cocoons, fur, and feathers. Pygmy Nuthatches forage primarily on insects during the breeding season and on pine seed and insects in winter.

Photo: R. LeValley

**Distribution and Abundance**

This species is an uncommon resident in northeastern counties and along the east slope of Cascades, and in the Blue Mountains**.** Breeding Bird Survey data from 1966 to 2013 and from 2003 to 2013 indicate stable trends in the Great Basin province, all western USA routes combined, Washington, Oregon, California, and British Columbia; data confidence is high for California and western USA routes combined and moderate for all other areas. The size of Washington's breeding population is unknown.

**Habitat**

The Pygmy Nuthatch is restricted almost completely to ponderosa pine forests at low elevation in eastern Washington, and may be rarely found in adjacent Douglas-fir forest.

**References**

Leach, R. H.  2005. Pygmy Nuthatch (*Sitta pygmaea*). Pp 281-282 *in* T. R. Wahl, B. Tweit, and S. G. Mlodinow (eds.) Birds of Washington: Status and Distribution. Oregon State University Press, Corvallis, OR, USA. 436 pp.

**Pygmy Nuthatch:   Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Agriculture and aquaculture side effects | Forest managementLogging, fire suppression and commercial and residential development that removes or degrades mature ponderosa pine habitat | Protect existing habitat using a variety of conservation tools. Restore degraded pine forests by reducing the density of smaller trees and understory vegetation | Current insufficient | Both |
| 2 | Resource information collection needs | Better define the range of the species | Conduct standard surveys to better define range | Current insufficient | Both |
| 3 | Resource information collection needs | Information lacking for trends of population | Recruit volunteers to enable inclusion of additional BBS routes to increase reliability of data for Washington | Current insufficient | Both |

NOTE:  Numbers are for reference only and do not reflect priority.

## SAGE THRASHER (*Oreoscoptes montanus*)

*See Appendix B for a range and potential habitat distribution map

**Conservation Status and Concern**

This sagebrush obligate is vulnerable to population declines and range contractions due to loss or degradation of shrub-steppe habitat. Loss of shrub-steppe to conversion and fire, and degradation of habitat due to cheatgrass invasion and intensive livestock grazing are impacts.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| None | Candidate | Yes | G5 | S2B | Low/declining | Moderate-high |

**Biology and Life History**

The Sage Thrasher is a short-distance migrant with individuals arriving in eastern Washington by late March. Builds nest mostly in big sagebrush or three-tip sagebrush below the densest part of the shrub to provide concealment from aerial predators. Sage Thrashers may raise two broods annually.


Photo: M. Vander Haegen

**Distribution and Abundance**

This species is found throughout the Columbia Basin, primarily in areas with a substantial amount of sage. In those limited areas the species is a common breeder. Sage Thrashers are not present in Methow Valley and are locally distributed and uncommon in Okanogan Valley. Breeding Bird Survey data indicate downward trends at the scale of the Great Basin and individual states (Idaho, Nevada, Oregon and Utah) from 1966 to 2013, although the trend in Washington was stable, where reliability was moderate compared to high reliability in all other states and the province. In the period 2003 to 2013 the trend was stable in all states noted above and the Great Basin. The size of Washington's breeding population is unknown.

**Habitat**

Sage Thrashers are generally dependent on large patches and expanses of sagebrush for breeding, but will use small fragments of sagebrush among agricultural fields. This species does not use other habitats for foraging or nesting, but sometimes uses other habitats during dispersal and migration.

**References**


Reynolds, T. D., T. D. Rich, and D. A. Stephens. 1999. Sage Thrasher (O*reoscoptes montanus*). Birds of North America 463: 1-24.

Vander Hagen, W. M. 2005. Sage Thrasher (O*reoscoptes montanus*). Pp 299 - 300 *in* T. R. Wahl, B. Tweit, and S. G. Mlodinow (eds.) Birds of Washington: Status and Distribution. Oregon State University Press, Corvallis, OR, USA. 436 pp.

**Sage Thrasher: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Fish and wildlife habitat loss or degradation | Habitat loss and fragmentation to residential development, burning, and herbicide and pesticide treatments | Protect habitat; control cheatgrass; identify degraded habitat for restoration | Current insufficient | Both |
| 2 | Agriculture and aquaculture side effects | Habitat loss and fragmentation to agricultural conversion, burning, herbicide and pesticide treatments | Protect habitat; identify degraded habitat for restoration; evaluate CRP leases to provide functional habitat on private lands | Current insufficient | Both |
| 3 | Agriculture and aquaculture side effects | Habitat degradation due to intensive grazing by livestock | Develop and promote best management practices for grazing in shrub-steppe habitat; protect habitat; control cheatgrass; identify degraded habitat for restoration; identify ways to reduce intensive grazing pressure; evaluate CRP leases to provide functional habitat on private lands | Current insufficient | Both |
| 4 | Invasive and other problematic species and genes | Invasion by cheatgrass and other exotic plants degrades the ecological integrity of the habitat | Control cheatgrass; identify degraded habitat for restoration; evaluate CRP leases to provide functional habitat on private lands | Current insufficient | Both |
| 5 | Resource information collection needs | Need to assess ecological integrity of existing shrub-steppe for Sage Thrasher | Conduct studies on use of sagebrush patches in landscapes of differing patchiness to support design of conservation strategy | Current insufficient | Both |

NOTE: Numbers are for reference only and do not reflect priority.

## SAGEBRUSH SPARROW (*Artemisiospiza nevadensis*)

*See Appendix B for a range and potential habitat distribution map

### Conservation Status and Concern

The Sagebrush Sparrow is a species of concern because large expanses of big sagebrush, its preferred habitat, have been lost or degraded.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| None | Candidate | Yes | G5 | S3B | Low/declining | Moderate-high |

### Biology and Life History

This is a sagebrush obligate species, typically associated with big sagebrush in eastern Washington. Most males arrive on the breeding grounds already paired and begin singing from the tops of sagebrush to establish and defend a breeding territory. Nest building begins in mid-March, typically within or under a big sagebrush shrub. While the male sings to defend the territory, the female builds an open cup nest and lays three eggs that she will incubate for 10 to 16 days. After eggs hatch, the young usually leave the nest in 9 to 10 days. Most females raise two broods per year. Females that are successful at raising young typically return to the same site in successive years. During the breeding season, they forage on the ground for insects, spiders, small fruits and seeds. During the non-breeding season, diet includes seeds, plant material and insects.

Photo: M. Vander Haegen

### Distribution and Abundance

The Sagebrush Sparrow prefers sagebrush/bunchgrass shrub-steppe landscapes of the Columbia Basin and is an uncommon migrant and summer resident in shrub-steppe of eastern Washington. This sparrow migrates to overwintering areas between central California and central Nevada, south to northern Mexico. Trends in the Great Basin and in individual states (Nevada, Utah) since 1966 are stable, as is the trend in Washington; however, the Washington trend is based on a small sample that may not be reliable. Declining trends have been reported in Idaho (moderate reliability) and Oregon (high reliability). There is no population estimate for Washington.

### Habitat

This species' preferred habitat is big sagebrush. Sagebrush Sparrows appear to be sensitive to patch size, and probability that they will use a site is higher in areas with large expanses of unconverted shrub-steppe, typically areas greater than 2,500 acres.

#### References


Martin, J. W. and B. A. Carlson 1998. Sage Sparrow (*Amphispiza belli*). Birds of North America 326: 1-20.

Vander Haegen, W. M. 2005. Sage Sparrow (*Amphispiza belli*). Pp 328 – 329 in T. R. Wahl, B. Tweit, and S. G. Mlodinow (eds.) Birds of Washington: Status and Distribution. Oregon State University Press, Corvallis, OR, USA. 436 pp.

**Sagebrush Sparrow: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Fish and wildlife habitat loss or degradation | Habitat loss and fragmentation | Protect core areas of habitat; identify degraded habitat for restoration and establish connectivity between core areas | Current insufficient | Both |
| 2 | Agriculture and aquaculture side effects | Habitat loss and fragmentation due to agricultural conversion | Protect and restore habitat; evaluate CRP leases to provide functional habitat on private lands | Current insufficient | Both |
| 3 | Agriculture and aquaculture side effects | Habitat degraded by intensive grazing | Outreach; develop and promote best management practices | Current insufficient | Both |
| 4 | Invasive and other problematic species and genes | Habitat degradation | Identify degraded habitat for restoration; control cheatgrass | Current insufficient | Both |
| 5 | Resource information collection needs | Landscape-level habitat use | Conduct studies on use of sagebrush patches in landscapes of differing patchiness and connectivity | Current insufficient | Both |

NOTE: Numbers are for reference only and do not reflect priority.

## SLENDER-BILLED WHITE-BREASTED NUTHATCH (*Sitta carolinensis aculeata*)

**Conservation Status and Concern**

This species is of concern due to its dependence on large, mature oak trees to provide nest cavities and food and the fragmentation of oak trees from agriculture and residential development.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| Species of Concern | Candidate | Yes | G5TU | S1 | Critical/declining | Low-moderate |

**Biology and Life History**

The Slender-billed White-breasted Nuthatch often uses naturally occurring cavities, including those made by woodpeckers, in living trees for roosting and nesting. Individuals use multiple cavities during the year. Pairs establish territories of about 25 to 37 acres and occupy the same territories year-round. Foraging typically occurs on the trunk and larger limbs of trees. Weevils and earwigs are important parts of the diet during breeding and post-breeding periods; they also feed on acorns during winter.


Photo: WDNR

**Distribution and Abundance**

This subspecies formerly occurred from the Puget Trough south to Oregon. The northern extent of the distribution has contracted southward and the range is currently primarily limited to Clark and Cowlitz Counties where it is rare. The Washington population likely consists of fewer than 50 individuals.

**Habitat**

This subspecies appears to be dependent on oak and oak-conifer woodlands. In Washington and Oregon, they are commonly associated with Oregon white oak, as well as black cottonwood and Oregon ash. Nuthatch densities are greater in areas with higher numbers of large trees, which provide more surface area for foraging and have more natural cavities for nesting and roosting. Large open-grown oaks in woodlands with sparse understories are particularly important as habitat because these trees have more cavities and foraging substrate than oaks grown in densely vegetated habitats. Birds are therefore more abundant in smaller (less than 30 acres) woodland patches, which by definition have more edge, than in larger (greater than 62 acres) patches.

**References**

Chappell, C. B. 2005. White-breasted nuthatch (*Sitta carolinensis*). Pp 280 - 281 *in* T. R. Wahl, B. Tweit, and S. G. Mlodinow (eds.) Birds of Washington: Status and Distribution. Oregon State University Press, Corvallis, OR, USA. 436 pp.

Hagar, J. C., and M. A. Stern. 2001. Avifauna in oak woodlands of the Willamette Valley, Oregon. Northwestern Naturalist 82:12-25.

Peter, D. and C. Harrington. 2002. Site and tree factors in Oregon white oak acorn production in western Washington and Oregon. Northwest Science 76:189-201.

Pravosudov, V. V. and T. C. Grubb, Jr. 1993. White-breasted nuthatch (*Sitta carolinensis*). Birds of North America 54: 1-16.

Viste-Sparkman, K. 2006. White-breasted Nuthatch density and nesting ecology in oak woodlands of the Willamette Valley, Oregon. M.S. thesis, Oregon State University, Corvallis, Oregon.

**Slender-Billed White Breasted Nuthatch: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Fish and wildlife habitat loss or degradation | Conversion of oak and oak-conifer woodlands | Work with landowners to incorporate conservation of this species and oak woodlands into long-term land management | Current insufficient | Both |
| 2 | Fish and wildlife habitat loss or degradation | Small size and isolation of Washington populations | Conduct feasibility study for reintroductions; implement translocations if feasible | Current insufficient | Both |
| 3 | Resource information collection needs | Current status is unclear | Conduct surveys where pairs were historically found, characterize habitat, and identify additional areas to target surveys; assess factors that may account for loss of pairs at formerly occupied sites | Current insufficient | Both |

NOTE: Numbers are for reference only and do not reflect priority.

## STREAKED HORNED LARK (*Eremophila alpestris strigata*)

### Conservation Status and Concern

The Streaked Horned Lark is a subspecies only found in southwest Washington and western Oregon, with a total population estimated at less than 2,000.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| Threatened | Endangered | Yes | G5T2 | S1B | Critical/unknown | Moderate-high |

### Biology and Life History

Streaked Horned Larks forage on the ground in short vegetation of bare fields. They breed in grassland and remnant prairies of south Puget Sound, coastal beaches, and some islands in the lower Columbia River. They are known to overwinter in Oregon and on some of the lower Columbia River sites. They may rear two to three broods per season. This species is a coastal subspecies of the Pacific Northwest.


Photo: C. Baker

### Distribution and Abundance

This subspecies is an uncommon breeder on airport grasslands and remnant prairies and beaches of western Washington and Oregon; it is considered extirpated in British Columbia. In Washington, it currently breeds at 14 to 16 sites, including: three prairie areas used for Army training and five airports in the southern Puget lowlands; two to four sandy coastal sites; and four sites along the lower Columbia River. The entire subspecies population is estimated at 1,170 to 1,610 birds, with about 245 pairs detected in Washington in 2013. Density trends from standardized transect data for 2010 through 2012 produced an estimated average annual decline of 11.7 percent; intensive management may have stabilized the inland and Columbia River populations, but data suggest that females may be subject to high mortality rates.

### Habitat

In Washington, Streaked Horned Larks are found on prairie and grassland south of Puget Sound, coastal beaches, and islands and sparsely vegetated shoreline sites on the lower Columbia River. Streaked Horned Larks are also found on agricultural fields and drying seasonal wetlands in Oregon. Habitat consists of large expanses of bare or sparsely vegetated land, including fields, prairies, upper beaches, airports, and similar areas with low/sparse grassy vegetation.

#### References


Altman, B. 2011. Historical and current distribution and populations of bird species in prairie-oak habitats in the Pacific Northwest. Northwest Science 85:194-222.

Stinson, D. W. 2015. Periodic status review for the Streaked Horned Lark in Washington. Washington Department of Fish and Wildlife, Olympia, Washington.

**Streaked Horned Lark: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Resource information collection needs | Information needed on distribution, abundance and status | Occupancy surveys/counts at known and potential sites; compile, analyze data | Current sufficient | Both |
| 2 | Management Decision Needs | Disturbance/mortalities on Columbia River sites from dredged material deposition | Promote development of a management plan for dredged material at Columbia River sites | Current sufficient | External |
| 3 | Overharvesting of biological resources | Mortalities from collisions with aircraft on airfields | Create/restore nesting habitat away from runways | Current insufficient | External |
| 4 | Fish and wildlife habitat loss or degradation | Loss of prairie/grassland habitat | Acquire or restore nesting habitat | Current insufficient | External |
| 5 | Fish and wildlife habitat loss or degradation | Inbreeding/declining genetic health | Translocation from Oregon for genetic augmentation | Current sufficient | External |

NOTE: Numbers are for reference only and do not reflect priority.

## WESTERN BLUEBIRD *(Sialia mexicana)*

*See Appendix B for a potential range and habitat distribution map

### Conservation Status and Concern

Declines in recent decades caused primarily by habitat loss. Recent reintroductions onto San Juan Island may need additional translocations and removal of competitor's nests from nest boxes to be successful.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| None | Monitor | No | G5 | S3B | Low/declining | Moderate |

### Biology and Life History


Photo: W. Siegmund

Western Bluebirds are mainly insectivorous, feeding seasonally also on berries and other fruit. They are secondary cavity nesters, relying on cavities created by other species. Most females produce or attempt two broods per year. Fledged young are tended by the male if the female re-nests.

### Distribution and Abundance

This is an uncommon migrant and summer resident in western Washington, except for the Fort Lewis area, where it is common due to an unprecedented nest box program. It was recently reintroduced onto San Juan Island. Availability of nesting cavities is a major limiting factor for bluebird populations. Breeding Bird Survey data show no significant change in numbers from 1966 to 2012. Nest box programs have been used with much success; a breeding population that has exceeded 200 pairs has been documented at Joint Base Lewis McChord, which constitutes by far the largest breeding location in western Washington; the remainder of the western population is dispersed and a total population estimate has not been established.

### Habitat

Western Bluebirds inhabit woodland/prairie mosaic, agricultural areas and recently harvested or burned forest where snags or cavity trees are present. Cover types includes open woodlands, farmlands, orchards, savanna, riparian woodlands, and burned forests. They use many open forest types, including post-fire and post-harvest forests, if sufficient snags are present to provide nest and perch sites. Nests are in natural tree cavities, abandoned woodpecker holes, or bird nest boxes, and standing snags/cavity trees are important habitat features.

### References


Buchanan, J. B. 2005. Western Bluebird (*Sialia mexicana*). Pp 290 - 291 *in* T. R. Wahl, B. Tweit, and S. G. Mlodinow (eds.) Birds of Washington: Status and Distribution. Oregon State University Press, Corvallis, OR, USA. 436pp.

Slater, G. L. and B. Altman. 2011. Avian restoration in the Prairie-Oak Ecosystem: a reintroduction case study of Western Bluebirds to San Juan Island, Washington. Northwest Science 85:223-232.

**Western Bluebird: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Management decision needs | Scarcity of snags in some forest landscapes | Retention of snags via incentive-based programs or other strategies | Current insufficient | WDFW |
| 2 | Fish and wildlife habitat loss and degradation | Long-term success of translocation efforts | Continue to monitor and evaluate success of translocation efforts to the San Juan Islands | TBD | TBD |

NOTE: Numbers are for reference only and do not reflect priority.

# REFERENCE MATERIAL

## SECTION A: Alphabetical list of species

## SECTION B: Explanation of Terms

# Conservation Status Table

**Federal Status**
Refers to legal designations under the Federal Endangered Species Act (listed as Endangered, Threatened, or Candidate species, or designated as a Sensitive species or Species of Concern.

**State Status**
The Washington Fish and Wildlife Commission has classified 46 species as Endangered, Threatened or Sensitive, under WAC 232-12-014 and WAC 232-12-011. Other designations include Candidate and Monitor.

**PHS (Priority Habitats and Species Program)**
A species listed under the PHS program is considered to be a priority for conservation and management and requires protective measures for survival due to population status, sensitivity to habitat alteration and/or tribal, recreational or commercial importance. Management recommendations have been developed for PHS species and habitats, and can assist landowners, managers and others in conducting land use activities in a manner that incorporates the needs of fish and wildlife.

**Global (G) and State (S) Rankings:** Refers to NatureServe status rankings provided by the Natural Heritage Program. These conservation status ranks complement legal status designations and are based on a one to five scale, ranging from critically imperiled (1) to demonstrably secure (5). The global (G) and state (S) geographic scales were used for the SGCN species fact sheets. For more on the methodology used for these assessments, please see: Methodology for Assigning Ranks - NatureServe.

**State Rank:** characterizes the relative rarity or endangerment within the state of Washington.
**S1** = Critically imperiled
**S2** = Imperiled
**S3** = Rare or uncommon in the state – vulnerable
**S4** = Widespread, abundant, and apparently secure i
**S5** = Demonstrably widespread, abundant, and secure in the State
**SA** = Accidental in the state.
**SE** = An exotic species that has become established in the state.
**SH** = Historical occurrences only are known, perhaps not verified in the past 20 years, but the taxon is suspected to still exist in the state.
**SNR** or **S?** = Not yet ranked. Sufficient time and effort have not yet been devoted to ranking of this taxon.
**SP** = Potential for occurrence of the taxon in the state but no occurrences have been documented.
**SR** = Reported in the state but without persuasive documentation which would provide a basis for either accepting or rejecting the report (e.g., misidentified specimen).
**SRF** = Reported falsely in the state but the error persists in the literature.
**SU**= Unrankable. Possibly in peril in the state, but status is uncertain. More information is need.
**SX** = Believed to be extirpated from the state with little likelihood that it will be rediscovered.
**SZ** = Not of conservation concern in the state.

Qualifiers are sometimes used in conjunction with the State Ranks described above:

**B** - Rank of the breeding population in the state.
**N** - Rank of the non-breeding population in the state.

**Global Rank:** characterizes the relative rarity or endangerment of the element world-wide.
**G1** = Critically imperiled globally
**G2** = Imperiled globally
**G3** = Either very rare and local throughout its range or found locally (even abundantly at some of its locations) in a restricted range - vulnerable
**G4** = Widespread, abundant, and apparently secure globally
**G5** = Demonstrably widespread, abundant, and secure globally, though it may be quite rare in parts of its range
**GH** = Historical occurrences only are known, perhaps not verified in the past 20 years, but the taxon is suspected to still exist somewhere in its former range.
**GNR** or **G?** = Not yet ranked. Sufficient time and effort have not yet been devoted to ranking of this taxon.
**GU** = Unrankable. Possibly in peril range-wide but status uncertain. More information is needed.
**GX** = Believed to be extinct and there is little likelihood that it will be rediscovered.

Qualifiers are used in conjunction with the Global Ranks described above:
**Tn** Where n is a number or letter similar to those for Gn ranks, above, but indicating subspecies or variety rank. For example, G3TH indicates a species that is ranked G3 with this subspecies ranked as historic.

1. Key Conservation Threats (Stressor) and Actions Table

The **"Level of Investment"** column is meant to be a coarse assessment of whether the action referenced is sufficient (stay the course), insufficient (invest more resources when available), or "new action needed" (nothing is currently underway and new action needs to be initiated).

The **"Lead"** column refers to whether WDFW has the lead for that particular action (WDFW), or whether external conservation partners have the lead (external), or whether WDFW shares the lead with one or more organizations (Both).

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State Wildlife Action Plan Update

# Appendix A-3

## Species of Greatest Conservation Need

## Fact Sheets

# AMPHIBIANS AND REPTILES

**Conservation Status and Concern**

**Biology and Life History**

**Distribution and Abundance**

**Habitat Needs**

**Stressors**

**Conservation Actions Needed**

Washington Department of Fish and Wildlife
2015

# Appendix A-3

## SGCN Amphibians and Reptiles – Fact Sheets

# Table of Contents

# What is Included in Appendix A-3

**Introduction**
Appendix A-3 is one component of the State Wildlife Action Plan (SWAP) Update, and contains information about amphibians and reptiles included in our Species of Greatest Conservation Need (SGCN) list for 2015. Included are fact sheets for each of the amphibians and reptiles identified as Species of Greatest Conservation Need in the 2015 SWAP. The information provided includes a summary of the conservation concern and conservation status, description distribution and habitat, climate change sensitivity and an overview of key threats and conservation actions needed.

**What it means to be an SGCN**
The SGCN list includes both amphibians and reptiles that have some form of official protection status and those which may be in decline, but are not yet listed as part of either the Federal or State Endangered Species program. One of the purposes of the SWAP is to direct conservation attention to species and habitats *before* they become imperiled and recovery becomes more difficult and costly. Presence on this list does not necessarily mean that conservation attention will be directed towards these species; rather, that conservation actions for the species are *eligible* for State Wildlife Grants funding, and may be more competitive for other grant programs. It also raises the profile of a species to a wide audience of conservation partners and may encourage other organizations to initiate projects that may benefit the species.

**Climate Vulnerability**
Please see Chapter 5 for an explanation of the methodology used to assess climate vulnerability. For a full list of all the SGCN ranks, including a narrative description of sensitivity and references, please see Appendix C.

**Explanation of terms used in the document**
Please see Section B (page 74) for a description of terms and abbreviations used in this document.

**Alphabetical List of Species**
For an alphabetical list of all the amphibians and reptiles included, please see Section A (page 73).

**References**
References are provided separately with each fact sheet, and also collectively for all SGCN amphibians and reptiles in the REFERENCES section at the end of this document.

# SALAMANDERS

## TIGER SALAMANDER (*Ambystoma tigrinum*)

*See Appendix B for a potential range and habitat distribution map

**Conservation Status and Concern**

The Washington status is based on the small number of populations, a range that is restricted to a region that has been heavily altered, and a lack of information about this species. Of greatest concern is the drastic decline in stream flows and water body volume in much of Lincoln County and adjacent portions of Grant and Adams Counties caused by water withdrawal for agriculture. Larger remaining water bodies may not be suitable habitat because they may contain introduced predatory fish that eat larval salamanders.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| None | Monitor | No | G5 | S3 | Medium/unknown | Moderate-high |

**Biology and Life History**

Photo: L. Hallock

This is a large, stocky, blotched salamander (to 6.4 inches snout to vent length). Metamorphosed forms spend most of their lives in the subterranean environment. Surface activity is nocturnal. They migrate to breeding ponds in the spring. Eggs are laid in mid-March to early April in the Columbia Basin. Whether or not the larval salamanders metamorphose depends on a combination of genetic and environmental factors. Larvae are capable of transforming in the fall of their first year but in permanent water bodies delay for two or more years. They can also become sexually mature in the larval form. The gilled adults (or neotenes) can grow to larger sizes than the metamorphosed forms. Ponds often contain many different size classes of larvae. All forms are gape-limited, opportunistic predators with invertebrates making up majority of the diet. Large terrestrial adults may also take small vertebrates. They are important predators in ponds and can influence both the vertebrate and invertebrate communities. They are long-lived (16 to 25 years) although the lifespan of wild individuals is likely less.

**Distribution and Abundance**

Tiger Salamanders are the most widely distributed of all North American salamanders. In Washington, they occur primarily within the Columbia Plateau Ecoregion. Occurrences in the Okanogan and Eastern Cascades Ecoregions are limited to the steppe and ponderosa pine vegetation zones. An isolated record for Klickitat County is documented through a specimen collected in the 1930s but no populations are currently known in this county.

**Habitat**

Occurrence is primarily in arid areas that support shrub-steppe vegetation. They tolerate some habitat disturbance and alteration. In the Colville area, they occupy lower elevations in dry habitat types characterized by ponderosa pine/Douglas-fir forest. They are habitat generalist but they do require fishless water bodies for breeding. Soil types suitable for burrowing are also important because they are active burrowers and also use mammal burrows. Breeding takes place primarily in perennial ponds, although seasonal water bodies are also used. Gilled adults occur only in perennial ponds; their ability to metamorphose is lost with increasing age. Mass mortality events of the larvae can occur if ponds dry.

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### Tiger Salamander: Conservation Threats and Actions

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Resource information collection needs | Lack of information on status and distribution. | Continue research, surveys and monitoring to understand species distribution and status. | Current insufficient | Both |
| 2 | Fish and wildlife habitat loss and degradation | Loss and degradation of suitable shrub-steppe habitat that this species relies upon in WA. | Protect native shrub-steppe habitat from further degradation or conversion to agriculture. | Current insufficient | Both |
| 3 | Agriculture and aquaculture side effects | Drying of water bodies and streams due to withdrawals of irrigation water at rates faster than the aquifers can naturally replenish. Surface water declines in the Lincoln County region since the 1980s are likely related to ground water withdrawals and declines in the Columbia River aquifer. | Protect Tiger Salamander habitat by preventing the drying of wetlands, ponds, lakes and streams. Protect the aquatic habitat that remains. | Current insufficient | Both |
| 4 | Invasive and other problematic species | Stocking of non-native predatory fish in Tiger Salamander habitat. Tiger Salamanders avoid water bodies with fish. | Identify important areas for Tiger Salamanders and prohibit fish stocking in occupied water bodies. | Current insufficient | WDFW |

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 5 | Climate change and severe weather | Drying of water bodies and streams. Loss of aquatic habitat is already an issue in parts of the Columbia Basin (see previous entry). Periods of drought would exacerbate the situation. | Maintain robust populations and suitable aquatic habitats across the range. | Nothing current - new action needed | Both |

NOTE: Numbers are for reference only and do not reflect priority.

## COPE'S GIANT SALAMANDER (*Dicamptodon copei*)

*See Appendix B for a potential range and habitat distribution map

**Conservation Status and Concern**

The main concerns for this species have to do with protection of stream integrity. Activities that alter the integrity of small and medium-sized forested streams are of concern, especially those actions that increase water temperature and sedimentation. Sedimentation is particularly problematic in low-gradient streams, as increased silt deposition may fill crucial microhabitats such as the spaces between rocks and logs that are used as sheltering, hiding and nesting sites.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| None | Monitor | No | G3G4 | S3S4 | Unknown/stable | Moderate-high |

**Biology and Life History**


Photo: W. Leonard

This is a medium-sized, marbled gold and brown salamander with a rounded snout, indistinct costal grooves and a laterally compressed tail. Metamorphosed forms are rare. Rather, most become sexually mature in the larval stage. Average size at maturity is 2.6 to 3 inches snout to vent length. Similar to other giant salamander species, most activity is probably nocturnal and much time is spent in subterranean microhabitats. Larval forms tend to be common. Larvae can be observed year round in flowing water bodies and may also be present in higher elevation still-water habitats connected to flowing water bodies. Breeding takes place in the spring, summer and fall with peak activity in the spring and fall. The female guards the eggs for 200 days or more until they hatch.

**Distribution and Abundance**

This species is found in western Washington and extreme northwestern Oregon. In Washington, Cope's Giant Salamanders occur primarily west of the Cascade Crest in the Pacific Coast, southern Puget Trough and West Cascades ecoregions. They are the only giant salamander documented north of the Chehalis River in the Olympic Peninsula.

**Habitat**

Cope's Giant Salamanders are primarily associated with small to medium-sized mountain streams in moist coniferous forests. Giant salamanders are often the dominant vertebrate within streams. During the day, they are typically concealed under rocks or woody debris. Occasionally they can be observed moving about in the stream. As mentioned above, activities that alter the integrity of small and medium-sized forested streams are of concern, especially those actions that increase water temperature and sedimentation. Sedimentation is particularly problematic in low-gradient streams, as increased silt deposition may fill crucial microhabitats such as the spaces between rocks and logs that are used as sheltering, hiding and nesting sites.

**Reference**

Hallock, L. A. and K. R. McAllister. 2009. Cope's Giant Salamander. Washington Herp Atlas. http://www1.dnr.wa.gov/nhp/refdesk/herp/

**Cope's Giant Salamander: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Resource management needs | Lack of information. Local declines and extirpations may have occurred but lack of documentation available. | Assess population. | Current insufficient | Both |
| 2 | Fish and wildlife habitat loss and degradation | Loss of riparian vegetation that results in elevated stream temperatures, erosion and increased sedimentation. This species requires cool water temperatures and microhabitats such as the spaces between rocks and logs that are used as sheltering, hiding and nesting sites. | Protect riparian buffers around occupied streams. | Current insufficient | Both |

NOTE: Numbers are for reference only and do not reflect priority.

## CASCADE TORRENT SALAMANDER (*Rhyacotriton cascadae*)

*See Appendix B for a range and potential habitat distribution map

**Conservation Status and Concern**

This species is sensitive to temperature variation and increased sedimentation that may be caused by disturbances such as logging and road construction. Some populations are isolated by surrounding areas of unsuitable habitat and are vulnerable to extirpation through stochastic events exacerbated by habitat loss. Temperature sensitivity and limited dispersal ability makes this species potentially sensitive to climate change.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| None | Candidate | Yes | G3 | S3 | Medium/unknown | High |

**Biology and Life History**


Photo: W. Leonard

Cascade torrent salamanders may be active year-round at lower elevations. Larval torrent salamanders have tiny external gills. Adults have very reduced lungs and breathe mostly through their skin. Breeding phenology is unknown, but may occur during most of the warmer months of the year. Eggs are most likely laid in the spring. The first described Cascade torrent salamander nest was found on 14 August 2003 in a second-order headwater stream on the west slope of the Cascade Mountains in Skamania County under a cobble-sized rock in the middle of a calm stretch of the stream channel 4 inches deep by 24 inches wide by 28 inches long. This differs from other *Rhyacotriton* species that are described as laying eggs in deep cracks and crevices of springs and seeps. The nest contained 5 eggs that were not attached to the substrate or each other. The larval period is thought to be long; a Columbia Gorge population was estimated to require 4 to 5 years before metamorphosis.

**Distribution and Abundance**

In Washington, this species ranges from the west slopes of the Cascade Mountains south of Nisqually River to the Columbia River. Distribution is patchy. They can reach high densities in optimal habitat.

**Habitat**

This species is generally found in high-gradient, cold streams, seepages and waterfall splash zones, typically in areas with a thick canopy cover. Interestingly however, this species survived in many sites that were completely deforested by the 1980 eruption of Mount St. Helens. They usually occur in stream segments or off-channel habitats, such as seeps and waterfall splash zones, that are shallow, slow flowing and that have gravel or rock rubble that is silt-free. Adults are strongly associated with water and individuals are almost always found in contact with either free water or saturated substrates. During rainy wet periods individuals may be found in wet terrestrial forest settings away from streams or seepages.

**References**

Hallock, L. A. and K. R. McAllister. 2005. Cascade Torrent Salamander. Washington Herp Atlas. http://www1.dnr.wa.gov/nhp/refdesk/herp/

Jones, L. L. C., W. P. Leonard, and D. H. Olson, editors. 2005. Amphibians of the Pacific Northwest. Seattle Audubon Society, Seattle, Washington. xii + 227pp.

**Cascade Torrent Salamander: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Resource information collection needs | Lack of information on status and distribution. | Continue research, surveys and monitoring to understand species distribution and status. | Current insufficient | Both |
| 2 | Fish and wildlife habitat loss and degradation | Increase in water temperatures and sedimentation. This species is closely associated with cool forested streams. | Leave suitable forested buffers on occupied streams to prevent water temperature increases and sedimentation. | Current insufficient | Both |
| 3 | Climate change and severe weather | Direct mortality and loss of micro-habitat features due to stream flooding, erosion and scouring. | Leave refuge areas of intact habitat. Buffered streams in clear cuts are more likely to be impacted by extreme precipitation and wind events. | Current insufficient | Both |
| 4 | Climate change and severe weather | Stream and seep drying. This species is closely associated with cool forested streams. | Minimize habitat fragmentation and maintain robust populations across landscape. | Current insufficient | Both |
| 5 | Climate change and severe weather | Loss of suitable habitat. This species is closely associated with cool forested streams and dependent on specific microhabitat features. | Minimize habitat fragmentation and maintain robust populations across landscape. | Current insufficient | Both |
| 6 | Climate change and severe weather | Warming and drying of streams. This species is closely associated with cool forested streams. | Minimize habitat fragmentation and maintain robust populations across landscape. | Current insufficient | Both |

NOTE: Numbers are for reference only and do not reflect priority.

## COLUMBIA TORRENT SALAMANDER (*Rhyacotriton kezeri*)

*See Appendix B for a potential range and habitat distribution map

**Conservation Status and Concern**

The Washington status is based on the small global range, narrow environmental specificity and the potential concern that the species' headwater habitat may not be fully protected. In Washington, some occurrences are in protected areas (e.g., Natural Area Preserves) and some riparian habitat protections occur through forest practices rules and Habitat Conservation Plans. The temperature sensitivity and limited dispersal ability makes this species potentially sensitive to climate change.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| Species of Concern | Monitor | No | G3 | S3 | Medium/unknown | Moderate-high |

**Biology and Life History**


Photo: W. Leonard

This is a small, aquatic, stream-adapted salamander (less than 2.4 inches snout to vent length). They are active year-round. The reproductive ecology is poorly known. The mating season is probably prolonged similar to other torrent salamander species. Only five nests have been found, presumably because the eggs are laid in inaccessible recesses in head-water streams and seeps. The situation regarding parental care and communal nesting are unclear; both have been observed but neither was consistent at the five described nests. The incubation period is long (7 to 9 months). The larval period is also long (more than 2 years). Metamorphosed forms eat a variety of aquatic and semiaquatic invertebrates and larval forms eat aquatic invertebrates. Torrent salamanders are desiccation intolerant, have highly reduced lungs and consequently depend on skin surfaces for oxygen uptake. Individuals are highly sedentary with movements limited to 10 feet or less.

**Distribution and Abundance**

This species is endemic to the coastal ranges of southwestern Washington and northwestern Oregon. Distribution in Washington is restricted to the Willapa Hills. Distribution within the range is patchy and they can be locally common in suitable habitat.

**Habitat**

Columbia Torrent Salamanders occur in mature, coastal, coniferous forests where they inhabit relatively cold, permanent streams, seepages and waterfall splash zones Stream segments tend to be shallow, slow flowing and have gravel or rock rubble with low levels of silt. They tend to be more abundant in streams with northerly aspects and steep gradients. During rainy wet periods, metamorphosed individuals may occasionally be found in wet terrestrial forest settings away from streams or seepages.

**References**

Hayes, M. and T. Quinn. 2014. Columbia Torrent Salamander (*Rhyacotriton kezeri*). AmphibiaWeb: Information on amphibian biology and conservation. [web application]. Berkeley, California: AmphibiaWeb. Available: http://amphibiaweb.org/. (Accessed: Nov 12, 2014).

O'Donnell, R., C. Richart. 2012. Diet of the Columbia Torrent Salamander, *Rhyacotriton kezeri* (Caudata: Rhyacotritonidae): Linkages between Aquatic and Terrestrial Ecosystems *In* Forested Headwaters. Northwestern Naturalist 93(1):17-22. 2012
Russell, K. and A. Gonyaw, J. Strom, K. Diemer and K. Murk. 2002. Three new nests of the Columbia Torrent Salamander, *Rhyacotriton kezeri*, in Oregon with observations of nesting behavior. Northwestern Naturalist 83:19-22.

**Columbia Torrent Salamander: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Resource information collection needs | Lack of information on status and distribution. | Continue research, surveys and monitoring to understand species distribution and status. | Current insufficient | Both |
| 2 | Fish and wildlife habitat loss and degradation | Increase in water temperatures and sedimentation. | Leave suitable forested buffers on occupied streams to prevent water temperature increases and sedimentation. | Current Sufficient | Both |
| 3 | Climate change and severe weather | Stream flooding, erosion and scouring. Stream flooding, erosion and scouring could result in direct mortality and/or loss of suitable microhabitat. | Leave refuge areas of intact habitat. Buffered streams in clear cuts are more likely to be impacted by extreme precipitation and wind events. | Unknown | Both |
| 4 | Climate change and severe weather | Loss of suitable habitat. These are small, salamanders that are closely associated with cool streams and seeps; they do not move long distances. | Minimize habitat fragmentation and maintain robust populations across landscape. | Unknown | Both |
| 5 | Climate change and severe weather | Drying of streams may result from unusually low rainfall for a prolonged period. | Minimize habitat fragmentation and maintain robust populations across landscape. | Unknown | Both |
| 6 | Climate change and severe weather | Warming and drying of streams. Columbia Torrent Salamanders are closely associated with cool, forested streams and cannot tolerate warm waters. | Minimize habitat fragmentation and maintain robust populations across landscape. | | Both |

NOTE: Numbers are for reference only and do not reflect priority.

## OLYMPIC TORRENT SALAMANDER (*Rhyacotriton olympicus*)

*See Appendix B for a potential range and habitat distribution map

**Conservation Status and Concern**

The status is based on the small global range (Washington endemic) and narrow environmental specificity. Most known occurrences (77 percent) are within Olympic National Park with an additional 15 percent of locations on the Olympic National Forest. National Forest occurrences are within Late-Successional Reserves and Adaptive Management Areas that provide some level of riparian habitat protection. Occurrence in landscapes with more intact, mature habitat with legacy structures (e.g., coarse woody debris) will likely buffer some impacts of climate change for this temperature-sensitive species with limited dispersal ability.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| Species of Concern | Monitor | No | G3 | S3 | Medium/unknown | High |

**Biology and Life History**

This is a small, aquatic, stream-adapted salamander (less than 2.4 inches snout to vent length). They are active year-round. The mating season is probably prolonged. No nests have been found presumably because the eggs are laid in inaccessible recesses in head-water streams and seeps. Clutch number is also unknown but is likely small (8 or less eggs). The incubation and larval periods are long (7 to 9 months and more than 2 years respectively). They are opportunistic predators on invertebrates. They are desiccation intolerant, have highly reduced lungs and depend on skin surfaces for oxygen uptake. Individuals are sedentary with movements limited to several meters or less.

Photo: W. Leonard

**Distribution and Abundance**

This species is endemic to the Olympic Peninsula. Distribution within the range is patchy. The species was found to be widespread within Olympic National Park where it was found in 41 percent of 168 streams and 47 percent of 235 seeps surveyed.

**Habitat**

They occur in mature coniferous forests where they inhabit cold, permanent streams, seepages and waterfall splash zones. Stream segments tend to be shallow, slow flowing and have gravel or rock rubble with low levels of silt. They tend to be more abundant in streams with north aspects, steep gradients and cobble substrates. Spaces between rocks are used for cover. Occupied streams need to be protected with forested riparian buffers that provide stream shading, near-stream terrestrial ambient moisture regimes, large wood recruitment and dispersal habitat.

**References**

Adams, M. J. and R. B. Bury. 2002. The endemic headwater stream amphibians of the American Northwest: associations with environmental gradients in a large forested preserve. Global Ecology and Biogeography 11:169–178

Howell, B. and Roberts, C. 2008. A Conservation Assessment for the Olympic Torrent Salamander (*Rhyacotriton olympicus*). Submitted to the Interagency Special Status and Sensitive Species Program, USDA Forest Service Region 6 and USDI Bureau of Land Management, Washington and Oregon.

**Olympic Torrent Salamander: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Resource information collection needs | Lack of information on status and distribution. | Continue research, surveys and monitoring to understand species distribution and status. | Current insufficient | Both |
| 2 | Fish and wildlife habitat loss and degradation | Increased water temperatures and sedimentation. This species is closely associated with cool, forested streams and cannot tolerate warm waters. Also, sediment can fill the interstitial spaces between rocks where this species shelters. | Leave suitable forested buffers on streams occupied by torrent salamanders to prevent water temperature increases and sedimentation. | Current sufficient | Both |
| 3 | Climate change and severe weather | Direct mortality and loss of micro-habitat features due to stream flooding, erosion and scouring. | Leave refuge areas of intact habitat. Buffered streams in clear cuts are more likely to be impacted by extreme precipitation and wind events. | Unknown | Both |
| 4 | Climate change and severe weather | Changes to macro- and micro- habitat. These are small, salamanders that are closely associated with streams and they do not move long distances. | Minimize habitat fragmentation and maintain robust populations across landscape. | Unknown | Both |
| 5 | Climate change and severe weather | Streams and seeps drying. This species is closely associated with cool, forested streams and moist conditions and they do not move long distances. | Minimize habitat fragmentation and maintain robust populations across landscape. | Unknown | Both |

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 6 | Climate change and severe weather | Unusually warm water. This species is closely associated with cool, forested streams and cannot tolerate warm waters. | Minimize habitat fragmentation and maintain robust populations across landscape. | | Both |

NOTE: Numbers are for reference only and do not reflect priority.

## DUNN'S SALAMANDER (*Plethodon dunni*)

*See Appendix B for a range and potential habitat distribution map

### Conservation Status and Concern

The Washington status is based on the small state range, narrow environmental specificity and concern that riparian habitats the species relies upon may not be fully protected. The need for retention of large woody debris is also of concern.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| None | Candidate | Yes | G4 | S3 | Low/stable | Moderate-high |

### Biology and Life History

Dunn's salamander is the largest of the northwestern Plethodontids (lungless salamanders). All life stages are terrestrial. They require moist conditions and, therefore, most surface activity takes place in the spring and fall when temperatures are above freezing. Dunn's salamanders lay their eggs in clusters on dry land within moist areas of cover such as in rotted logs or in crevices within wet, rocky areas. A clutch of eggs may range from 4 to 15. One nest was found in a decayed log next to a stream, with the female curled around nine eggs. There is no free-living larval stage. Hatchlings emerge as juvenile salamanders.

Photo: W. Leonard

### Distribution and Abundance

This species is relatively rare in Washington. It occurs only in the Willapa Hills of the Olympic Physiographic Province. The range extends north to the Chehalis River and east to the Cowlitz River. This is the northern extreme of this species' range.

### Habitat

Dunn's salamanders live in the shaded rocky edges of highly humid forested streams and moist talus (rock fragment piles). They prefer areas that are permanently moist but not in flowing water. Adults often hide under rocks, in splash zones near streams and occasionally under woody debris. This species has also been found upslope, away from stream channels. They may wander on the forest floor during rainy nights in the wet season, seeking cover in moist microhabitats such as forest duff or downed wood during the day.

**References**

Hallock, L. A. and K. R. McAllister. 2005. Dunn's Salamander. Washington Herp Atlas. http://www1.dnr.wa.gov/nhp/refdesk/herp/

Jones, L. L. C., W. P. Leonard, and D. H. Olson, editors. 2005. Amphibians of the Pacific Northwest. Seattle Audubon Society, Seattle, Washington. xii + 227pp.

**Dunn's Salamander: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Resource information collection needs | Lack of information on status and distribution. | Continue research, surveys and monitoring to understand species distribution and status. | Current insufficient | Both |
| 2 | Fish and wildlife habitat loss and degradation | Loss of suitable habitat. This species is closely associated with cool forested streams and dependent on specific microhabitat features. | Prevent habitat modification at occupied sites. | Current insufficient | Both |
| 3 | Climate change and severe weather | Loss of suitable habitat. This species is closely associated with cool forested streams and dependent on specific microhabitat features. | Minimize habitat fragmentation and maintain robust populations across landscape. | Current insufficient | Both |

NOTE: Numbers are for reference only and do not reflect priority.

## LARCH MOUNTAIN SALAMANDER (*Plethodon larselli*)

*See Appendix B for a range and potential habitat distribution map

**Conservation Status and Concern**

The status is based on the small global range, narrow environmental specificity and concern that there is not adequate protection for this species' specialized habitat of rocky accumulations and talus. Any ground-disturbing activity or land use that changes the moisture regimes and permeability of inhabited rocky substrates, such as over-story tree removal and gravel removal, may threaten populations. In addition, the sedentary habits and specific habitat requirements likely hinder dispersal and colonization to new areas as well as limiting gene flow between populations.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| Species of Concern | Sensitive | Yes | G3 | S3 | Low/unknown | Moderate-high |

**Biology and Life History**


Photo: W. Leonard

This is a small, striped salamander (less than 2 inches snout to vent length). Most of its life is spent in the subterranean environment and it is surface-active only about 20 to 90 days a year. Surface activity is triggered whenever moisture and temperature regimes are appropriate, primarily in the spring and fall. Breeding takes place in the autumn and spring months. No nests have been found. Development of larvae takes place in the egg; there is no free-living aquatic larval stage. Sexual maturity is reached at 3 to 3.5 years and 4 to 4.5 years for males and females respectively. They are predators on a variety of invertebrates. The movements are poorly documented, but it is clear that home ranges tend to be only 10 to 100 feet in diameter. These salamanders are lungless and depend on moist skin surfaces for oxygen uptake.

**Distribution and Abundance**

This species is endemic to Washington and northern Oregon. The main distribution is along a 34 mile stretch of the Columbia River Gorge in southern Washington and northern Oregon and discontinuously northward in the Cascades in the Snoqualmie Pass-Kachess Lake area.

**Habitat**

Larch Mountain Salamanders are associated with talus, scree, gravelly soils and other areas of accumulated rock where interstitial spaces exist between the rock and soil. Steep slopes are also an important habitat feature. They inhabit a diverse range of forested and non-forested habitats. Occupied rocky substrates in non-forested areas are usually north facing and nonvascular plants, especially mosses, dominate the ground cover. In some areas of the Cascade Mountains, they inhabit old-growth coniferous forests without significant exposed rocky areas. They also inhabit lava tubes in the Mount St. Helens vicinity. In all of these habitats, important microhabitats include woody debris, leaf litter and rocks.

**References**
Hallock, L. A. and K. R. McAllister. 2005. Larch Mountain Salamander. Washington Herp Atlas. http://www1.dnr.wa.gov/nhp/refdesk/herp/
NatureServe. 2014. Larch Mountain Salamander. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.1. NatureServe, Arlington, Virginia. Available http://explorer.natureserve.org. (Accessed: November 13, 2014).
Petranka, J. W. 1998. Salamanders of the United States and Canada. Smithsonian Institutional Press, Washington. 587pp.

### Larch Mountain Salamander: Conservation Threats and Actions

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Resource information collection needs | Lack of information on status and distribution. | Continue research, surveys and monitoring to understand species distribution and status. | Current insufficient | Both |
| 2 | Fish and wildlife habitat loss and degradation | Removal of trees. This small, non-vagile species needs cool, moist conditions. | Prevent habitat modification at sites occupied by Larch Mountain Salamanders. | Current insufficient | Both |
| 3 | Energy development and distribution | Mining of rock and boulders. This small, non-vagile species is closely associated with rock features such as talus. | Prevent habitat modification at sites occupied by Larch Mountain Salamanders. | Current insufficient | Both |
| 4 | Climate change and severe weather | Loss of suitable habitat. This small, non-vagile species needs moist conditions and is closely associated with rock features such as talus. Surface activity is limited by moisture and temperature. | Prevent habitat modification at sites occupied by Larch Mountain Salamanders. | Current insufficient | Both |
| 5 | Climate change and severe weather | Drying of habitat. Surface activity is limited by moisture and temperature (fall and spring). These salamanders are lungless and depend on moist skin surfaces for oxygen uptake. | Prevent habitat modification at sites occupied by Larch Mountain Salamanders. | Current insufficient | Both |

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 6 | Climate change and severe weather | Warming and drying of habitat. This small, non-vagile species needs moist conditions. Surface activity is limited by moisture and temperature. These salamanders are lungless and depend on moist skin surfaces for oxygen uptake. | Prevent habitat modification at sites occupied by Larch Mountain Salamanders. | Current insufficient | Both |

NOTE: Numbers are for reference only and do not reflect priority.

## VAN DYKE'S SALAMANDER (*Plethodon vandykei*)

**Conservation Status and Concern**

Van Dyke's Salamander is one of relatively few vertebrate species endemic to Washington. It is at risk due to its limited distribution and apparently small, isolated populations.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| Species of Concern | Candidate | Yes | G3 | S3 | Low/unknown | Moderate-high |

**Biology and Life History**


Photo: W. Leonard

Most surface activity takes place in the spring after snowmelt and before summer drought and in the fall after the onset of fall rains and before temperatures approach freezing. More specifically, most surface activity occurs when soil moisture is high (moist or wet) and soil temperatures are between 39 to 57˚F. Because this species may occupy wet habitats, it is sometimes active on the surface even in the summer. Nests found on the Olympic Peninsula (elevations below 2300 feet) were laid in early May and development was completed by early October. Females brood and guard the eggs during the summer. One nest was under a moss covered stone; a grape-like cluster of eggs were attached to the stone by a single gelatinous thread. Another clutch was found in a moist, partially rotted log along a stream in old-growth forest (western red-cedar/Douglas-fir/western hemlock/grand fir) in Washington. There is no larval stage; hatchlings emerge as juvenile salamanders. These salamanders are lungless and depend on moist skin surfaces for oxygen uptake.

**Distribution and Abundance**

This species is endemic to Washington State. They occur in three disjunct areas in the Willapa Hills, on the Olympic Peninsula, and in the southern Cascade Ranges. These areas are separated by glacial and alluvial deposits that may limit regional distribution. They generally occur in small isolated populations.

**Habitat**

Van Dyke's Salamander is usually associated with streams, seepages, and rock outcrops. It has been associated with habitats that maintain cool temperature and moist conditions. In coastal areas, it is often most abundant in old forest stands that have complex stand structure and moderate to high levels of woody debris and colluvial rock present. It has also been reported from forested talus, upland sites, and in cave entrances. Interestingly, small populations survived in the Mount Saint Helens' blast zone; these were probably protected by their subterranean refugia and heavy snowpack. Large decaying conifer logs near streams appear to be important habitat for nests.

**References**

Hallock, L. A. and K. R. McAllister. 2005. Van Dyke's Salamander. Washington Herp Atlas. http://www1.dnr.wa.gov/nhp/refdesk/herp/

Jones, L. L. C., W. P. Leonard, and D. H. Olson, editors. 2005. Amphibians of the Pacific Northwest. Seattle Audubon Society, Seattle, Washington. xii + 227pp.

Washington Department of Fish & Wildlife (WDFW). 2014. WDFW Wildlife Survey and Management Database.

**Van Dyke's Salamander: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Resource information collection needs | Lack of information on status and distribution. Species occurs in small, scattered populations throughout its range. Vulnerable to stochastic events. | Continue research, surveys and monitoring to understand species distribution and status. | Current insufficient | Both |
| 2 | Fish and wildlife habitat loss and degradation | Loss of suitable habitat. This species is closely associated with cool forested streams and dependent on specific microhabitat features. | Prevent habitat modification at occupied sites. | Insufficient | Both |
| 3 | Climate change and severe weather | Loss of suitable habitat. This species is closely associated with cool forested streams and dependent on specific microhabitat features. | Minimize habitat fragmentation and maintain robust populations across landscape. | Insufficient | Both |

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 4 | Climate change and severe weather | Loss of suitable habitat. This species is closely associated with cool forested streams and dependent on specific microhabitat features. | Minimize habitat fragmentation and maintain robust populations across landscape. | Insufficient | Both |
| 5 | Climate change and severe weather | Loss of suitable habitat. This species is closely associated with cool forested streams and dependent on specific microhabitat features. | Minimize habitat fragmentation and maintain robust populations across landscape. | Insufficient | Both |

NOTE: Numbers are for reference only and do not reflect priority.

# TOADS

## WESTERN TOAD (*Anaxyrus boreas*)

*See Appendix B for a range and potential habitat distribution map

**Conservation Status and Concern**

In Washington, Western Toad declines have been documented in the Puget Trough and the lower Columbia River below Bonneville Dam. Of about 107 historical sites in those areas, only about 19 are thought to still be extant. Elsewhere in the state, toads are locally common in many areas.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| Species of Concern | Candidate | Yes | G4 | S3S4 | In lowland Puget Sound: Low/unknown | Moderate-high |

**Biology and Life History**

Photo: K. McAllister

In general, breeding starts in mid-April at low elevation sites in western Washington and in late April or early May at low elevation sites in eastern Washington. Toads at higher elevations tend to breed later. Onset of egg laying at each location varies from 1 to 3 weeks each year depending on site conditions such as snow melt. Tadpole development to metamorphosis takes approximately 2 months depending on temperature and food availability. The newly metamorphosed toads disperse from the breeding sites *en masse* for 1 to 2 weeks. Informal observations indicate that many populations return to the same breeding location each year. Transformed toads are primarily terrestrial, but often occur near water bodies, especially in drier climates. Overwintering habitat has not been described for Washington. In lowland western Washington, individual toads have been found in mid-February within duff under sword ferns suggesting that some individuals overwinter terrestrially in areas with mild winters or at least occur terrestrially during the mild portions of winters.

**Distribution and Abundance**

Western Toads occur in all Washington ecoregions. Within the Washington portion of the Columbia Plateau, their distribution is limited to the edges of the ecoregion except in the southeast corner of the state. They are locally abundant in some areas, but local declines have been documented in others.

**Habitat**

This species occurs in a variety of terrestrial habitats including prairies, forests, canyon grasslands and ponderosa pine-Oregon oak habitat. They appear absent from most of the shrub-steppe and steppe zones with the exception of the canyon grasslands in southeast Washington. Breeding waters are usually permanent and include wetlands, ponds, lakes, reservoir coves and the still-water off-channel habitats of rivers, as well as river edges.

**References**

Hallock, L.A. and K.R. McAllister. 2005. Western Toad. Washington Herp Atlas. http://www1.dnr.wa.gov/nhp/refdesk/herp/speciesmain.html

### Western Toad: Conservation Threats and Actions

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Fish and wildlife habitat loss or degradation | Road mortality when moving to and from breeding sites. Newly metamorphosed toads disperse *en masse* and gather in piles. When this happens on roads, thousands of toads can be killed by a single vehicle. Adults are also killed as they move to and from breeding sites. | 1. Identify and map known crossings.<br>2. Avoid road building near breeding sites.<br>3. When possible, close roads to vehicles during dispersal periods (e.g., ATV use on gated dirt roads).<br>4. Create passage structures to circumvent roads. | Current insufficient | Both |
| 2 | Fish and wildlife habitat loss or degradation | Loss of upland habitat through the development on shorelines and aroundwaterbodies used for breeding. | Protect known pockets of abundance and breeding areas. | Current insufficient | External |
| 3 | Fish and wildlife habitat loss and degradation | Habitat alteration and degradation. | Protect known pockets of abundance and breeding areas. | Current insufficient | External |
| 4 | Resource information collection needs | Lack of information on status and distribution. | Research, surveys and monitoring to understand species distribution and status. | Current insufficient | Both |
| 5 | Resource information collection needs | Taxonomic uncertainty may mean one or more taxa are in greater decline; causes of decline not understood. | Conduct genetic studies. | Nothing current - new action needed | External |
| 6 | Invasive and other problematic species | Chytrids and other fungi, and parasites have contributed to declines throughout the species' range; however, chytrids have not yet been detected in WA toads. | Include testing for chytrids, fungal infections, and trematode infections in survey and monitoring protocols | Nothing current - new action needed | Both |
| 7 | Fish and wildlife habitat loss or degradation | Transportation and service corridors - roads and railroads. | Avoid road building near breeding sites, or provide crossings. | Current insufficient | External |

NOTE: Numbers are for reference only and do not reflect priority.

## WOODHOUSE'S TOAD (*Anaxyrus woodhousii*)

*See Appendix B for a potential range and habitat distribution map

**Conservation Status and Concern**

The Washington State status is based on the small number of populations, a limited distribution restricted to shrub-steppe habitat in a region heavily altered for agriculture and urban development (e.g., Tri-Cities area), and a lack of information about the species.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| None | Monitor | No | G5 | S3 | Unknown/unknown | Moderate-high |

**Biology and Life History**


Photo: W. Leonard

This is a medium to large (2 to 5 inches snout to vent length) terrestrial toad with a stout body, broad waist, short legs, a round head and short snout. Activity starts in late April to early May and continues into October. Adult activity is crepuscular and nocturnal; smaller toads can occasionally be found during the day, as can newly metamorphosed "toadlets" on shorelines. Male chorusing and breeding in Franklin, Benton and Grant Counties occurs from May to July depending on conditions at each breeding site. Egg development to hatching is rapid (less than 10 days). Tadpole development is completed in approximately 2 months and metamorphosis occurs in the summer or fall of the first year. The toads are opportunistic predators that primarily eat invertebrates such as insects. The adult toads are terrestrial but burrow below the surface during the day. Information about overwintering behavior is not known for Washington but likely is terrestrial and in the vicinity of the breeding pond.

**Distribution and Abundance**

In Washington, Woodhouse's Toads occur in a small area of the Columbia Plateau Ecoregion along the Snake River and along the Columbia River between the Priest Rapids Dam and John Day Dam. Occurrences have also been documented in the Eltopia and Wahluke Branch irrigation canal systems in Franklin County on the Hanford Site and Juniper Dunes.

**Habitat**

Occurrences are found in shrub-steppe habitat near the Columbia and Snake Rivers. Breeding takes place in a variety of still-water habitats, including shallow temporarily flooded sites, ponds and sloughs. They will also lay eggs in stagnant areas of small, slow-flowing streams. Transformed toads are terrestrial. Soil types suitable for burrowing are important because they spend the day burrowed below the surface. Habitats include riparian areas, shrub-steppe and grassland.

**References**

Hallock, L. A. and K. R. McAllister. 2005. Woodhouse's Toad. Washington Herp Atlas. http://www1.dnr.wa.gov/nhp/refdesk/herp/

Jones, L. L. C., W. P. Leonard and D. H. Olson (Eds.). 2005. *Amphibians of the Pacific Northwest*. Seattle Audubon Society. 227 pp.

**Woodhouse's Toad: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Resource information collection needs | Lack of information on status and distribution. | Research, surveys and monitoring to understand species distribution and status. | Current insufficient | Both |
| 2 | Fish and wildlife habitat loss and degradation | Loss and degradation of suitable shrub-steppe habitat that this species relies upon in WA. | Protect native shrub-steppe habitat from conversion and degradation due to agriculture. | Current insufficient | Both |
| 3 | Resource information collection needs | This species has a limited distribution in WA. | Research, surveys and monitoring to understand species distribution and status. | Current insufficient | Both |
| 4 | Resource information collection needs | Little is known about the habitat requirements of this species in WA. | More information is needed on this species to understand its status and habitat management. | Current insufficient | Both |

NOTE: Numbers are for reference only and do not reflect priority.

# FROGS

## ROCKY MOUNTAIN TAILED FROG (*Ascaphus montanus*)

**Conservation Status and Concern**

This species is vulnerable to management practices that alter the riparian or aquatic zones of streams, especially those practices that change the moisture regime, increase sediment load, reduce woody debris input and change stream bank integrity. Protection of headwater streams is particularly important.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| Species of Concern | Candidate | Yes | G4 | SNR | Low/unknown | Moderate-high |

**Biology and Life History**

Photo: B.Moon

Rocky Mountain Tailed Frogs are present year-round in and near perennial streams. They are generally active at night, but tadpoles and frogs can also be observed during the day. They are most active from April to October, but this varies by site and conditions. Mating occurs typically in fall; females retain sperm and lay eggs in early summer. Eggs hatch usually in late summer, but larvae may remain in nest site until the following summer. The larval period lasts a few years. Metamorphosis usually takes place in late summer, and metamorphs require several additional years to attain sexual maturity. All life stages are adapted for life in fast-flowing streams. The male's "tail" is used for internal fertilization, which prevents sperm from being washed away. Eggs are attached to the undersides of rocks to keep them in place. The tadpoles have a large sucker-like mouth that allows them to feed and move in high-energy streams without losing contact and unintentionally drifting.

**Distribution and Abundance**

In Washington, populations are found only in the Blue Mountains. The Washington Department of Fish and Wildlife database contains 229 observation records reported from 1997 to 2010. The occupied area is small and little is known about population size, habitat conditions or threats.

**Habitat**

This species is restricted to perennial streams found in or associated with cold, clear, rocky streams in mature forests. During wet weather, adults and juveniles may move into upland habitat adjacent to the stream. A recent study in Idaho found tailed frogs persisted in streams that occurred in burned forest and post-burn regenerated forest showing that under certain conditions, tailed frogs can be resilient to physical stream changes resulting from natural disturbance. This included persisting in water much warmer than previously reported in the field.

**References**

Dunham, J. B., A. E. Rosenberger, C. H. Luce, and B. E. Rieman. 2007. Influences of wildfire and channel reorganization on spatial and temporal variation in stream temperature and the distribution of fish and amphibians. Ecosystems 10(2):335-346

Hallock, L. A. and K. R. McAllister. 2005. Rocky Mountain Tailed Frog. Washington Herp Atlas. http://www1.dnr.wa.gov/nhp/refdesk/herp/

WDFW. 2014. WDFW Wildlife Survey and Management Database.

### Rocky Mountain Tailed Frog: Conservation Threats and Actions

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Resource information collection needs | Inventory is needed in the Blue Mountains. | Continue research, surveys and monitoring to understand species distribution and status. | Current insufficient | Both |
| 2 | Fish and wildlife habitat loss and degradation | This species is closely associated with cool forested streams. Protection of headwater streams is particularly important. | Prevent habitat modification at occupied sites. | Current insufficient | Both |
| 3 | Fish and wildlife habitat loss and degradation | Degradation of riparian areas from livestock. This species occurs on livestock rangeland and livestock impacts, well known to influence riparian systems, are currently not being paid attention to as potentially significant to this species. | Survey rangeland locations where Rocky Mountain Tailed Frogs are known to occur and assess habitat impacts. | Current insufficient | Both |
| 4 | Climate change and severe weather | Loss of suitable habitat. This species is closely associated with cool forested streams and adapted for a life history in swiftly flowing water. | Minimize habitat fragmentation and maintain robust populations across landscape. | Current insufficient | Both |

NOTE: Numbers are for reference only and do not reflect priority.

## COLUMBIA SPOTTED FROG (*Rana luteiventris*)

*See Appendix B for a range and potential habitat distribution map

**Conservation Status and Concern**

Populations of this species in the Columbia Basin are declining, likely due primarily to habitat loss and alteration, although other factors such as fish stocking may also cause declines. This species is aquatic, so drying of ponds and creeks related to agricultural water withdrawals is a threat in the region.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| None | Candidate | Yes | G4 | S4 | In Columbia Basin: Low/unknown | Moderate-high |

**Biology and Life History**

Photo: W. Leonard

Breeding in the Columbia Basin begins in late March to early April. In the Okanogan Highlands breeding starts in late April to early May at mid-elevation sites between 2,000 to 3,500 feet and late May to early June at elevation sites greater than 4,500 feet. Typically the egg masses are deposited in communal clusters. Embryos take approximately 3 to 5 weeks to develop, depending on the temperature regime and elevation. Metamorphosis typically occurs in late summer but may be delayed at higher elevation sites. They become sexually mature in 2 to 6 years, depending on location and elevation. Though movements of up to 4 miles have been recorded, the species generally stays in wetlands along streams within .6 miles of their breeding pond. Frogs in isolated ponds may not leave those sites.

**Distribution and Abundance**

In Washington, the Columbia Spotted Frog occurs east of the Cascade Mountain crest in the East Cascades, Okanogan, Canadian Rocky Mountain, Columbia Basin, and Blue Mountain Ecoregions, and spilling over the Cascade crest to the west slope in the north Cascades near Harts and Rainy Passes. Small, scattered populations occur in the shrub-steppe vegetation zones of the Columbia Basin.

**Habitat**

This species is relatively aquatic and is rarely found far from water. It occupies a variety of still-water habitats and can also be found in streams and creeks. It is common to see these frogs basking on the shore or on floating debris. Breeding habitat is the seasonally flooded margins of wetlands, ponds and lakes. Flooded pools and still water edges of creeks may also be used in some areas. Egg masses are laid in shallow water where they receive little or no shading from vegetation. Waters that remain aerobic and do not freeze to the sediments (such as springs and creeks) are most likely necessary for winter survival in areas subject to freezing.

**References**
Bull, E. L. and M. P. Hayes. 2001. Post-breeding season movements of Columbia spotted frogs (*Rana luteiventris*) in northeastern Oregon. Western North American Naturalist 61:119-123.
Hallock, L. A. and K. R. McAllister. 2005. Columbia Spotted Frog. Washington Herp Atlas. http://www1.dnr.wa.gov/nhp/refdesk/herp/

**Columbia Spotted Frog: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Invasive and other problematic species | Introduced, non-native, predatory species such as American Bullfrog and warm-water game fish. | Better understand overlap of species range and fish, then minimize impacts from fish in lakes and ponds. If possible, exterminate bullfrogs where found. | Current insufficient | Both |
| 2 | Resource information collection needs | Successional changes in vegetation may threaten this species, but are unstudied and poorly understood. | Research, surveys and habitat monitoring to understand successional changes in vegetation. | Nothing current—new action needed | Both |
| 3 | Fish and wildlife habitat loss and degradation | Altered hydrology, agricultural water withdrawal and other factors (e.g., salmon restoration projects) can eliminate suitable aquatic habitat. | Protect known sites; identify and protect potential habitat. | Nothing current – new action needed | Both |
| 4 | Resource information collection needs | Lack of information on status and distribution. | Research, surveys and monitoring to understand species distribution and status. | Current insufficient | Both |
| 5 | Resource information collection needs | Loss of beaver and beaver ponds. | Conserve beaver populations and dynamic stream processes. | Current insufficient | Both |

NOTE: Numbers are for reference only and do not reflect priority.

## OREGON SPOTTED FROG (*Rana pretiosa*)

**Conservation Status and Concern**

The Washington status is based on the rarity of the species. Human-caused stressors include wetland loss and alteration, loss of disturbance processes that set back succession, introduction of non-native/invasive flora and fauna and alteration of creek and river channels. Only six watersheds are currently known to be occupied in Washington. Within a watershed, most breeding populations are small and many are isolated from other breeding populations. They require breeding sites in shallow water with short vegetation and full sun exposure. This habitat type is rapidly lost to invasive grasses without management such as grazing, haying, mowing or restoration to native flora.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| Candidate | Endangered | Yes | G2 | S1 | Low/declining | Moderate-high |

**Biology and Life History**


Photo: W. Leonard

This is a medium to large (adults from 2 to 4 inches snout to vent length) aquatic frog. The dorsal color is olive-brown to brick red with black spots. They are communal breeders that return to the same breeding areas each year. Breeding takes place in February and March. Breeding times differ depending on location and elevation and vary annually depending on water temperatures. Embryos take approximately 3 weeks to develop to hatching. Tadpoles transform in mid-summer of their first year. Radio-telemetry and mark-recapture studies have revealed that Oregon Spotted Frogs are relatively sedentary during the summer (driest period) and remain active underwater during the winter. The longest movement between captures in Washington was 1.5 miles and in Oregon was 1.7 miles.

**Distribution and Abundance**

The historical range in Washington is the Puget Trough Ecoregion and the southern extent of the Eastern Cascades Ecoregion in Whatcom, Skagit, Thurston, Skamania and Klickitat Counties. Current occurrences are in the Sumas River, Black Slough, Samish River, upper Black River drainage, lower Trout Lake Creek drainage and at Conboy Lake and Camas Prairie in the Outlet Creek drainage.

**Habitat**

This species is highly aquatic and rarely found away from water. Extant populations occur in large shallow wetland systems associated with a stream or stream network. Breeding habitat is in seasonally flooded margins of wetlands and areas of extensive shallows (approximately 6 to 8 inches deep). Egg masses are placed in areas where they receive little or no shading from vegetation. Waters that remain aerobic and do not freeze to the sediments are necessary for winter survival in areas subject to freezing. Beaver impounded systems appear to provide many of the habitat requirements of this species.

**References**

Hallock, L. A. 2013. Draft State of Washington Oregon Spotted Frog Recovery Plan. Washington Department of Fish and Wildlife, Olympia. 93 pp.

Hallock, L. A. and K. R. McAllister. 2005. Oregon Spotted Frog. Washington Herp Atlas. http://www1.dnr.wa.gov/nhp/refdesk/herp/

**Oregon Spotted Frog: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Resource information collection needs | Lack of information on status and distribution. | Inventory areas that might still support this species and monitor known populations. | Current insufficient | Both |
| 2 | Invasive and other problematic species | Invasive reed canarygrass. Oregon Spotted Frogs oviposition habitat is located in seasonally flooded, shallow water (less than 6 inches), with short vegetation and full sun exposure. Reed canarygrass is invasive, has a dense growth pattern and grows to over 5 feet tall. | Manage reed canarygrass either by keeping it short (mowing, haying, livestock grazing) or remove it. | Current insufficient | Both |
| 3 | Invasive and other problematic species | Lack of disturbance to wetlands. Oregon Spotted Frogs oviposition habitat is located in seasonally flooded, shallow water (less than 6 inches), with short vegetation and full sun exposure. This is typical of early successional wetland plant growth. | Create or mimic disturbance processes at sites occupied by Oregon Spotted Frogs. Examples include introducing beaver, use of fire, mowing, haying and/or grazing. | Current insufficient | Both |
| 4 | Invasive and other problematic species | Non-native predatory fish and American Bullfrogs. These species prey on Oregon Spotted Frogs. | Prevent non-native predatory fish and American Bullfrogs from establishing populations at Oregon Spotted Frog occupied sites. | Current insufficient | Both |
| 5 | Climate change and severe weather | Drying of aquatic habitats occupied by Oregon Spotted Frog and subsequent changes to vegetation (expansion of trees, shrubs, and reed canarygrass etc.) | Prevent drying of wetlands and streams occupied by Oregon Spotted Frogs. Remove and manage trees, shrubs and reed canarygrass in breeding habitat. | Current insufficient | Both |

NOTE: Numbers are for reference only and do not reflect priority.

## NORTHERN LEOPARD FROG (*Lithobates pipiens*)

**Conservation Status and Concern**

Only one known population remains in Washington; there is limited information about population status and trends; efforts are underway to determine the feasibility of translocations to portions of the former range.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| Species of Concern | Endangered | Yes | G5 | S1 | Low/declining | Moderate-high |

**Biology and Life History**

Photo: J. Wisniewski

Northern Leopard Frogs are semi-aquatic, requiring aquatic and terrestrial habitats. They typically overwinter underwater, but are primarily terrestrial during summer months, and forage predominately for insects in moist areas. During late spring, males attract females to breeding ponds by vocalizing. A grapefruit-sized egg mass is deposited just below the water surface and attached to vegetation in warm, shallow, open, lentic areas. Eggs may hatch within a few days or weeks depending on conditions. Tadpoles forage mainly on algae and detritus and complete metamorphosis in 60 to 90 days; newly metamorphosed frogs emerge from ponds in mid-July through September. Northern Leopard Frogs may be preyed on by many species throughout their life history, but the most common are likely mustelids, bullfrogs, and fish.

**Distribution and Abundance**

The last known population of Northern Leopard Frog in Washington occupies the North Potholes Reservoir Unit of the Columbia Basin Wildlife Area in the Crab Creek drainage; this area has been designated the Northern Leopard Frog Management Area (NLFMA). This species has experienced range-wide declines throughout the western states and Canada. Historically, Northern Leopard Frogs were found throughout eastern Washington, and 17 occupied sites were recognized throughout the Columbia, Crab Creek, Pend Oreille, Snake, Spokane, and Walla Walla River drainages.

**Habitat**

Northern Leopard Frogs require unique breeding, foraging, and overwintering habitats in close proximity due to their limited dispersal ability. Breeding occurs in shallow, lentic areas exposed to sunlight with short emergent vegetation for attachment of egg masses. In summer, Northern Leopard Frogs forage throughout moist areas including meadows, fields, irrigation ditches and scrublands. Northern Leopard Frogs require deep, well-oxygenated water that does not freeze solid for hibernation. Invasion by non-native vegetation and tall emergent encroachment through wetland succession reduces exposed shoreline, limiting the availability of suitable habitat for breeding and foraging. Bullfrog colonization and fish entry to the NLFMA by surface water connections during spring flooding increases predation vulnerability; ideal Northern Leopard Frog habitat would be bullfrog and fish-free.

**References**

Alberta Northern Leopard Frog Recovery Team. 2005. Alberta Northern Leopard Frog Recovery Plan, 2005-2010. Alberta Sustainable Resource Development, Fish and Wildlife Division, Alberta Species at Risk Recovery Plan no. 7. Edmonton, AB. 26pp.

Germaine, S., and D. Hays. 2007. Distribution and post-breeding environmental relationships of northern leopard frogs (Rana pipiens) in Grant County, Washington. Final Report. Washington Department of Fish and Wildlife, Wildlife Program, Olympia.

Hallock, L. A. and K. R. McAllister. 2005. Northern Leopard Frog. Washington Herp Atlas. http://www.1dnr.wa.gov/nhp/refdesk/herp/

**Northern Leopard Frog: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Invasive and other problematic species | Non-native aquatic species including American Bullfrogs, mosquito fish and other non-native fish. Bullfrogs are predatory for all life stages of Northern Leopard Frogs, mosquito fish prey on amphibian egg masses and tadpoles. | 1. Remove mosquito fish from ponds previously occupied by Northern Leopard Frogs.<br>2. Prevent introduction of non-native fish to ponds occupied by this species.<br>3. Manage habitat to favor this species but not favor bullfrogs and fish (e.g., create seasonal ponds).<br>4. Create and maintain barriers such as dikes that prevent non-native fish from entering ponds occupied by this species. | Current insufficient | WDFW |
| 2 | Fish and wildlife habitat loss and degradation | Loss of suitable breeding habitat due to water management in the reservoir (drawdowns, backups). | Create and restore breeding habitat (seasonal ponds). | Nothing current – new action needed | Both |
| 3 | Agriculture and aquaculture side effects | The upcoming Odessa Supplemental Feed Route will influence water levels in Potholes Reservoir and may impact the amount of suitable habitat in the NLFMA. | 1. Maintain suitable habitat to allow for dispersal and movement.<br>2. Monitor population.<br>3. Pursue opportunities to establish new populations.<br>4. Use adaptive management to deal with the high level of uncertainty regarding potential habitat changes. | Current insufficient | Both |

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 4 | Invasive and other problematic species | Unknown impacts to population from disease. | Additional disease monitoring is necessary to determine the extent of the disease threat in the NLFMA. | Current insufficient | WDFW |
| 5 | Invasive and other problematic species | Wetland succession and tall emergent vegetation encroachment (e. g. Reed Canary Grass, phragmites, and non-native cattails) reduces suitability of habitat. | Set back succession; reduce tall emergent vegetation and encourage short emergent cover through chemical and mechanical treatments. | Current insufficient | WDFW |

NOTE: Numbers are for reference only and do not reflect priority

# TURTLES

## GREEN SEA TURTLE (*Chelonia mydas*)

**Conservation Status and Concern**

A rare visitor off the outer Washington coast, this declining species is threatened by a number of factors occurring primarily outside of the state. However, issues related to consumption of plastic pollution could be addressed in Washington.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| Threatened | Threatened | No | G3 | SNA | Low/unknown | Moderate |

**Biology and Life History**

Green sea turtles are unique among sea turtles in that adults are herbivorous, feeding primarily on seagrass and algae. Sexual maturity occurs at 20 to 50 years. Adult females return every 2 to 4 years to lay eggs at the same beaches where they were born. Females nest at two-week intervals, laying an average of five clutches of eggs per nesting season. In Florida, green turtle nests contain an average of 135 eggs; incubation lasts about 2 months. Hatchlings swim to the open ocean, where they feed on pelagic plants and animals. At 3 to 5 years of age, juveniles travel to nearshore foraging sites. Adult females migrate hundreds or thousands of kilometers between foraging areas and nesting beaches.


Photo: B. Inaglory

**Distribution and Abundance**

The species is most widely distributed in tropical and subtropical waters near islands and along continental coasts between 30°N and 30°S worldwide. Along western North America, it occurs primarily south of California, but rarely extends northward to southern Alaska. It is rare in Washington, with four individuals stranded on outer coast beaches from 2002 to 2012.

**Habitat**

Feeding occurs in shallow, low-energy marine waters with abundant submerged vegetation, and also in convergence zones in open ocean. Coral reefs and rocky outcrops near feeding areas are often used for resting. Nesting occurs on sandy beaches, usually on islands but also on the mainland.

**References**

NatureServe Explorer. http://explorer.natureserve.org/servlet/NatureServe?init=Species K. Wilkinson and L. Todd, unpublished data

**Green Sea Turtle: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Resource information collection needs | Improve documentation of green sea turtles recorded in Washington. | Work with National Marine Fisheries Service, stranding organizations, vessel operators, and others to better document presence of green sea turtles in Washington. | Current insufficient | Both |
| 2 | Fish and wildlife habitat loss or degradation | Oceanic pollution. Plastics such as plastic bags, balloons, and other debris are eaten, which can result in mortality. | Support efforts to reduce plastic pollution in oceans. | Current insufficient | Both |

NOTE: Numbers are for reference only and do not reflect priority.

## LEATHERBACK SEA TURTLE (*Dermochelys coriacea*)

**Conservation Status and Concern**

This declining species, which may occur more regularly off the outer Washington coast than previously known, is threatened by numerous factors happening primarily outside of the state. However, issues related to oil spills and fishing gear entanglement as well as consumption of plastic pollution could be addressed in Washington.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| Endangered | Endangered | No | G2 | SNA | Low/unknown | Moderate |

**Biology and Life History**

This species, which is the world's largest sea turtle, moves hundreds or thousands of kilometers between nesting beaches and distant marine waters; transequatorial migrations have been documented. Gravid females go directly from temperate latitudes to preferred nesting beaches. Individual females may nest on multiple beaches within a region. The principal food is jellyfish, although other invertebrates, fishes, and seaweed are sometimes eaten. The species dives almost continuously, sometimes to several thousand meters, but may linger at the surface at midday.

Photo: C. Lombard

**Distribution and Abundance**

Leatherback turtles occur in tropical, temperate, and subpolar oceans worldwide. Some of the turtles foraging off the west coast of North America, including Washington, nest in western New Guinea. Most populations in the Pacific are in steep decline. Numbers of turtles visiting Washington's waters are unknown, but telemetry suggests abundance may be higher than indicated by the few sightings.

**Habitat**

The species inhabits open ocean, often near the edges of continental shelves. Inshore waters (e.g., bays and estuaries) are occasionally used; higher latitude waters are visited in summer. Nests are placed on sloping sandy beaches backed by vegetation, often near deep water and rough seas. The largest colonies occur on continental, rather than island, beaches. Absence of a fringing reef appears to be important for nesting sites. Newly formed nesting habitat may be rapidly utilized.

**References**


Benson, S. R., T. Eguchi, D. G. Foley, K. A. Forney, H. Bailey, C. Hitipeuw, B. P. Samber, R. F. Tapilatu, V. Rei, P. Ramohia, J. Pita, and P. H. Dutton. 2011. Large-scale movements and high-use areas of western Pacific leatherback turtles, *Dermochelys coriacea*. Ecosphere 2(7):art84. doi:10.1890/ES11-00053.1.

NatureServe Explorer. http://explorer.natureserve.org/servlet/NatureServe?init=Species

**Leatherback Sea Turtle:  Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Resource information collection needs | Improve documentation of leatherback sea turtles recorded in Washington. | Work with National Marine Fisheries Service stranding organizations, vessel operators, and others to better document presence of leatherbacks in Washington. | Current insufficient | Both |
| 2 | Overharvesting of biological resources | Incidental capture in fishing gear. | Support efforts to reduce fisheries bycatch, including turtle exclusion devices in trawl fisheries, large circle hooks in longline fisheries, and time and area closures for gillnets. | Current insufficient | Both |
| 3 | Fish and wildlife habitat loss or degradation | Oceanic pollution. Plastics such as plastic bags, balloons, and other debris are commonly eaten, which can result in mortality. | Support efforts to reduce plastic pollution in oceans. | Current insufficient | Both |
| 4 | Energy development and distribution | Mortality from oil spills. | Expand safeguards to prevent oil spills. | Current insufficient | Both |

NOTE:  Numbers are for reference only and do not reflect priority.

## LOGGERHEAD SEA TURTLE (*Caretta caretta*)

### Conservation Status and Concern

A very rare visitor off the outer Washington coast, this declining species is threatened by factors occurring primarily outside of the state. However, issues related to consumption of plastic pollution could be addressed in Washington.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| Endangered | Threatened | No | G3 | SNA | Low/unknown | Moderate-high |

### Biology and Life History

Diet of all life stages is mostly benthic invertebrates (crabs, other crustaceans, and mollusks) and occasionally jellyfish. Sexual maturity is reached at about 45 years of age. Nesting occurs mainly at night, often at high tide. Females lay eggs in three to five nests per nesting season, with 80 to 120 eggs per clutch. In the eastern U.S., nesting takes place in late April to early September. Incubation lasts about two months. The species is known to make long migrations; some Pacific loggerheads migrate over 7460 miles between nesting beaches in Japan and feeding grounds off Mexico.

Photo: B. Gratewicke

### Distribution and Abundance

The species occurs throughout the tropical and temperate regions of the Atlantic, Pacific, and Indian Oceans. Most records along the U.S. west coast are of juveniles along the coast of California, with very few sightings reported off Washington, Oregon, and northward to Alaska. The west coast of Mexico, including the Baja Peninsula, provides critically important habitat for juveniles. Loggerheads nest in tropical and subtropical regions; the only known nesting areas in the North Pacific are in southern Japan. The species is very rare in Washington, with none stranded on outer coast beaches from 2002 to 2012.

### Habitat

Loggerhead sea turtles mostly inhabit continental shelf and nearshore marine waters, but occur pelagically during migration. Hatchlings move to masses of sargassum at sea, where they remain for perhaps 3 to 5 years. Nesting occurs on open sandy beaches in warm temperate and subtropical regions, generally at high energy, relatively narrow, steeply sloped, coarse-grained beaches.

### References

NatureServe Explorer. http://explorer.natureserve.org/servlet/NatureServe?init=Species K. Wilkinson and L. Todd, unpublished data

**Loggerhead Sea Turtle: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Resource information collection needs | Improve documentation of Loggerhead Sea Turtles recorded in Washington. | Work with National Marine Fisheries Service, stranding organizations, vessel operators, and others to better document presence of Loggerhead Sea Turtles in Washington. | Current insufficient | Both |
| 2 | Fish and wildlife habitat loss or degradation | Oceanic pollution. Plastics such as plastic bags, balloons, and other debris are eaten, which can result in mortality. | Support efforts to reduce plastic pollution in oceans. | Current insufficient | Both |

NOTE: Numbers are for reference only and do not reflect priority.

## WESTERN POND TURTLE (*Actinemys [Clemmys] marmorata*)

**Conservation Status and Concern**

In the 1990s, only two populations remained in the Columbia River Gorge with estimates of less than 200 individuals. Because of recovery efforts, currently there are six populations with approximately 800 turtles. Many issues remain for the recovery of this species. Habitat must be managed to prevent invasive weeds from overgrowing the nesting areas. Predation by non-native American Bullfrogs on hatchlings, as well as mammalian predation on nests, prevents natural recruitment of hatchlings at many sites. Disease has emerged as a major concern in recent years due to the discovery that a substantial number of turtles have diseased shells (ulcerative shell disease). The cause of the disease is under investigation but is not yet known.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| In review | Endangered | Yes | G3G4 | S1 | Low/increasing | Moderate |

**Biology and Life History**

This species is primarily aquatic, but strays from water to lay eggs, to disperse to new water bodies, to overwinter and to aestivate during periods of drought. Western Pond Turtles are active as soon as water temperatures are warm enough and basking is possible, usually in late March or early April. Adult activity continues until late September or October depending on weather conditions and location. Western Pond Turtles spend a great deal of time basking

Photo: OR Dept. Fish & Wildlife

on logs at the surface of ponds. A recent telemetry study of juvenile turtles found that some turtles were still active in December at a site in the Columbia River Gorge. Western Pond Turtles are omnivorous.

**Distribution and Abundance**
The range of the Western Pond Turtle extends from the Puget Sound Lowlands in Washington through western Oregon and California, and south to Baja California. Western Pond Turtles disappeared from the Puget lowlands by the 1980s, with only a few isolated adult turtles remaining. By 1990, the Western Pond Turtle population in Washington had declined to an estimated 150 animals remaining in the wild at only two sites in the Columbia River Gorge. Because of recovery efforts, currently six populations occur in Washington with approximately 800 turtles. Two sites are in South Puget Sound and four occur in the Columbia River Gorge.

**Habitat**
Western Pond Turtles utilize a variety of flowing and still water habitats in other parts of their range, but in Washington they are only known from ponds and lakes. They nest in grasslands and open woodland around ponds.

**References**
Hallock, L. A. and K. R. McAllister. 2005. Western Pond Turtle. Washington Herp Atlas. http://www1.dnr.wa.gov/nhp/refdesk/herp
Pramuk, J. F. Koontz, M. Tirhi, S. Zeigler, K. Schwartz, and P. Miller (eds.) 2013. The Western Pond Turtle in Washington: A Population and Habitat Viability Assessment. IUCN/SSC Conservation Breeding Specialist Group, Apple Valley, M. N. Schmidt, T, and M. Tirhi. 2014.

**Western Pond Turtle: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Fish and wildlife habitat loss or degradation | Habitat loss, degradation and fragmentation. Lack of suitable habitat for reintroduction sites. | Conserve suitable habitat; protect significant areas; Protect or restore nesting habitat at existing and potential sites. Establish new sites to meet reintroduction plan goals. | Current sufficient | Both |
| 2 | Invasive and other problematic species | American Bullfrogs and introduced warm-water fish. | Implement bullfrog and fish control as needed. | Current insufficient | Both |
| 3 | Invasive and other problematic species | Invasive tall vegetation overgrowing the nesting habitats and uplands. | Continue to remove and control vegetation in areas significant for Western Pond Turtles such as nesting sites. | Current insufficient | WDFW |

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 4 | Resource information collection needs | Continue to monitor populations to trigger intervention if necessary to avoid massive declines. | Study mortality rates & nature/intensity of threats acting on key demographic stages (i.e. hatchlings reared in the wild and adults). | Current sufficient | WDFW |
| 5 | Resource information collection needs | Understand shell disease epidemiology, survival rate of affected individuals, and effects on reproduction. | Study shell disease and make management decisions from the science. | Current insufficient | Both |

NOTE: Numbers are for reference only and do not reflect priority.

# LIZARDS

## PYGMY HORNED LIZARD (*Phrynosoma douglasii*)

*See Appendix B for a potential range and habitat distribution map

**Conservation Status and Concern**

The conservation concern for this species is because its distribution is primarily restricted to the highly altered and fragmented shrub-steppe in Eastern Washington.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| None | Monitor | No | G5 | S3 | Medium/unknown | Moderate |

**Biology and Life History**


Photo: W. Siegmund

This is a medium-sized lizard, rather toad-like in appearance with a blunt snout, round flattened body, short legs and a short triangular tail. They are cryptic and their coloration tends to match the substrate. The females are significantly larger than the males. Activity starts in late March in the Columbia Basin. Adults are active mid-day during spring and fall but in summer are inactive during the middle of the day when temperatures are at their maximum. Mating takes place soon after emergence in the spring. Young are born live in late summer approximately two months after mating. Surface activity continues into October. A study in Washington found that neonates feed almost exclusively on ants (89 percent), while ants made up about 72 percent of the adult diet.

**Distribution and Abundance**
They reach the northern extent of their range in Washington and occur primarily in the Columbia Plateau Ecoregion. Abundance varies from site to site. The statewide trend for this specie is unknown.

**Habitat**
In Washington, they occupy shrub-steppe habitat. They require soil conditions that allow them to burrow below the surface and substrate that is well-drained. Field research in Kittitas County found Pygmy Horned Lizards to have a disproportionate preference for lithosol terrain. Females in the final month of gestation, however, tended to use loamy and ecotone terrains. Other findings of this study suggest populations may need a variety of substrate types to meet all their needs. In addition to these terrain types, Pygmy Horned Lizards in Washington are also known to occur in loamy terrain without lithosols, on vegetated sand dunes, and even in some agricultural settings where patches of native habitat are present.

**References**
Hallock, L. A. and K. R. McAllister. 2005. Pygmy Short-horned Lizard. Washington Herp Atlas. http://www1.dnr.wa.gov/nhp/refdesk/herp/
Lahti, M. 2005. Ecology of the Pygmy Short Horned Lizard (*Phrynosoma douglasii*) in Washington. Master's Thesis. Central Washington University, Ellensburg, Washington. 73 pp.
Lahti, M. and D. Beck. 2010. Ecology of the Pygmy short-horned lizard (*Phyrnosoma douglasii*). Northwestern Naturalist. 91(2):134-144.
Lahti, M. and D. Beck. 2007. Ecology and ontogenetic variation of diet in the pygmy short-horned lizard (*Phyrnosoma douglasii*). American Midland Naturalist 159:327-339.

**Pygmy Horned Lizard: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Resource information collection needs | Lack of information on status and distribution. | Research, survey and monitoring are needed to understand the status, distribution and habitat needs of this species. | Current insufficient | Both |
| 2 | Fish and wildlife habitat loss and degradation | Loss and degradation of suitable shrub-steppe habitat due to conversion to agriculture. | A strategy needs to be developed to make sure that enough suitable shrub-steppe habitat is maintained to support viable populations of this lizard. | Current insufficient | Both |

NOTE: Numbers are for reference only and do not reflect priority.

## SAGEBRUSH LIZARD (*Sceloporus graciosus*)

*See Appendix B for a potential range and habitat distribution map

**Conservation Status and Concern**

The Washington status is based on the species' obligate association with sand dunes in the Columbia Basin where greater than 70 percent of this habitat type has been lost since the 1970s.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| Species of Concern | Candidate | Yes | G5 | S3 | Low/declining | Moderate-high |

**Biology and Life History**


Photo: T. Thompson

This is a small (less than 2.4 inches snout to vent length) gray or brown lizard with a mid-dorsal stripe, two light colored dorsolateral stripes, and a series of dark chevron-shaped blotches between the stripes. They are primarily ground dwelling lizards. In Washington, they are active on warm, sunny days from early April through October. They are gregarious and interact with other lizards, often under the canopy of shrubs. They prey on small insects and arachnids. Eggs are laid in early summer. Hatchlings appear in early August.

**Distribution and Abundance**

In Washington, Sagebrush Lizards occur in the Columbia Plateau and Okanogan ecoregions where they occur on sand dunes. Sagebrush Lizards tend to be common where they occur but their habitat is being fragmented by various factors.

**Habitat**

In Washington, Sagebrush Lizards are associated with vegetated sand dunes and associated sandy habitats that support shrubs and have large areas of bare ground. Typically, they can be seen on the ground at the edge of shrubs and other vegetation that provide cover from predators and relief from mid-day heat. They will also climb into the lower branches of shrubs to shelter from the mid-day heat. At night, on rainy days and on cool, cloudy days they move underground or shelter under cover objects such as rocks and woody debris. Habitat for these lizards is degraded by invasive plants, such as cheatgrass, that grow densely between shrubs and eliminate bare ground. Excessive livestock grazing can also degrade habitat by removing too much vegetation and damaging the lower limbs of shrubs. Without the lower limbs, shrubs do not provide retreats for Sagebrush Lizards. Overwintering habitat has not been studied in Washington but is likely within sand dune habitat.

**References**
Green, G. A., K. B. Livezey, and R. L. Morgan. 2001. Habitat selection by Northern Sagebrush Lizards (Sceloporus graciosus graciosus) in the Columbia Basin, Oregon. Northwestern Naturalist 82(3): 111-115.
Hallock, L. A., R. D. Haugo and R. Crawford. 2007. Conservation Strategy for Washington Inland Sand Dunes. Unpublished report from Washington Department of Natural Resources' Natural Heritage Program (Olympia), Report 2007-05.
Hallock, L. A. and K. R. McAllister. 2005. Sagebrush Lizard. Washington Herp Atlas. http://www1.dnr.wa.gov/nhp/refdesk/herp/

**Sagebrush Lizard: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Resource information collection needs | Lack of information about status. This species is associated with sand dunes. Loss and alteration of sand dune habitat continues to occur throughout the Columbia Basin. Therefore, Sagebrush Lizard populations must be monitored to make sure they are persisting. | Monitor populations to make sure their habitat remains suitable and the populations persist. | Current insufficient | Both |
| 2 | Fish and wildlife habitat loss and degradation | Sand dune conversion to agriculture. | Protect sand dune habitat. | Current insufficient | Both |
| 3 | Invasive and other problematic species | Stabilization of sand dunes and loss of bare soils interspersed with vegetation. Non-native invasive species, especially cheatgrass, are stabilizing sand dunes and altering the habitat so that it is not suitable for Sagebrush Lizards. | Prevent land use practices that increase non-native invasive species. Where these plants already occur, find ways to remove and/or prevent expansion. | Current insufficient | Both |

NOTE: Numbers are for reference only and do not reflect priority.

## SIDE-BLOTCHED LIZARD (*Uta stansburiana*)

*See Appendix B for a potential range and habitat distribution map

### Conservation Status and Concern

The Washington State status is based on the small number of populations and a distribution that is restricted to the heavily altered shrub-steppe vegetation of Eastern Washington.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| None | None | No | G5 | S3 | Medium/unknown | Moderate |

### Biology and Life History


Photo: W. Flaxington

This is a small (maximum size 2.2 inches snout to vent length) brown or gray lizard with a mottling of black, brown and light colored markings on the dorsal surface. They are very cryptic and blend into their surroundings. In Washington, activity typically starts in early to mid-March and continues through October. They are ground dwelling lizards that do not climb in vegetation although they will climb on rocks and basalt outcrops. They are gregarious and interact with other lizards, often under the canopy of shrubs. They are active mid-day during spring and fall but in summer are inactive during the middle of the day when temperatures are at their maximum. They are not surface active on rainy days or cool cloudy days. Eggs are probably laid in May and hatchlings start to appear in mid-July. Both adults and juveniles prey on insects and arachnids.

### Distribution and Abundance

In Washington, Side-blotched Lizards are shrub-steppe obligates that occur primarily in the driest areas of the central Columbia Basin. Most documented occurrences are in Grant and Benton Counties with additional occurrences in adjacent counties. Side-blotched Lizards are gregarious and tend to be common to abundant where they occur.

### Habitat

Side-blotched Lizards are associated with arid areas that support shrub-steppe habitat. They are most common in areas with bare ground interspersed with shrubs and other vegetation (*e.g.*, shrubland with grasses). They also occupy dry washes, rocky canyons, sand dunes and road edges. Typically, individuals can be seen on the ground at the edge or under shrubs or other vegetation that provides cover from predators. During the heat of the day and during rainy and/or cool periods, they retreat underground or move under cover objects such as rocks and woody debris. Habitat for these lizards is degraded by invasive plants such as cheatgrass and knapweed that grow densely between shrubs and eliminate bare ground. Excessive livestock grazing can also degrade habitat by removing too much vegetation and damaging the lower limbs of shrubs. Without the lower limbs, shrubs do not provide retreats for Side-blotched Lizards.

### References

Hallock, L. A. and K. R. McAllister. 2005. Side-blotched Lizard. Washington Herp Atlas. http://www1.dnr.wa.gov/nhp/refdesk/herp/

**Side-blotched Lizard: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Resource information collection needs | Lack of information on status and distribution. | Research, survey and monitoring are needed to understand the status, distribution and habitat needs of this species. | Current insufficient | Both |
| 2 | Fish and wildlife habitat loss and degradation | Loss and degradation of suitable shrub-steppe habitat that this species relies upon in WA. | Protect native shrub-steppe habitat from conversion and degradation due to agriculture. | Current insufficient | Both |
| 3 | Invasive and other problematic species | Changes to vegetation/habitat from non-native invasive plant species. This species requires habitat with bare ground between plants. Non-native, invasive species, such as cheatgrass, create dense ground cover that is not suitable for this species. | Prevent land use practices that increase non-native invasive species. Where these plants already occur, find ways to remove and/or prevent expansion. | Current insufficient | Both |
| 4 | Fish and wildlife habitat loss and degradation | Changes in vegetation due to livestock grazing. Livestock grazing can result in removal of too much vegetation, introduction of invasive weeds, crushing of burrows and changes to the structure of shrubs (e.g., cattle can damage/destroy the lower branches of shrubs as they graze under the shrubs). | Prevent livestock use and grazing practices that remove excessive amounts of vegetation (change the character of the habitat), introduce invasive weeds, and change the structure of shrubs (e.g., cattle can damage/destroy the lower branches of shrubs as they graze under the shrubs). | Current insufficient | Both |

NOTE: Numbers are for reference only and do not reflect priority.

# SNAKES

## CALIFORNIA MOUNTAIN KINGSNAKE (*Lampropeltis zonata*)

**Conservation Status and Concern**

In Washington, occurs at the northern extreme of its range and the population is isolated from the rest of its range by approximately 200 miles. The species' range in Washington is small with few individuals documented. They occur in the Columbia River Gorge in an area of the state that ~~is highly desirable and~~ is likely to see increased development and vehicular traffic over the next decade.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| None | Candidate | Yes | G4G5 | S2? | Low/unknown | Low-moderate |

**Biology and Life History**

Little is known about this species in Washington. It is chiefly diurnal, but may be nocturnal during warm weather. Similar to other snake species occupying the same area, it most likely becomes active in late March or April and remains active until October. Mating probably takes place in May with three to nine eggs laid in June or July. The incubation period is approximately 60 days.

Photo: A.P. Summers

**Distribution and Abundance**

The Washington range is limited to the southernmost areas of eastern Skamania County and western Klickitat County. The Washington range is isolated from the rest of the species' range by approximately 200 miles. Unsubstantiated reports exist for the Blue Mountains and Yakima County. Nothing is known about their abundance in Washington.

**Habitat**

The species occurs in moist microhabitats in Oregon white oak-ponderosa pine forest, where individuals are usually found under woody debris and rocks.

**References**

Hallock, L. A. and K. R. McAllister. 2005. California Mountain Kingsnake. Washington Herp Atlas. http://www.1dnr.wa.gov/nhp/refdesk/herp/

**California Mountain Kingsnake: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Resource information collection needs | Lack of information on status and distribution. | Conduct comprehensive surveys to determine distribution and population numbers. | Current insufficient | WDFW |
| 2 | Fish and wildlife habitat loss or degradation | Loss, degradation and fragmentation of habitat and well as an increase in vehicle traffic. They occur in the Columbia River Gorge - an area of the state that is highly desirable and is likely to see increased development and vehicular traffic over the next decade. | Determine where populations occur and how to protect those populations from development and road mortality. | Current insufficient | WDFW |
| 3 | Overharvesting of Biological Resources | Removal from the wild. These are attractive snakes with docile temperaments that can be easily tamed and kept in captivity. This makes them vulnerable to collecting as pets. | Public outreach and education. Make sure that laws protecting this species are enforced. | Current insufficient | WDFW |

NOTE: Numbers are for reference only and do not reflect priority.

## DESERT NIGHTSNAKE (*Hypsiglena chlorophaea*)

### Conservation Status and Concern

The Washington State status is based on a distribution that is primarily restricted to the shrub-steppe vegetation that has been heavily altered in Washington.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| None | Monitor | No | G5 | S3 | Medium/unknown | N/A |

### Biology and Life History

This is a small, (less than 18 inches in total length) spotted snake with dark brown blotches in the neck region. In Washington, Desert Nightsnakes are active from April to October. As their common name suggests, they are primarily nocturnal. Mating takes place in the spring. Three to nine eggs are laid in June or July each year. Little else is known regarding Desert Nightsnake reproduction in Washington. Similarly, survival rate, growth rates, and longevity are largely unknown. Nightsnakes eat small lizards and smaller snakes, as well as lizard eggs, frogs, and other small prey.

Photo: B. Hughes

### Distribution and Abundance

In Washington, Desert Nightsnakes have been documented in the Columbia Plateau, Eastern Cascades, and Okanogan Ecoregions. Distribution may be limited by the occurrence of certain lizard prey species. From 2003 to 2004, 66 new observations were made from seven Washington counties by a student as part of his graduate studies. This suggested that the species was more common than was previously known.

### Habitat

Most Desert Nightsnake occurrences in Washington are from arid areas that support shrub-steppe vegetation, but occurrences in the Leavenworth area are in ponderosa pine forests. Individuals are usually found in rocky areas, but have also been found in sagebrush flats that are not rocky. During the day, individuals can be found sheltering under surface objects, generally rocks. However, during prolonged periods of hot weather, they may move deep into talus, rock fissures or rodent burrows.

#### References


Hallock, L. A. and K. R. McAllister. 2005. Night Snake. Washington Herp Atlas. http://www1.dnr.wa.gov/nhp/refdesk/herp

Nussbaum, R. A., E. D. Brodie, Jr., and R.M. Storm. 1983. Amphibians and Reptiles of the Pacific Northwest. University of Idaho Press, Moscow, Idaho. 332 pp.

Weaver, R. E. 2008. Distribution, abundance, and habitat associations of the Night Snake (*Hypsiglena torquata*) in Washington State. Northwestern Naturalist 89: 164-170.

**Desert Nightsnake: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Resource information collection needs | Lack of information on status and distribution. | Research, survey and monitoring are needed to understand the status, distribution and habitat needs of this species. | Current insufficient | Both |
| 2 | Fish and wildlife habitat loss and degradation | Loss and degradation of suitable shrub-steppe habitat that this species relies upon in WA. | A strategy needs to be developed to make sure that enough suitable shrub-steppe habitat is maintained to support viable populations of this snake. | Current insufficient | Both |
| 3 | Overharvesting of Biological Resources | Destruction of rattlesnake hibernacula also negatively affects nightsnakes because they often share hibernacula with rattlesnakes. | Environmental education and outreach. Protect snake dens on public lands. | Current insufficient | Both |

NOTE: Numbers are for reference only and do not reflect priority.

## RING-NECKED SNAKE (*Diadophis punctatus*)

*See Appendix B for a potential range and habitat distribution map

**Conservation Status and Concern**

The Washington State status is based on the small number of observations, patchy distribution and lack of information. Some of the distribution is in the Columbia Basin, a heavily altered region of the state heavily impacted by agriculture.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| None | Monitor | No | G5 | S3S4 | Unknown/unknown | Low-moderate |

**Biology and Life History**

This is a small, dark snake with shiny scales and an orange band or "ring" around the neck. The underside is bright orange. They are secretive and rarely surface active during the day. Little is known about them in Washington. Similar to other snake species in Washington, they are likely active from March through October varying somewhat from year to year and by location. Females deposit about three eggs per year in early in July. They feed primarily on salamanders and lizards, but may also eat earthworms, frogs, insects and smaller snakes.

Photo: W. Flaxington

**Distribution and Abundance**

The main distribution in Washington follows the east slope of the Cascade Mountains from the Ellensburg area south to the Columbia Gorge and west to Longview. They also occur along the eastern portion of the Snake River. Distribution is likely continuous between the Klickitat and Yakima Counties but there are no records in WDFW's database to support this. Isolated records of individual snakes were collected in Whitman County in 1937 and 1938; Walla Walla County in 1975; and two locations in Cowlitz County (Kalama and confluence of Mill Creek and the Columbia River) in 1959 and 1982 respectively. Observations for this species are rarely submitted to the WDFW database and no studies have been conducted in Washington. Consequently, nothing is known about the status or abundance of this species.

**Habitat**

Based on collection and observation records, Ring-necked Snakes occur in ponderosa pine-Oregon white oak, mixed forest and shrub-steppe. Occurrences in shrub-steppe are often associated with riparian areas. Ring-necked Snakes are usually found under woody debris, rocks or on roads at night. Eggs are deposited in stabilized talus and rotting logs.

**References**


Hallock, L. A. and K. R. McAllister. 2005. Ring-necked Snake. Washington Herp Atlas. http://www1.dnr.wa.gov/nhp/refdesk/herp/

Nussbaum, R. A., E. D. Brodie, Jr., and R.M. Storm. 1983. Amphibians and Reptiles of the Pacific Northwest. University of Idaho Press, Moscow, Idaho. 332 pp.

**Ring-necked Snake:  Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Resource information collection needs | Lack of information on status and distribution. | Research, survey and monitoring are needed to understand the status, distribution and habitat needs of this species. | Current insufficient | Both |

## SHARP-TAILED SNAKE   (*Contia tenuis*)

*See Appendix B for a range and potential habitat distribution map

**Conservation Status and Concern**

The Washington status and concern is based on the small number of populations, patchy distribution and lack of information.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| Species of Concern | Candidate | Yes | G5 | S3 | Low/unknown | Moderate |

**Biology and Life History**

Photo:  W. Leonard

This is a diminutive, semi-fossorial species with a distinct ventral pattern of alternative black and cream colored bands and a short tail that terminates with a small spike-like scale.  These snakes are rarely encountered and little studied.  Most surface activity occurs when the surface is cool and moist in the spring and fall although observations have been made in most months of the year.  The snakes are typically found under cover objects.  Aggregations are often observed.  Breeding takes place in April or May.  Eggs are laid in late June or July and hatching occurs in the fall.  Activity is confined to relatively small areas.  The greatest distance moved by two study snakes in Canada was 128 and 305 feet.  Snakes also show evidence of site tenacity, with some snakes found repeatedly under the same cover objects.  The long, re-curved teeth appear to be a specialization for grasping and holding mollusks, the primarily prey of this snake.

**Distribution and Abundance**

Sharp-tailed Snakes occur from British Columbia, Canada into southern California.  In Washington, Common Sharp-tailed Snakes are known from thirteen disjunct areas.  West of the Cascade Crest there is an historical record for Pierce County and two recently discovered sites on Orcas and San Juan Islands.  East of the Cascade Crest observations are from Chelan, Kittitas, Yakima, Klickitat and Skamania Counties.  Almost nothing is known about abundance and some occurrences are based on a single observation.

**Habitat**

In the Pacific Northwest, they are found on the edges of coniferous or open hardwood forest. In Washington, the snakes have been found in 1) forest openings dominated by Garry Oak often with rock accumulations; 2) riparian/river floodplain with deciduous trees, shrubs and accumulations of decaying down woody logs; 3) shrub-steppe uplands with riparian areas that support deciduous trees and have accumulations of woody debris and rocks. The snakes are usually found in moist rotting logs or stable talus, often near streams or in other damp habitats. Small canopy gaps with rocky substrates, especially those that are south-facing, may be important for thermoregulation, egg development and growth of young.

**References**

Hallock, L. 2009. Conservation Assessment for the Sharp-tailed Snake (Contia tenuis) In Washington and Oregon. Unpublished Report. Washington Natural Heritage Program, Department of Natural Resources, Olympia. Submitted to the Interagency Special Status/Sensitive Species Program, Washington and Oregon. USDS Forest Service and Bureau of Land Management.

Ovaska, K. E. and C. Engelstoft. 2008. Conservation of the Sharp-tailed Snake (*Contia tenuis*) in urban areas in the Gulf Islands, British Columbia, Canada. In Mitchell, J., R. Jung Brown and B. Bartholomew Editors. 2008. Urban Herpetology. Herpetological Conservation 3:557-564. Society for the Study of Amphibians and Reptiles. Salt Lake City.

**Sharp-tailed Snake: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Resource information collection needs | Lack of information on status and distribution. | Research, survey and monitoring are needed to understand the status, distribution and habitat needs of this species. | Current insufficient | Both |
| 2 | Fish and wildlife habitat loss or degradation | Loss of prairie and oak habitat. With the exception of recent observations on San Juan Island, no extant occurrences are known from western Washington. This species is thought to have been associated with prairie habitat in western Washington and most of this habitat type was converted to agriculture or developed for housing. | Inventory and outreach to determine if this small, secretive snake still occurs in areas of western Washington other than the San Juan Islands. | Nothing current - new action needed | WDFW |
| 3 | Fish and wildlife habitat loss and degradation | Loss of suitable habitat due to harvest of trees. Little is known about threats to this species from habitat alteration but forestry practices likely impact local populations because the loss of canopy changes the moisture regime, increases temperature and removes down woody debris and leaf litter. | Identify where this species occurs and work with landowners to conserve habitat features important for the persistence of this species such as downed woody debris and rock features. | Nothing current - new action needed | WDFW |

NOTE: Numbers are for reference only and do not reflect priority.

## STRIPED WHIPSNAKE (*Coluber taeniatus*)

### Conservation Status and Concern

The Washington status is based on the small number of populations. Currently only two populations are verified extant. Threats include conversion of habitat to agriculture, degradation of native shrub-steppe habitat from irrigation water and invasive weeds, basalt mining, single home construction and increasing vehicular traffic on roads and highways that bisect the occupied areas.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| None | Candidate | Yes | G5 | S1 | Low/declining | Low-moderate |

### Biology and Life History


Photo: D. Hagin

They are long, slender, striped snakes that are alert, visual and fast-moving. Adults can grow to 6 feet total length but are typically shorter in Washington. They are diurnal. Spring emergence starts in late-March in Washington. Females lay eggs in July. Clutch sizes range from three to seven. The incubation period is 44 to 58 days. Lizards are the predominant prey; small mammals, snakes, young birds and insects are also taken occasionally. Maximum recorded dispersal distance from a den at Tooele Valley, Utah was 2.2 miles. They return to the vicinity of the hibernaculum in September. They overwinter communally with other snake species and use the same hibernaculum every year. Striped Whipsnakes may live as long as 20 years.

### Distribution and Abundance

Striped Whipsnakes reach the northern extent of their range in Washington. They were probably never common in Washington. Only 15 museum specimens are known and until 2004, only 11 sight observations had been submitted to the WDFW database. Together these represent 16 unique locations in Yakima, Kittitas, Grant, Benton, Franklin, Lincoln and Walla Walla counties. Concern about the species' status was triggered by lack of observations during large scale herpetological inventories in the 1990s that included inventory at historically occupied areas. Only two areas located 4.4 miles apart are verified extant currently. The population size is unknown.

### Habitat

In Washington, Striped Whipsnakes are shrub-steppe obligates and occur primarily in the driest areas of the central Columbia Basin. The habitat of the extant populations included basalt outcrops and relatively undisturbed shrubland with grasses and a low cover of invasive cheatgrass. Soils surrounding the basalt outcrops are sandy and supported larger shrubs including big sage and spiny hop sage. The snakes shelter during the active season in basalt outcrops and mammal burrows. The hibernacula are also in basalt outcrops. The snakes show strong site fidelity to sheltering and overwintering locations. Mammal burrows may be important for egg laying.

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Hallock, L. 2006. Summary Report on the Striped Whipsnake (*Masticophis taeniatus*) in Washington. Natural Heritage Report 2006-05. Prepared for the Bureau of Land Management, Wenatchee.

Parker, W. S and W. S. Brown. 1972. Telemetric study of movements and oviposition of two female *Masticophis t. taeniatus*. Copeia 1972 (4): 892-895.

### Striped Whipsnake: Conservation Threats and Actions

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Resource information collection needs | Lack of information on status and distribution. | Currently, only two extant populations are known in Washington. Inventory efforts and outreach must continue to determine if other populations occur in the state. | Current insufficient | WDFW |
| 2 | Fish and wildlife habitat loss and degradation | Loss and degradation of suitable shrub-steppe habitat that this species relies upon in WA. | Because of the apparent rarity of this species, lands where it occurs need to be protected from agricultural conversion. | Current insufficient | Both |
| 3 | Fish and wildlife habitat loss and degradation | Shrub-steppe habitat degraded by irrigation water. | Protect habitat at risk for conversion to irrigated cropland that could provide suitable habitat within or between occupied areas. | Current insufficient | Both |
| 4 | Invasive and other problematic species | Changes to vegetation/ habitat. This species, and its lizard prey, requires habitat with bare ground between plants. Non-native, invasive species such as cheatgrass create dense ground cover. | Prevent land use practices that increase non-native invasive plant species. Where these plants already occur, find ways to remove and/or prevent expansion. | Current insufficient | Both |
| 5 | Fish and wildlife habitat loss and degradation | Changes in vegetation may result from unsustainable livestock grazing through the removal of too much vegetation, the introduction of invasive weeds, crushing of mammal burrows (used by the snakes) and damage to the lower branches of shrubs from grazing under the shrubs. | Provide technical assistance to producers grazing within vicinity of known Striped Whipsnake hibernacula. | Current insufficient | Both |

NOTE: Numbers are for reference only and do not reflect priority.

# REFERENCES

## SECTION A: Alphabetical list of species

## SECTION B:  Explanation of Terms

### Conservation Status Table

Federal Status
Refers to legal designations under the Federal ESA (listed as Endangered or Threatened or recognized as a Candidate species for listing), or designated as a Sensitive species.

State Status
The Washington Fish and Wildlife Commission has classified 46 species as Endangered, Threatened or Sensitive, under WAC 232-12-014 and WAC 232-12-011.  Species can also be designated Candidate Species for state listing by WDFW policy.

PHS (Priority Habitats and Species Program)
A species listed under the PHS program is considered to be a priority for conservation and management and requires protective measures for survival due to population status, sensitivity to habitat alteration and/or tribal, recreational or commercial importance.  Management recommendations have been developed for PHS species and habitats, and can assist landowners, managers and others in conducting land use activities in a manner that incorporates the needs of fish and wildlife.

**Global (G) and State (S) Rankings:**  Refers to NatureServe status rankings provided by the Natural Heritage Program.  These conservation status ranks complement legal status designations and are based on a one to five scale, ranging from critically imperiled (1) to demonstrably secure (5).  The global (G) and state (S) geographic scales were used for the SGCN species fact sheets.  For more on the methodology used for these assessments, please see:  Methodology for Assigning Ranks - NatureServe.

**State Rank:**  characterizes the relative rarity or endangerment within the state of Washington.
**S1** = Critically imperiled
**S2** = Imperiled
**S3** = Rare or uncommon in the state – vulnerable
**S4** = Widespread, abundant, and apparently secure i
**S5** = Demonstrably widespread, abundant, and secure in the State
**SA** = Accidental in the state.
**SE** = An exotic species that has become established in the state.
**SH** = Historical occurrences only are known, perhaps not verified in the past 20 years, but the taxon is suspected to still exist in the state.
**SNR** = Not yet ranked. Sufficient time and effort have not yet been devoted to ranking of this taxon.
**SP** = Potential for occurrence of the taxon in the state but no occurrences have been documented.
**SR** = Reported in the state but without persuasive documentation which would provide a basis for either accepting or rejecting the report (e.g., misidentified specimen).
**SRF** = Reported falsely in the state but the error persists in the literature.
**SU**= Unrankable. Possibly in peril in the state, but status is uncertain. More information is need.
**SX** = Believed to be extirpated from the state with little likelihood that it will be rediscovered.
**SZ** = Not of conservation concern in the state.

Qualifiers are sometimes used in conjunction with the State Ranks described above:

**B** - Rank of the breeding population in the state.
**N** - Rank of the non-breeding population in the state.

**Global Rank:** characterizes the relative rarity or endangerment of the element world-wide.
**G1** = Critically imperiled globally
**G2** = Imperiled globally
**G3** = Either very rare and local throughout its range or found locally (even abundantly at some of its locations) in a restricted range - vulnerable
**G4** = Widespread, abundant, and apparently secure globally
**G5** = Demonstrably widespread, abundant, and secure globally, though it may be quite rare in parts of its range
**GH** = Historical occurrences only are known, perhaps not verified in the past 20 years, but the taxon is suspected to still exist somewhere in its former range.
**GNR** = Not yet ranked. Sufficient time and effort have not yet been devoted to ranking of this taxon.
**GU** = Unrankable. Possibly in peril range-wide but status uncertain. More information is needed.
**GX** = Believed to be extinct and there is little likelihood that it will be rediscovered.

Qualifiers are used in conjunction with the Global Ranks described above:
**Tn** Where n is a number or letter similar to those for Gn ranks, above, but indicating subspecies or variety rank. For example, G3TH indicates a species that is ranked G3 with this subspecies ranked as historic.

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State Wildlife Action Plan Update

# Appendix A-4

## Species of Greatest Conservation Need

## Fact Sheets

# FISH

**Conservation Status and Concern**

**Biology and Life History**

**Distribution and Abundance**

**Habitat Needs**

**Stressors**

**Conservation Actions Needed**

Washington Department of Fish and Wildlife
2015

# Appendix A-4

## SGCN Fish – Fact Sheets

# Table of Contents

# What is Included in Appendix A-4

**Introduction**
Appendix A-4 is one component of the State Wildlife Action Plan (SWAP) Update, and contains information about fish included in our Species of Greatest Conservation Need (SGCN) list for 2015. Included are fact sheets for each of the fish identified as Species of Greatest Conservation Need in the 2015 SWAP. The information provided includes a summary of the conservation concern and conservation status, description distribution and habitat, climate change sensitivity and an overview of key threats and conservation actions needed.

**What it means to be an SGCN**
The SGCN list includes both fish that have some form of official protection status and those which may be in decline, but are not yet listed as part of either the Federal or State Endangered Species program. One of the purposes of the SWAP is to direct conservation attention to species and habitats *before* they become imperiled and recovery becomes more difficult and costly. Presence on this list does not necessarily mean that conservation attention will be directed towards the fish; rather, that conservation actions for the species are *eligible* for State Wildlife Grants funding, and may be more competitive for other grant programs. It also raises the profile of a fish to a wide audience of conservation partners and may encourage other organizations to initiate projects that may benefit the species.

**Climate Vulnerability**
Please see Chapter 5 for an explanation of the methodology used to assess climate vulnerability. For a full list of all the SGCN ranks, including a narrative description of sensitivity and references, please see Appendix C.

**Explanation of terms used in the document**
Please see Section B (page 114) for a description of terms and abbreviations used in this document.

**Alphabetical List of Species**
For an alphabetical list of all the fish included, please see Section A (page 112).

**References**
References are provided separately with each fact sheet, and also collectively for all SGCN fish in the REFERENCES section at the end of this document.

# SUMMARY OF THE FISH SGCN

## Overview

There are 51 fish species or species units included on Washington's Species of Greatest Conservation Need list. A species unit is an "evolutionarily significant unit" (ESU) or a "distinct population segment" (DPS) as designated by NOAA-National Marine Fisheries Service and U.S. Fish and Wildlife Service, respectively, as units of a taxonomic species for ESA-listing purposes, or is a geographically designated population grouping (e.g., Bull Trout – Coastal Recovery Unit). The 18 exclusively marine species represent about 7.5 percent of Puget Sound area marine fishes or about 4.5 percent of marine fishes in all of Washington's marine waters. Of about 50 native freshwater and anadromous (freshwater and marine phases) fishes in Washington, the number of taxonomic species (22; species rather than species units are counted) in SGCN group represent 44 percent of these. Rockfish (genus *Sebastes*) and Pacific salmon and steelhead (genus *Oncorhynchus*) form about half of SGCN list, but species diversity ranges from the Olympic Mudminnow (a Washington freshwater endemic) to the Bluntnose Sixgill Shark. Distribution of these fishes ranges from Pacific coastal waters to mountain streams of the interior Columbia Basin. Threats in common across a broad diversity of SGCN fishes include habitat loss and degradation from land and water uses, lack of abundance trend data, unintentional overharvesting, and passage barriers due to dams, road crossings, diking, and other artificial structures.

## Distribution

Of the 18 SGCN species that live exclusively in marine environments, seven occur within the confined marine waters of the Salish Sea (Puget Sound, Strait of Juan de Fuca, and Strait of Georgia). The other marine fishes and the anadromous fishes occur in these waters and in the Pacific Ocean. Most of the anadromous salmonids have a large Pacific Ocean range during marine phases of their life histories. In freshwater, anadromous fishes generally have well-defined spawning distributions, but rearing distributions may range more widely. Migration corridors between marine and freshwater habitats are essential elements of anadromous fishes' natural distributions, and include vital estuarine habitats. Due to their varied life histories, anadromous fishes are present year-round in freshwater habitats. Of the 13 exclusively freshwater SGCN species (including three non-anadromous salmonid species), eight occur only in eastern (east of Cascades Mountains crest) Washington in Columbia Basin streams and lakes. Only two of the exclusively freshwater fishes (Olympic Mudminnow and Salish Sucker) do not occur in the Columbia Basin. Several freshwater species have relatively small or limited distributions in Washington.

## Abundance Status - Size and Trends

Quantitative abundance and trend data for many SGCN fish species are lacking. Current population or unit size was unknown for 49 percent of the species, and abundance trend was unknown for 59 percent of the species. In many cases, information used to judge abundance status is qualitative, based on fishery-dependent data, or based on few, short-term surveys. Data insufficiency is considered a conservation threat for many SGCN fishes. Of the seven marine fish with status ratings, five were rated at critical and two were rated at low abundances, and trends were rated as stable. All of the ESA-listed anadromous salmonids have long-term abundance data to rate status. For abundance ratings, 11 were low and three were medium; for trend ratings, two were declining, seven were stable, four were increasing and one was unknown. Only one of the freshwater salmonid species (Westslope Cutthroat Trout) was rated, and it had medium abundance and stable trend. Acquiring quantitative data for SGCN species is an action that will clearly benefit the design and evaluation of conservation actions.

### Conservation Concerns

To effectively conserve SGCN fish species we must attend to multiple sources of habitat degradation and loss. For many of the marine species, we need to curtail the loss of and restore degraded nearshore breeding and rearing habitats, such as spawning beaches for Pacific Herring, Sand Lance, and Surf Smelt, and eelgrass and algal habitats. In Puget Sound, residential and industrial shoreline uses and development that reduce and degrade marine habitats and water quality require management by multiple jurisdictions. In freshwater environments, we need to continue mitigation and elimination of impacts from dams, culverts, road crossings, and other instream modifications. Dams pose threats to all anadromous and some freshwater species by reducing, fragmenting, and modifying river habitats and by altering natural flow regimes and water quality. Dams may still impede juvenile and adult passage even where artificial passage has been constructed. Agricultural, urban, residential and commercial land-uses have removed, modified, or degraded estuarine, floodplain, riverine, riparian, and wetland habitats essential to anadromous and freshwater fishes. Restoration of these habitats must continue in order to improve abundance, productivity and persistence of numerous SGCN species. Threats from habitat loss and degradation are intensified for species with small or restricted ranges such as Olympic Mudminnow, Margined Sculpin, Salish Sucker, and Burbot. For anadromous salmonid SGCN species, hatchery production and hatchery-origin fish pose several kinds of threats to natural populations. Management of these risks is on-going and must continue in order to meet ESA-related recovery goals. For many SGCN fish species, mortality due to fishery-related impacts (unintentional or incidental catch, illegal harvest) is a threat that continues to need direct management and public education. The freshwater salmonid species continue to face threats from interbreeding with hatchery bred and released non-native salmonids. Invasive non-native freshwater fishes pose competition and predation threats to various SGCN species, especially those with limited native ranges (e.g., Pygmy Whitefish). Lack of data, such as on abundance, distribution, breeding habitats and/or viability status, is considered a threat for many SGCN species and will require significant investment to rectify.

### Conservation Success

The status of Hood Canal Summer Chum Salmon ESU has improved considerably since ESA-listing in 1999. Threat reduction actions, such as eliminating excessive harvest, and supplementing natural production by short-term hatchery propagation, both of which began prior to ESA-listing, have led to large increases in abundance for the ESU's two independent populations. Re-introductions of summer-run chum salmon to rivers that historically had sub-populations have occurred and continue to be monitored. Improvements to spawning and rearing habitats also have been made. Overall viability conditions are at a relatively high level.

# MARINE FISH

## BLUNTNOSE SIXGILL SHARK *(Hexanchus griseus)*

**Conservation Status and Concern**

This large and long-lived species uses Puget Sound as a nursery/pupping ground. Relatively little is known about their life history, population structure, or abundance trend.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| None | None | No | GNR | SNR | Unknown/unknown | Moderate |

**Biology and Life History**


Photo: Seattle Aquarium

The Bluntnose Sixgill Shark is a benthic species that is widely distributed over continental and insular shelves in temperate and tropical seas throughout the world. They are large and heavy-bodied with males reaching 11.5 feet and females reaching up to 15.8 feet or larger. Acoustic monitoring data suggest that Sixgill Sharks inhabit Puget Sound waters for several years as juveniles, making small seasonal migrations between a couple of core areas before leaving Puget Sound for the open coast. Their movement patterns suggest relatively small home ranges and site fidelity until they are documented leaving Puget Sound. There is documentation of one sixgill moving from Puget Sound to Point Reyes, California during a seven-month period. They are a powerful predator that feeds on a variety of prey species including sharks, rays, fish, and mammals. Predators on Bluntnose Sixgill Sharks primarily consist of other sharks, including their own species. Sixgills are viviparous and produce litters up to 108 pups, which may be sired by nine or more males.

**Distribution and Abundance**

In the absence of specific information about population structure, Sixgill Sharks are treated as a single population throughout Washington waters for assessment purposes. The present population size and abundance trends are not known, though anecdotal evidence suggests populations have declined in some areas of the Sound. Genotypic data collected from Puget Sound samples suggest one intermixing population. Evidence suggests that Puget Sound serves as a pupping and nursery grounds for this population, which is broadly distributed. This species was regularly caught by anglers in Puget Sound in the early 2000s, however all fisheries for Sixgill Sharks, including catch and release, are now closed in Washington.

**Habitat**

In Canadian Pacific waters, sixgills are found in inlets and along the continental shelf and slope typically at depths greater than 300 feet (range 0-8200 feet). They have been observed in shallower waters (less than 65 feet) in Puget Sound and near Hornby Island, B.C. by SCUBA divers, generally at night. Utilization of shallow water habitat observed in Puget Sound may increase exposure to polluted effluents

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**Bluntnose Sixgill Shark: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Resource information collection needs | Population, life history, and movements in WA state waters are data deficient. | Conduct extensive distribution and relative abundance surveys. Tagging studies produced successful results. | Current insufficient | WDFW |
| 2 | Overharvesting of biological resources | Illegal fishing and/or harvest of species. In all WA state waters, Sixgill Shark fisheries are closed. | Ensure no illegal fishing and/or harvest. | Current sufficient | WDFW |
| 3 | Education needs | Educate recreational anglers about shark conservation, catch/release stress on sharks during mating season. | Offer reports or detailed descriptions of reason to close shark fishery. | Current insufficient | Both |
| 4 | Fish and wildlife habitat loss or degradation | Because of their longevity and utilization of shallow waters near urban settings, they may accumulate a variety of chemicals. Potential effects on the fish include impacts on both growth and reproduction. | Assess burdens of toxic compounds throughout Puget Sound. Determine effects on populations and life histories, including reproduction using field studies, epidemiological information and/or laboratory studies. | Current insufficient | Both |

NOTE: Numbers are for reference only and do not reflect priority.

## BROADNOSE SEVENGILL SHARK (*Notorynchus cepedianus*)

Abundance estimates are data deficient for the population known to occur in Washington waters. Willapa Bay may be critical habitat for breeding and seasonal feeding grounds.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| None | None | No | GNR | SNR | Unknown/unknown | Moderate |

**Biology and Life History**

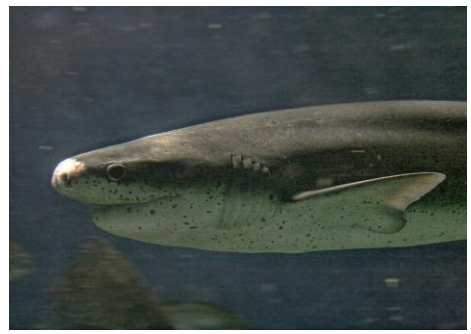

Photo: J.M. Nuñez

The Broadnose Sevengill Shark is one of only two shark species that have seven gill slits. Recent tagging studies in Willapa Bay have shown consistent seasonal patterns of estuary use during the summer and dispersing into nearshore coastal habitats during autumn. They are generally observed swimming slowly near the bottom; however they are capable of bursts of speed to capture prey including sharks, skates, rays, fish, cetaceans, and pinnipeds. Predators of this species primarily consist of other sharks, including their own species, and great white sharks. Maximum length has been observed at 9.5 feet while common length is 5 to 6.6 feet. They are viviparous and produce litters of up to 82 pups. Reproductive cycles may occur biennially with a gestation period of 12 months. The recreational fishery for this shark was closed in 2013, though both catch/release and retention fisheries previously occurred in Willapa Bay and Grays Harbor.

**Distribution and Abundance**

This species occurs in temperate nearshore waters around the world including bays and estuaries, and is known to migrate great distances. Recent tagging studies have detected them over the continental shelf near Oregon and Washington, which also move further south into California, suggesting the feasibility of broad-scale coastal movements to birthing, nursery and mating grounds. Although rarely observed in Puget Sound other than in vicinity of the Nisqually River Delta, Willapa Bay has a consistently returning population in spring and summer. Abundance estimates are data deficient for the population known to occur in Washington.

**Habitat**

Willapa Bay is the best known habitat for this species in Washington, which is likely critical for breeding and/or seasonal feeding grounds during spring and summer. Segregation by size and sex have been observed in Willapa Bay, with males and small females using the peripheral southern estuary channels before joining large females who remain in the central estuary channels. Some individuals consistently returned to specific areas within the estuary year after year.

**References**

Ebert, D. A. 2003. The sharks, rays and chimaeras of California. University of California Press, San Francisco.

Williams, G. D., Andrews, K. S., Katz, S. L., Moser, M. L., Tolimieri, N., Farrer, D. A. and Levin, P. S. (2012), Scale and pattern of broadnose sevengill shark *Notorynchus cepedianus* movement in estuarine embayments. Journal of Fish Biology, 80: 1380–1400. doi: 10.1111/j.1095-8649.2011.03179.x

**Broadnose Sevengill Shark: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Resource information collection needs | Population, life history, and movements in WA state waters are data deficient. | Conduct extensive distribution and relative abundance surveys. Tagging studies produced successful results. | Current insufficient | Both |
| 2 | Overharvesting of biological resources | Illegal fishing and/or harvest of species. In all WA state waters, Broadnose Sevengill Shark fisheries are closed. | Ensure no illegal fishing and/or harvest. | Current sufficient | WDFW |
| 3 | Education needs | Educate recreational anglers about shark conservation, catch/release stress on sharks during mating season. | Offer reports or detailed descriptions of reason to close shark fishery. | Current insufficient | WDFW |

NOTE: Numbers are for reference only and do not reflect priority

## BOCACCIO – PUGET SOUND/GEORGIA BASIN DPS (*Sebastes paucispinis*)

**Conservation Status and Concern**

Bocaccio once supported a commercial set-net fishery in south Puget Sound but catches declined precipitously in the 1990s. Bocaccio are now rarely encountered, and abundance is considered at a critical level.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| Endangered | Candidate | Yes | GNR | SNR | Unknown/unknown | Moderate-high |

**Biology and Life History**

Photo: NOAA

Bocaccio are a pelagic, long-bodied rockfish with few head spines and a very large mouth. The lower jaw is much longer than the upper jaw and has a small, distinct knob at the end. They are a large rockfish, measuring up to 36 inches and weighing up to 15 pounds. Coloration ranges from pink to gray with some individuals being dark red or golden orange. Black spots (melanistic blotches), a form of skin cancer, are common in adults. Aging for these fish has not been considered reliable, but they may live to be 50 years or more. Off of Oregon, females begin to mature at 21 inches and reach maturity at 24 inches. Spawning peaks in February in central and northern California, with females producing between 20,000 and 2.3 million eggs. Larval and juvenile Bocaccio are opportunistic feeders, consuming a range of micro- and macro-zooplankton, fish larvae, copepods and krill. Large juveniles and adults feed on squid and a range of fishes, including other rockfish, hake, anchovy, herring, and sablefish.

**Distribution and Abundance**

Bocaccio range from southeast Alaska to central Baja California and were once relatively common in localized habitats in south and central Puget Sound. Bocaccio have never been observed in WDFW dive surveys in Puget Sound and only one Bocaccio has ever been captured in WDFW trawl surveys (approximately 2,200 trawls). Several Bocaccio were observed with a remotely-operated vehicle at one location in the San Juan Islands in 2008, and a single individual was observed at that same location in 2012 with the same remotely operated vehicle (ROV). In south Puget Sound, Bocaccio made up 1.4 percent of the recreational catch in the 1960s then declined to 0.2 percent in the 1980s, and have not been recorded since 1996. The most recent abundance estimate for Bocaccio is from 2008 and only for the San Juan Islands. Bocaccio were formally designated as "overfished" in Federal waters. A recovery plan is currently under development.

**Habitat**

In coastal waters and Alaska, juvenile Bocaccio live in nearshore habitats and move deeper with age. Larvae and small juveniles are pelagic and commonly occur in the upper 295 feet of the water column, while juveniles sometimes form dense schools under drifting kelp mats. Adults occur at depths of 39 to 1578 feet (most abundant at 164 to 824 feet) and are often associated with steep slopes consisting of sand or rocky substrate, but also inhabit high relief boulder fields and areas with drop offs. The species forms pelagic schools as both juveniles and adults and may be mixed with Widow, Yellowtail, and

Vermilion Rockfish. Large Bocaccio may be sedentary, living in caves and crevices. Bocaccio observed during WDFW ROV surveys were associated with boulders at the base of a steep rocky pinnacle.

**References**

Love, M. S., M. Yoklavich, and L. Thorsteinson. 2002. The rockfish of the Northeast Pacific. Univ. of California Press. Berkeley, CA. 405pp.

National Marine Fisheries Service (NMFS). 2010. Endangered and threatened wildlife and plants: threatened status for the Puget Sound/Georgia Basin Distinct Population Segments of yelloweye and canary rockfish and endangered status for the Puget Sound/Georgia Basin Distinct Population Segment of bocaccio rockfish. Federal Register. pp. 22276-22290.

Palsson, W. A., T. S. Tsou, G.G. Bargmann, R. M. Buckley, J. E. West, M. L. Mills, Y. W. Cheng, and R. E. Pacunski. 2009. The biology and assessment of Rockfishes in Puget Sound. Washington Department of Fish and Wildlife Report FPT-09-04.

### Bocaccio - Puget Sound/Georgia Basin DPS: Conservation Threats and Actions

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Resource information collection needs | Areas used by all life history stages and movement of juveniles before selection of adult habitat are poorly understood and not known. | Fish survey required using diverse methods (e.g., ROV). Catch Per Unit Effort (CPUE) is low because they are hard to target. | Current insufficient | Both |
| 2 | Resource information collection needs | Need to update existing information. Insufficient information to conduct population assessments. | Annual fish surveys would provide more accurate results for population assessments. | Current insufficient | Both |
| 3 | Overharvesting of biological resources | By-catch in other fisheries, injuries from barotrauma can be fatal. | Offer fish descender devices and information on how to use them. Offer information on avoiding fishing in rockfish areas and methods to minimize by-catch when fishing. | Current insufficient | Both |
| 4 | Overharvesting of biological resources | Bocaccio are closed for retention. | Enforcement of law pertaining to fishery restrictions. | Current sufficient | Both |
| 5 | Education needs | Recreational anglers unable to identify species. | Educate anglers on rockfish identification. | Current insufficient | Both |

NOTE: Numbers are for reference only and do not reflect priority

## BROWN ROCKFISH (*Sebastes auriculatus*)

**Conservation Status and Concern**

A complete population assessment for this species is limited due to their wide distribution in Puget Sound and nearshore coastal habitats. They have been encountered rarely during WDFW Remotely Operated Vehicle (ROV)-based surveys (approximately 25 individuals between 2004 and 2014).

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| Species of Concern | Candidate | Yes | GNR | SNR | Unknown/unknown | Moderate-high |

**Biology and Life History**

Photo: S. Axtell, WDFW

Brown Rockfish are a light brown fish with dark- to red-brown mottling, often with a prominent brown blotch on each gill cover. Juveniles appear similar to adults. Like all rockfishes, they reproduce through internal fertilization and are viviparous. Approximately 50 percent of the population is mature between 9.5 to 12 inches and all the population is mature at 15 inches. Parturition of larval young generally occurs between April and June in Puget Sound. This species can reach 22 inches and live to at least 34 years of age. Adults are often solitary but may be found in small groups or in association with Quillback and Copper Rockfish. Prey items include small invertebrates and fishes. Depending upon the life history stage, predators may include larger rockfish, salmon, and marine mammals. This species is known to hybridize with Copper and Quillback Rockfishes in Puget Sound.

**Distribution and Abundance**

Brown Rockfish occur between Prince William Sound and southern Baja California and are found throughout Puget Sound, often occurring in bays and areas of low current velocity. Despite reduced population sizes of all rockfish species, the most recent surveys indicate brown rockfish densities are higher in south and central Puget Sound compared to the Strait of Juan de Fuca, the San Juan Islands, and Gulf of Georgia.

**Habitat**

Young-of-the-year Brown Rockfish are found in the water column for the first 2.5 to 3 months then settle in shallow water (to approximately 118 feet) onto rock and other hard substrates. Adults live between the nearshore to 443 feet and are most common above 394 feet on low- to high-relief habitats.

**References**


Love, M. S., M. Yoklavich, and L. Thorsteinson. 2002. The rockfishes of the Northeast Pacific. University of California Press, Berkeley.

Matthews, K. R. 1990. A comparative study of habitat use by young-of-the-year, subadult, and adult rockfish on four habitat types in Central Puget Sound. Fishery Bulletin 88: 223-239.

Seeb, L. W. 1998. Gene flow and introgression within and among three species of rockfishes, *Sebastes auriculatus, S. caurinus,* and *S. maliger*. Journal of Heredity 89:393-403.

Washington Department of Fish and Wildlife (WDFW), unpublished data

**Brown Rockfish: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Fish and wildlife habitat loss or degradation | Need to identify degraded habitats, including those impacted by derelict gear, poor water quality, and alteration/ development. | Assess levels of toxic compounds and habitat degradation/ loss throughout Puget Sound. Determine effects on population size, ontogeny, and reproduction through field, epidemiological, and/or laboratory studies. | Current insufficient | Both |
| 2 | Overharvesting of biological resources | Closed to harvest but are subject to poaching and bycatch (salmon/other bottomfish fisheries). | Enforce existing regulations. | Current insufficient | WDFW |
| 3 | Education needs | Need to increase public knowledge of species identification, life history, and vulnerability to pressure-related injuries. Also need to increase awareness of descending devices. | Develop materials and techniques for education and outreach to stakeholders (e.g., anglers, divers). | Current insufficient | Both |
| 4 | Resource information collection needs | Need to increase knowledge of distribution, abundance, and life history. | Research and surveys to detect species and their habitat associations for population estimates. | Current insufficient | Both |
| 5 | Resource information collection needs | Areas used by all life history stages and movement of juveniles before selection of adult habitat are poorly understood and/or not known. | Survey to detect habitat preferences of all rockfish life stages using diverse methods (e.g., ROV, SCUBA, trawl). | Current insufficient | Both |

## CANARY ROCKFISH – PUGET SOUND/GEORGIA BASIN DPS (*Sebastes pinniger*)

**Conservation Status and Concern**

The species has been declared overfished along the entire West Coast of North America and this DPS's Threatened status is due to severely reduced populations in Puget Sound and Georgia Basin.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| Threatened | Candidate | Yes | GNR | SNR | Low/unknown | Moderate-high |

**Biology and Life History**


Photo: S. Axtell and V. Okimura, WDFW

Canary Rockfish are typically distinguishable by their bright orange and white coloration, and juveniles have a distinct black spot on their dorsal fin. Larval release occurs primarily in spring and summer. Larvae and juveniles spend several months in the water column before moving to kelp beds and shallow water. After the juveniles descend to the bottom and become adults they are less vulnerable to predators. Prey typically consists of small crustaceans, such as krill and copepods, but they are also known to prey on small fish. Predators include larger rockfish, lingcod, pinnipeds, and sharks. Like most rockfish, Canary Rockfish are highly susceptible to pressure-related injuries caused by displacement to the water's surface when caught by anglers. Canary Rockfish can grow to 29 inches long and at least 84 years old.

**Distribution and Abundance**

Canary Rockfish occur from southeast Alaska to southern California. Populations have been declining along the entire West Coast since the 1970s and the species was declared overfished in 1999. Trawl fisheries in the past were the likely cause for this significant decline, as they would target large schools. Because of their increased rarity, their overfished condition in coastal waters, and a lack of assessment information in Puget Sound, Canary Rockfish were federally listed as Threatened in Puget Sound and Georgia Basin in 2010.

**Habitat**

A deeper living rockfish associated with a variety of rocky and coarse habitats, adults collect in large numbers around pinnacles and high relief rock, often in high current areas and deeper water (264 to 660 feet). Adults also have been encountered over low-relief habitat, including mud flats and concentrations of shell hash. Some adults tagged in the ocean have moved long distances. Juveniles are known to be pelagic in large schools within depths of 100 feet.

**References**
Kramer, D. E., and V.M. O'Connell. 1995. Guide to northeast Pacific rockfishes: genera *Sebastes* and *Sebastolobus*. Alaska Sea Grant College Program, University of Alaska.
Love, M. S., M. Yoklavich, and L. Thorsteinson. 2002. The rockfishes of the northeast Pacific. University of California Press.
NMFS. 2010. Endangered and threatened wildlife and plants: threatened status for the Puget Sound/Georgia Basin Distinct Population Segments of yelloweye and canary rockfish and endangered status for the Puget Sound/Georgia Basin Distinct Population Segment of bocaccio rockfish. Federal Register. pp. 22276-22290.

### Canary Rockfish - Puget Sound/Georgia Basin DPS: Conservation Threats and Actions

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Resource information collection needs | Areas used by all life history stages and movement of juveniles before selection of adult habitat are poorly understood and not known. | Fish survey required using diverse methods (i.e. ROV, divers). Tagging studies yield few returns. CPUE is low because they are hard to target. | Current insufficient | Both |
| 2 | Resource information collection needs | Need to update existing information. Insufficient information to conduct population assessments. | Annual fish surveys would provide more accurate results for population assessments. | Current insufficient | Both |
| 3 | Overharvesting of biological resources | By-catch in other fisheries, injuries from barotrauma can be fatal. | Offer fish descender devices and information on how to use them. Offer information on avoiding fishing in rockfish areas and methods to minimize by-catch when fishing. | Current insufficient | Both |
| 4 | Overharvesting of biological resources | Canary Rockfish are closed for retention. | Enforcement of law pertaining to fishery restrictions. | Current sufficient | Both |
| 5 | Education needs | Recreational anglers unable to identify species. | Educate anglers on rockfish identification. | Current insufficient | Both |

NOTE: Numbers are for reference only and do not reflect priority.

## CHINA ROCKFISH (*Sebastes nebulosus*)

**Conservation Status and Concern**
China rockfish population status is unknown, early life history is especially poorly understood, and relatively few are landed in the coastal recreational fishery.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| None | Candidate | Yes | GNR | SNR | Unknown/unknown | Moderate-high |

**Biology and Life History**
China Rockfish are a solitary bottomfish species that reside on rocky reefs and are rarely observed off the bottom. Their cryptic coloration and behavior allow them to be obscured by their surroundings. They reach a maximum size of 45 cm and live to at least age 79 years. Larval release occurs primarily in spring and summer. Prey typically consists of small crustaceans. Predators may include other rockfish, lingcod, sharks, seals, sea lions, and humans. Like most rockfish, they are highly susceptible to pressure related injuries caused by displacement to the surface when caught by anglers.


Photo: S. Axtell, WDFW

**Distribution and Abundance**
China Rockfish are considered a nearshore species and live at depths from 10 to 420 feet, and are distributed from the Gulf of Alaska to Southern California. They are occasionally caught by recreational anglers off the northern Washington coast. Recreational harvest within Puget Sound has been closed, however they are uncommon throughout the Sound. Reportedly China Rockfish were an important commercial species in Puget Sound during the nineteenth century but have been reported in catch statistics at very low levels since at least the 1970s. The population of China Rockfish is unknown, and their early life stage history is poorly understood.

**Habitat**
Adults prefer high energy, high-relief rocky habitat with numerous cavities and crevices for resting. The species appears to be very territorial with small home ranges, moving less than 33 feet for lengthy periods. This distinct habitat preference is a limited area along the Washington coast.

**References**

Kramer, D. E., and V. M. O'Connell. 1995. Guide to northeast Pacific rockfishes: genera *Sebastes* and *Sebastolobus*. Alaska Sea Grant College Program, University of Alaska.

Love, M. S., M. Yoklavich, and L. Thorsteinson. 2002. The rockfishes of the northeast Pacific. University of California Press.

**China Rockfish: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Resource information collection needs | Areas used by all life history stages and movement of juveniles before selection of adult habitat are poorly understood and not known. | Fish survey required using diverse methods (i.e. ROV, divers). Tagging studies yield few returns. CPUE is low because they are hard to target. | Current insufficient | Both |
| 2 | Resource information collection needs | Need to update existing information. Insufficient information to conduct population assessments. | Annual fish surveys would provide more accurate results for population assessments. | Current insufficient | Both |
| 3 | Overharvesting of biological resources | By-catch in other fisheries, injuries from barotrauma can be fatal. | Offer fish descender devices and information on how to use them. Offer information on avoiding fishing in rockfish areas and methods to minimize by-catch when fishing. | Current insufficient | Both |
| 4 | Overharvesting of biological resources | Habitat for this species is distinct and limited area. | Establish Marine Protected Areas or area-gear restrictions. | Current insufficient | Both |
| 5 | Education needs | Recreational anglers unable to identify species. | Educate anglers on rockfish identification. | Current insufficient | Both |

NOTE: Numbers are for reference only and do not reflect priority.

## COPPER ROCKFISH (*Sebastes caurinus*)

### Conservation Status and Concern

A complete assessment for this species is limited due to their wide distribution in Puget Sound and nearshore coastal habitats. In a 2008 San Juan Islands survey, they were most abundant rockfish species encountered, other than Puget Sound rockfish. Overall, populations have declined recently.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| None | Candidate | Yes | GNR | SNR | Critical/stable | Moderate-high |

### Biology and Life History

Copper Rockfish is an important species of the nearshore, benthic rockfish assemblage in Puget Sound. Adults are relatively sedentary and have well defined home ranges. Maximum size is 26 inches and maximum age is 50 years. Larval release occurs primarily in spring and summer. Prey typically consists of small crustaceans. Predators include larger rockfish, lingcod, pinnipeds, and sharks. Like most rockfish, they are highly susceptible to pressure related injuries caused by displacement to the surface when caught by anglers.

Photo: S. Axtell and V. Okimura, WDFW

### Distribution and Abundance

Copper Rockfish are found throughout Puget Sound and nearshore coastal marine waters from the Gulf of Alaska to southern California. They are occasionally caught by recreational anglers off the northern Washington coast. Recreational harvest within Puget Sound has been closed, however they are common throughout the Sound. Historically they have been the most commonly encountered rockfish species in Puget Sound, and in an ROV-based study of the San Juan Archipelago in 2008 they were the second most common rockfish species encountered, after Puget Sound rockfish. Their populations in both North and South Sound have precipitously declined to low levels in recent years.

### Habitat

Copper Rockfish live predominantly in rocky areas as adults, shoaling with other rockfish species. They inhabit depths less than 200 feet and associate with high-relief rocky habitats throughout the inland marine waters of Washington. Juveniles settle fairly rapidly and inhabit upper layers of the kelp canopy, moving to deeper layers before occupying adult habitat.

#### References


Kramer, D. E., and V. M. O'Connell. 1995. Guide to northeast Pacific rockfishes: genera *Sebastes* and *Sebastolobus*. Alaska Sea Grant College Program, University of Alaska.

Love, M. S., M. Yoklavich, and L. Thorsteinson. 2002. The rockfishes of the northeast Pacific. University of California Press.

Matthews, Kathleen R. 1990. "An experimental study of the habitat preferences and movement patterns of copper, quillback, and brown rockfishes (Sebastes spp.)." *Environmental Biology of Fishes* 29.3 (1990): 161-178.

Pacunski R. E., W. Palsson, and H. G. Greene. 2013. Estimating fish abundance and community composition on rocky habitats in the San Juan Islands using a small remotely operated vehicle. Olympia, WA: Washington Department of Fish and Wildlife. FPT 13-02 FPT 13-02. 57pp.

**Copper Rockfish: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Resource information collection needs | Areas used by all life history stages and movement of juveniles before selection of adult habitat are poorly understood and not known. | Fish survey required using diverse methods (i.e. ROV, divers). Tagging studies yield few returns. CPUE is low because they are hard to target. | Current insufficient | Both |
| 2 | Resource information collection needs | Need to update existing information. Insufficient information to conduct population assessments. | Annual fish surveys would provide more accurate results for population assessments. | Current insufficient | Both |
| 3 | Overharvesting of biological resources | By-catch in other fisheries, injuries from barotrauma can be fatal. | Offer fish descender devices and information on how to use them. Offer information on avoiding fishing in rockfish areas and methods to minimize by-catch when fishing. | Current insufficient | Both |
| 4 | Fish and wildlife habitat loss or degradation | Copper Rockfish are long lived, commonly occurring in urbanized basins of Puget Sound. They accumulate and concentrate persistent organic pollutants and heavy metals. | Determine effects on populations, life histories, reproduction, and epidemiological information in laboratory studies. | Current insufficient | Both |
| 5 | Education needs | Recreational anglers unable to identify species. | Educate anglers on rockfish identification. | Current insufficient | Both |

NOTE: Numbers are for reference only and do not reflect priority.

## GREENSTRIPED ROCKFISH (*Sebastes elongatus*)

**Conservation Status and Concern**

Abundance and distribution of this species are poorly known. A status assessment of Greenstriped Rockfish in Puget Sound concluded that federal Endangered Species Act (ESA) listing was not warranted.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| None | Candidate | Yes | GNR | SNR | Unknown/unknown | Moderate-high |

**Biology and Life History**


Photo: WDFW

Greenstriped Rockfish are slender with four distinctive horizontal green stripes over a background body coloration of white to pinkish, and both juveniles and adults are colored similarly. The species reaches a maximum size of 43 cm, with females growing slightly larger than males, and lives to about 54 years. Off of Oregon and Washington, 50 percent of males matured by 9.5 inches or 10 years, while 50 percent of females matured by 8.7 inches or 7 years. Like all rockfishes, they reproduce through internal fertilization and are viviparous. Larvae are released January-July off Oregon but after June in British Columbia; timing of larval release in Washington waters is unknown. At a length of about 1.2 inches, juveniles settle to depths 131 feet or deeper; they grow at a mean rate of 0.2 inches per month, and move to deeper water as they mature. Both juveniles and adults tend to be solitary. Depending on life history stage, they prey on krill, shrimp, copepods, amphipods and small fish and squid, and are preyed upon by larger rockfish, lingcod, salmon, birds, and marine mammals.

**Distribution and Abundance**

Greenstriped Rockfish are found in coastal waters from the Eastern Aleutian Islands (Alaska) to northern Baja California (Mexico). Within Puget Sound, WDFW has occasionally encountered the species during fishery-independent trawl and remotely-operated-vehicle surveys in relatively low densities (typically less than 4 fish per 2.5 acres) in the Strait of Juan de Fuca, Whidbey Basin, and Hood Canal.

**Habitat**

Greenstriped Rockfish are primarily found at depths of 328 to 984 feet, although they have been found as shallow as 40 feet and as deep as 3,757 feet. While most rockfish species inhabit rocky habitats, they tend to occur more frequently on less-complex substrates such as sand, mud, and low-relief cobble patches. Due to their substrate preferences, this species was regularly caught as bycatch in commercial trawl fisheries in Puget Sound until closure of these fisheries in 2010.

**References**

Butler, J. L., M. S. Love, and T. E. Laidig. 2012. A guide to the rockfishes, thornyheads, and scorpionfishes of the northeast Pacific. University of California Press. Berkeley and Los Angeles, CA. 185pp.

Drake J. S., E. A. Berntson, J. M. Cope, R. G. Gustafson, and E. E. Holmes. 2010. Status review of five rockfish species in Puget Sound, Washington: bocaccio (*Sebastes paucispinis*), canary rockfish (*S. pinniger*), yelloweye rockfish (*S. ruberrimus*), greenstriped rockfish (*S. elongatus*), and redstripe rockfish (*S. proriger*). Seattle, WA: NOAA Fisheries. 234pp.

Lamb, A. and P. Edgell. 2010. Coastal fishes of the Pacific Northwest. Harbour Publishing Co. Ltd. Madeira Park, BC. 335pp.

Love, M. S., M. Yoklavich, and L. Thorsteinson. 2002. The rockfishes of the northeast Pacific. University of California Press. Berkeley and Los Angeles, CA. 404pp.

Pacunski R. E., W. Palsson, and H. G. Greene. 2013. Estimating fish abundance and community composition on rocky habitats in the San Juan Islands using a small remotely operated vehicle. Olympia, WA: Washington Department of Fish and Wildlife. FPT 13-02 FPT 13-02. 57pp.

### Greenstriped Rockfish: Conservation Threats and Actions

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Resource information collection needs | Areas used by all life history stages and movement of juveniles before selection of adult habitat are poorly understood and not known. | Fish survey required using diverse methods (i.e. ROV, divers) because they are hard to target. | Current insufficient | Both |
| 2 | Resource information collection needs | Need to update existing information. Insufficient information to conduct population assessments. | Annual fish surveys would provide more accurate results for population assessments. | Current insufficient | Both |
| 3 | Overharvesting of biological resources | By-catch in other fisheries, particularly trawls. | Offer information on avoiding fishing in rockfish areas and methods to avoid by-catch when fishing. | Current insufficient | Both |
| 4 | Overharvesting of biological resources | Habitat for this species is distinct and limited area. | Establish Marine Protected Areas or area-gear restrictions. | Current insufficient | Both |
| 5 | Education needs | Recreational anglers unable to identify species. | Educate anglers on rockfish identification. | Current insufficient | Both |

NOTE: Numbers are for reference only and do not reflect priority.

## QUILLBACK ROCKFISH (*Sebastes maliger*)

**Conservation Status and Concern**

This species is currently considered depleted in both North and South Puget Sound, though increased fishery regulations and reductions in harvest have produced an increasing abundance trend in some areas.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| None | Candidate | Yes | GNR | SNR | Critical/stable | Moderate-high |

**Biology and Life History**


Photo: S. Axtell, WDFW

Quillback Rockfish are distinguished by their strong head spines and deeply notched dorsal fin spines, which are mildly venomous. Adults exhibit limited movements away from the bottom and often have a small home range, and have been observed returning to the same site seasonally. Larval release occurs primarily in spring and summer. Their primary source of prey is small crustaceans and fishes. Predators include larger rockfish, lingcod, pinnipeds, and sharks. They reach a maximum size of 24 inches and live to age 95 years (73 is the oldest age from Puget Sound). Like most rockfish, they are highly susceptible to pressure related injuries caused by displacement to the surface when caught by anglers.

**Distribution and Abundance**

Quillback Rockfish are found throughout Puget Sound and nearshore coastal marine waters from the Gulf of Alaska to southern California. They are occasionally caught by recreational anglers off the northern Washington coast. Recreational harvest within Puget Sound has been closed, however they are common throughout the Sound. Historically, Quillback Rockfish was the second most common rockfish species in Puget Sound. This species is currently considered depleted in both North and South Puget Sound, though increased fishery regulations and reductions in harvest have produced an increasing abundance trend in some areas.

**Habitat**

Inhabits nearshore and deep waters to 700 feet in Puget Sound and commonly prefers crevices within low and high relief rocky reef, as well as sponges or mud substrate. It is one of the few rockfish species that is observed nearly as often over soft substrate as over hard bottoms. Surveys for post-larval Quillback Rockfish found them in similar but fewer places as settling Copper Rockfish.

**References**


Kramer, D. E., and V. M. O'Connell. 1995. Guide to northeast Pacific rockfishes: genera *Sebastes* and *Sebastolobus*. Alaska Sea Grant College Program, University of Alaska.

Love, M. S., M. Yoklavich, and L. Thorsteinson, 2002. The rockfishes of the northeast Pacific. University of California Press.

Matthews, K. R. 1990. "An experimental study of the habitat preferences and movement patterns of copper, quillback, and brown rockfishes (Sebastes spp.)." *Environmental Biology of Fishes* 29.3 (1990): 161-178.

**Quillback Rockfish: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Resource information collection needs | Areas used by all life history stages and movement of juveniles before selection of adult habitat are poorly understood and not known. | Fish survey required using diverse methods (i.e. ROV, divers). Tagging studies yield few returns. CPUE is low because they are hard to target. | Current insufficient | Both |
| 2 | Resource information collection needs | Need to update existing information. Insufficient information to conduct population assessments. | Annual fish surveys would provide more accurate results for population assessments. | Current insufficient | Both |
| 3 | Overharvesting of biological resources | By-catch in other fisheries, injuries from barotrauma can be fatal. | Offer fish descender devices and information on how to use them. Offer information on avoiding fishing in rockfish areas and methods to minimize by-catch when fishing. | Current insufficient | Both |
| 4 | Overharvesting of biological resources | Habitat for this species is a distinct and limited area. | Establish Marine Protected Areas or area-gear restrictions. | Current insufficient | Both |
| 5 | Education needs | Recreational anglers unable to identify species. | Educate anglers on rockfish identification. | Current insufficient | Both |

NOTE: Numbers are for reference only and do not reflect priority.

## REDSTRIPE ROCKFISH (*Sebastes proriger*)

**Conservation Status and Concern**

Abundance and distribution of this species is poorly known. A 2010 status assessment of Redstripe Rockfish in Puget Sound concluded that federal ESA listing was not warranted.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| None | Candidate | Yes | GNR | SNR | Unknown/unknown | Moderate-high |

**Biology and Life History**

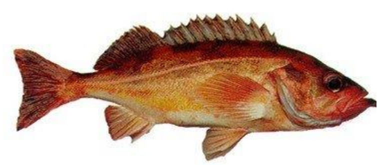
Photo: WDFW

Redstripe Rockfish are streamlined with reduced spines relative to other rockfishes and a strong, dark symphyseal knob on their lower jaw. Both juveniles and adults are colored similarly, with red/pink/yellowish bodies (sometimes with tan dorsal saddles) and a clear lateral line that forms a distinctive, lighter-color stripe. The species reaches a maximum size of 20 inches, with females becoming slightly larger than males, and lives to about 55 years. Off of Oregon and Washington, 50 percent of males matured by 10 inches or 7 years, while 50 percent of females matured by 11 inches or 7 years. Like all rockfishes, they reproduce through internal fertilization and are viviparous. Larvae are released April-July throughout their coastal distribution, but little else is known about their settlement patterns. Adults can be solitary or exist in small groups or schools. In British Columbia, the species has been noted to form near-bottom schools during the day but disperse into the water column at night. Depending on life history stage, they prey on krill, shrimp, and small fishes, and are preyed upon by larger rockfish, lingcod, salmon, birds, and marine mammals.

**Distribution and Abundance**

Redstripe Rockfish are found in coastal waters extending from the southeastern Bering Sea (Alaska) to southern Baja California (Mexico), while being most abundant from southeastern Alaska to central Oregon. Within Puget Sound, WDFW has occasionally encountered the species during fishery-independent trawl and remotely-operated-vehicle surveys in relatively low densities (typically less than four fish per 2.5 acres) in the eastern Strait of Juan de Fuca, central San Juan Channel, and South Sound basin.

**Habitat**

Redstripe Rockfish are primarily found at depths of 492 to 902 feet, although adults have been found as shallow as 121 feet (juveniles, 16 feet) and as deep as 1677 feet. Like many rockfish species, they tend to occur on or slightly above high-relief, complex habitats, and can be solitary or exist in small groups or schools. The species is commonly targeted in mid-water trawls and sometimes caught in bottom trawls and hook-and-line fisheries, though retention of all rockfish species in Puget Sound was made illegal in 2010.

**References**

Butler, J. L., M. S. Love, and T. E. Laidig. 2012. A guide to the rockfishes, thornyheads, and scorpionfishes of the northeast Pacific. University of California Press. Berkeley and Los Angeles, CA. 185pp.

Drake J. S., E. A. Berntson, J. M. Cope, R. G. Gustafson, and E. E. Holmes. 2010. Status review of five rockfish species in Puget Sound, Washington: bocaccio (*Sebastes paucispinis*), canary rockfish (*S. pinniger*), yelloweye rockfish (*S. ruberrimus*), greenstriped rockfish (*S. elongatus*), and redstripe rockfish (*S. proriger*). Seattle, WA: NOAA Fisheries. 234pp.

Lamb, A. and P. Edgell. 2010. Coastal fishes of the Pacific Northwest. Harbour Publishing Co. Ltd. Madeira Park, BC. 335pp.

Love, M. S., M. Yoklavich, and L. Thorsteinson. 2002. The rockfishes of the northeast Pacific. University of California Press. Berkeley and Los Angeles, CA. 404pp.

### Redstripe Rockfish: Conservation Threats and Actions

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Resource information collection needs | Areas used by all life history stages and movement of juveniles before selection of adult habitat are poorly understood and not known. | Fish survey required using diverse methods (i.e. ROV, divers) because they are hard to target. | Current insufficient | Both |
| 2 | Resource information collection needs | Need to update existing information. Insufficient information to conduct population assessments. | Annual fish surveys would provide more accurate results for population assessments. | Current insufficient | Both |
| 3 | Overharvesting of biological resources | By-catch in other fisheries. | Offer information on avoiding fishing in rockfish areas and methods to minimize by-catch when fishing. | Current insufficient | Both |
| 4 | Overharvesting of biological resources | Habitat for this species is distinct and limited area. | Establish Marine Protected Areas or area-gear restrictions. | Current insufficient | Both |
| 5 | Education needs | Recreational anglers unable to identify species. | Educate anglers on rockfish identification. | Current insufficient | Both |

NOTE: Numbers are for reference only and do not reflect priority.

## TIGER ROCKFISH (*Sebastes nigrocinctus*)

### Conservation Status and Concern

Tiger Rockfish population size and structure in Washington waters are unknown, early life history is poorly understood, individuals of all life history stages are rare in WDFW ROV surveys, and none have been captured in WDFW trawl surveys.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| None | Candidate | Yes | GNR | SNR | Unknown/unknown | Moderate-high |

### Biology and Life History


Photo: V. Okimura and S. Axtell, WDFW

Tiger Rockfish are red, pink or white with five vertical red, brown or black bars and two bars radiating from each eye. Juveniles appear similar to adults and may have spots between the bars that disappear with age. Like all rockfishes, they reproduce through internal fertilization and are viviparous. Age at maturity is unknown for this species, though most rockfishes mature at approximately 50 percent of their maximum length. Parturition of larval young occurs from at least February to June. This species can reach 24 inches and live to at least 116 years of age. Adults are often solitary and territorial but may be found in association with other rockfishes, especially Yelloweye Rockfish. Studies indicate high site fidelity and little vertical movement. Prey items include small benthic invertebrates, especially crab. Depending upon life history stage, predators may include larger rockfish, lingcod, birds, and marine mammals.

### Distribution and Abundance

Tiger Rockfish occur between the Aleutian Islands and Southern California. This species has apparently always appeared in limited numbers in Puget Sound fisheries due to their solitary nature and the limited gear types (e.g., set line, bottomfish jig) that would be able to access them on their preferred habitat. The rockfish fishery was closed in 2010 following ESA listing of Bocaccio, Canary Rockfish, and Yelloweye Rockfish. Fishery independent surveys have subsequently found limited numbers of Tiger Rockfish, with no individuals encountered during annual WDFW bottomfish trawls and few encountered in the San Juan Islands during WDFW ROV survey operations since 2004.

### Habitat

Post-larval Tiger Rockfish have been observed in drift kelp and in association with other floating debris. Juveniles have been observed on shallow rock piles, though little is known about their settlement patterns. Adults live between 30 to 980 feet, with most individuals found in or near crevices on high-relief, complex rock formations below 100 feet.

**References**
Hannah, R. W. and P. S. Rankin. 2011. Site fidelity and movement of eight species of Pacific rockfish at a high-relief rocky reef on the Oregon Coast. North American Journal of Fisheries Management 31: 483-494.
Lamb, A. and P. Edgell. 1986. Coastal fishes of the Pacific Northwest. Harbour Publishing Company Limited, Madeira Park, BC, Canada.
Love, M. S., M. Yoklavich, and L. Thorsteinson. 2002. The rockfishes of the Northeast Pacific. University of California Press, Berkeley.
Palsson, W. A., T. S. Tsou, G. G. Bargmann, R. M. Buckley, J. E. West, M. L. Mills, Y. W. Cheng, and R. E. Pacunski. 2009. The biology and assessment of rockfishes in Puget Sound. Washington Department of Fish and Wildlife.

### Tiger Rockfish: Conservation Threats and Actions

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Fish and wildlife habitat loss or degradation | Need to identify degraded habitats, including those impacted by derelict gear, poor water quality, and alteration/development. | Use land acquisitions, conservation easements and landowner agreements to protect significant colonies. | Current insufficient | Both |
| 2 | Overharvesting of biological resources | Closed to harvest but are subject to poaching and bycatch (salmon/other bottomfish fisheries). | Enforce existing regulations. | Current insufficient | WDFW |
| 3 | Education needs | Need to increase public knowledge of species identification, life history, and vulnerability to pressure-related injuries. Also need to increase awareness of descending devices. | Develop materials and techniques for education and outreach to stakeholders (e.g., anglers, divers). | Current insufficient | Both |
| 4 | Resource information collection needs | Need to increase knowledge of distribution, abundance, and life history. | Research and surveys to detect species and their habitat associations for population estimates. | Current insufficient | Both |

NOTE: Numbers are for reference only and do not reflect priority.

## YELLOWEYE ROCKFISH – PUGET SOUND/GEORGIA BASIN DPS (*Sebastes ruberrimus*)

**Conservation Status and Concern**

The species is declared overfished along the entire West Coast and has ESA Threatened status due to severely declining populations in Puget Sound and Georgia Basin.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| Threatened | Candidate | Yes | GNR | SNR | Critical/unknown | Moderate-high |

**Biology and Life History**

Photo: S. Axtell, WDFW

Yelloweye Rockfish are one of the largest rockfish species and typically distinguished by their bright yellow eyes and red-orange color. They are a solitary fish that rarely leaves the rocky reef, wall, or crevices on the bottom. Larval release occurs primarily in spring and summer. Little is known about their first year of life. Prey typically consists of small fish and crustaceans. Predators include larger rockfish, lingcod, pinnipeds, and sharks. These rockfish can reach 36 inches in length and a weight of 25 pounds, and can live to an age of 118 years (the oldest aged in Puget Sound to date was 73). They are known to mature relatively late in life, with about one half of the fish reaching sexually maturity at age 22 for males and 19 for females. Like most rockfish, they are highly susceptible to pressure related injuries caused by displacement to the surface when caught by anglers.

**Distribution and Abundance**

Yelloweye Rockfish occur from the Aleutian Islands to southern California. This ESA-listed DPS includes Yelloweye Rockfish in Puget Sound and Strait of Georgia areas. They may be found in the rocky reefs of northern coastal Washington, Strait of Juan de Fuca, San Juan Islands, and Hood Canal. Although uncommon in Puget Sound, fishers who targeted very specific locations and habitat types would catch them. Where abundance has been assessed, current population levels are well below historic reference levels. Assessments are ongoing.

**Habitat**

Juveniles occupy shallow to deep water with the more common rockfish species (e.g., Copper and Quillback Rockfishes) and move into deeper water as they age. Adults are relatively sedentary, living in association with high-relief rocky habitats and often near steep slopes. Adults are most common at depths from 300 to 600 feet.

**References**

Kramer, D. E., and V. M. O'Connell. 1995. Guide to northeast Pacific rockfishes: genera *Sebastes* and *Sebastolobus*. Alaska Sea Grant College Program, University of Alaska.

Love, M. S., M. Yoklavich, and L. Thorsteinson. 2002. The rockfishes of the northeast Pacific. University of California Press.

NMFS. 2010. Endangered and threatened wildlife and plants: threatened status for the Puget Sound/Georgia Basin Distinct Population Segments of yelloweye and canary rockfish and endangered status for the Puget Sound/Georgia Basin Distinct Population Segment of bocaccio rockfish. Federal Register. pp. 22276-22290.

**Yelloweye Rockfish - Puget Sound/Georgia Basin DPS: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Resource information collection needs | Areas used by all life history stages and movement of juveniles before selection of adult habitat are poorly understood and not known. | Fish survey required using diverse methods (i.e. ROV, divers). Tagging studies yield few returns. CPUE is low because they are hard to target. | Current insufficient | Both |
| 2 | Resource information collection needs | Need to update existing information. Insufficient information to conduct population assessments. | Annual fish surveys would provide more accurate results for population assessments. | Current insufficient | Both |
| 3 | Overharvesting of biological resources | By-catch in other fisheries, injuries from barotrauma can be fatal. | Offer fish descender devices and information on how to use them. Offer information on avoiding fishing in rockfish areas and methods to minimize by-catch when fishing. | Current insufficient | Both |
| 4 | Overharvesting of biological resources | Yelloweye Rockfish are closed for retention. May be caught along with legal bottomfish species. | Enforcement of law pertaining to fishery restrictions. | Current sufficient | Both |
| 5 | Education needs | Recreational anglers unable to identify species. | Educate anglers on rockfish identification. | Current insufficient | Both |

NOTE: Numbers are for reference only and do not reflect priority.

## PACIFIC COD – SALISH SEA POPULATION (*Gadus macrocephalus*)

**Conservation Status and Concern**

Abundance and distribution patterns of Pacific Cod in Washington waters are incompletely known. Historic overharvest has led to dramatic declines in encounter rate and the curtailment of both commercial and recreational fisheries.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| Species of Concern | Candidate | Yes | GNR | SNR | Unknown/unknown | Moderate-high |

**Biology and Life History**

Photo: S. Axtell, E. Wright, WDFW

Pacific Cod are a large-bodied fish typically colored brown or gray with brown spots or mottling on back and sides, with three dorsal fins, two anal fins, and a long chin barbel. The species mainly occurs at depths up to 1,640 feet over sand, mud, and clay substrates. They are moderately fast growing and relatively short-lived, reaching a maximum total length of 4 feet and maximum weight of 44 pounds. Average size observed in WDFW trawl surveys since 1987 is 1.4 feet and largest captured fish was 2.8 feet. Maximum age reported In Alaska was about 18 years. Preferred water temperatures appear to be between 32 to 50°F. Spawning occurs in winter and may be associated with onshore-offshore migrations depending on stock and local water temperatures. Females grow larger than males, reaching 50 percent maturity between 4 and 5 years of age, and produce from 225,000 to 6.4 million eggs annually. They are opportunistic feeders, consuming worms, crustaceans, fish, and fishery offal, and are prey for seabirds, fishes, and many marine mammals.

**Distribution and Abundance**

Pacific Cod occur throughout the coastal North Pacific Ocean. In Puget Sound, they are categorized into three components: North Sound (U.S. waters north of Deception Pass, including San Juan Islands, Strait of Georgia, and Bellingham Bay); West Sound (west of Admiralty Inlet and Whidbey Island, and U.S. Strait of Juan de Fuca); South Sound (south of Admiralty Inlet). Although they have been observed in all Puget Sound sub-basins during WDFW trawl surveys, they are uncommon in South Sound and only rarely encountered in Hood Canal and Whidbey Basin. Pacific Cod once supported large recreational and commercial fisheries in Puget Sound. Catch rates were highest in the 1970s then declined in the late 1980s, reaching a low point in the early 1990s, and showing no signs of recovery since. No Puget Sound abundance estimates have been made in over a decade.

**Habitat**

In Puget Sound, Pacific Cod are most commonly associated with soft bottom and low-relief habitats, including mud, sand, and gravel, but larger individuals may occasionally inhabit rock and boulder habitats. They can be found at most depths but are most commonly encountered at depths greater than 240 feet (WDFW trawl survey data). Puget Sound water temperatures are at high end of species' normal range and have been hypothesized as one factor limiting population size/recovery in the region.

**References**
Love, M. S. 2011. Certainly more than you want to know about the fishes of the Pacific coast. Really Big Press. Santa Barbara, CA. 649pp.
Palsson, W. A. 1990. Pacific cod (*Gadus macrocephalus*) in Puget Sound and adjacent waters: Biology and stock assessment. Wash. Dept. Fish. Tech. Rep. No. 112. 137pp.

**Pacific Cod - Salish Sea Population: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Resource information collection needs | Areas used by all life history stages and movement of juveniles before selection of adult habitat are poorly understood and not known. | Need for research on larval distribution. | Current insufficient | WDFW |
| 2 | Resource information collection needs | Need to update existing information. Information from annual trawl survey can be used to conduct population assessments. This information could be augmented with ROV collected data (e.g., 2012 survey). | Continue annual trawl surveys. | Current sufficient | WDFW |
| 3 | Overharvesting of biological resources | By-catch in other fisheries, injuries from barotrauma can be fatal. | Offer fish descender devices and information on how to use them. Offer information on avoiding fishing in rockfish areas and methods to minimize by-catch when fishing. | Current insufficient | WDFW |
| 4 | Overharvesting of biological resources | Pacific Cod are closed for retention in Marine Areas 8-1 to 13. Need to conduct updated population assessment to assess viability of fishery in currently open areas. | Enforcement of law pertaining to fishery restrictions. | Current sufficient | WDFW |
| 5 | Climate change and severe weather | Puget Sound temperatures are at the upper end of the species normal range. Increasing sea-surface temperatures may preclude recovery. | Enforcement of law pertaining to fishery restrictions. | Current sufficient | WDFW |
| 6 | Education needs | Recreational anglers unable to identify species. | Educate anglers on species identification. | Current insufficient | WDFW |

NOTE: Numbers are for reference only and do not reflect priority.

## PACIFIC HAKE – GEORGIA BASIN DPS (*Merluccius productus*)

**Conservation Status and Concern**

Pacific Hake populations in Puget Sound have not been assessed in over a decade, but prior to this time a marked decline was observed, resulting in cessation of commercial fisheries.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| Species of Concern | Candidate | Yes | GNR | SNR | Unknown/stable | Low-moderate |

**Biology and Life History**

Photo: S. Axtell and V. Okimura, WDFW

Pacific Hake is a cod-like fish with deeply notched second dorsal and anal fins. Both males and females mature between ages 3 to 4 years and release planktonic eggs in spawning aggregations located in several geographically segregated areas from late winter to spring. Planktonic larvae metamorphose at age 3 to 4 months. Individuals can grow to 36 inches and to live up to 20 years. The average size of Pacific Hake in WDFW trawl surveys since 1987 is 10 inches and the largest captured fish measured 30 inches. Juveniles and adults generally live in separate mid-water schools and both groups complete diurnal migrations from the bottom during the day and move up to feed at night. They also exhibit seasonal movements from deeper waters in fall and winter to more shallow waters during spring and summer. Prey include krill, copepods, shrimp, squid and small fishes, including other hake. Predators include Dogfish Sharks, other fishes, birds, marine mammals, and Humboldt Squid. Hake in this DPS are not affected by the parasite *Kudoa paniformis,* which is present in more than 50 percent of fish in Pacific coastal population and weakens muscle tissue.

**Distribution and Abundance**

There are three known populations of Pacific Hake in Washington: a migratory Pacific coastal population, a Strait of Georgia population, and a Puget Sound population. These last two form the Georgia Basin DPS. In Puget Sound, spawning aggregations are known in Port Susan and Dabob Bay. WDFW's Puget Sound assessments found a decline in biomass and size-at-age through 1999 after closure of a long-term fishery in 1991. In 2009 NOAA described Puget Sound Hake as severely depressed. A recent study found the Puget Sound population to be generally self-sustaining, with few immigrants, while relatively higher numbers of emigrants to Strait of Georgia population were observed. No abundance estimates have been made for Puget Sound population in over a decade.

**Habitat**

Juveniles are often found in mid-water schools above 650 feet. They also have been observed resting on soft substrates during visual studies, including WDFW remotely operated vehicle (ROV) surveys. In the Georgia Basin DPS, fish are restricted to depths of approximately 1,150 feet. Adults in the Pacific coastal population are found at depths between 40 to 4,600 feet.

**References**

Chittaro, P. M., R. W. Zabel, W. Palsson, and C. Grandin. 2013. Population interconnectivity and implications for recovery of a species of concern, the Pacific hake of Georgia Basin. Marine Biology 160: 1157-1170.

Gustafson, R. G., W. H. Lenarz, B. B. McCain, C. C. Schmitt, W. S Grant, T. L. Builder, R. D. Methot. 2000. Status review of Pacific hake, Pacific cod, and walleye pollock from Puget Sound, Washington. U.S. Dept. Commerce, NOAA Tech. Memo. NMFS-NWFSC-44, 275pp.
Love, M. S. 2011. Certainly more than you want to know about the fishes of the Pacific Coast. Really Big Press, Santa Barbara, CA.
McFarlane, G. A. and R. J. Beamish. 1985. Biology and fishery of Pacific whiting, *Merluccius productus*, in the Strait of Georgia. Marine Fisheries Review 47: 23-34.
National Oceanic and Atmospheric Administration (NOAA). 2009. Pacific hake (*Merluccius productus*) Georgia Basin DPS fact sheet. http://www.nmfs.noaa.gov/pr/pdfs/species/pacifichake_detailed.pdf
Pedersen, M. 1985. Puget Sound Pacific whiting, *Merluccius productus*, resource and industry: an overview. Marine Fisheries Review 47: 35-38.

**Pacific Hake - Georgia Basin DPS: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Resource information collection needs | Areas used by all life history stages and movement of juveniles before selection of adult habitat are poorly understood and not known. | Need for research on larval distribution. | Current insufficient | WDFW |
| 2 | Resource information collection needs | Need to update existing information. Information from annual trawl survey can be used to conduct population assessments. This information could be augmented with ROV collected data (e.g., 2012 survey) | Continue annual trawl surveys. | Current sufficient | WDFW |
| 3 | Overharvesting of biological resources | By-catch in other fisheries, injuries from barotrauma can be fatal. | Offer fish descender devices and information on how to use them. Offer information on avoiding fishing in rockfish areas and methods to minimize by-catch when fishing. | Current insufficient | WDFW |
| 4 | Overharvesting of biological resources | Pacific Hake are closed for retention in Marine Areas 8-1 to 13. Need to conduct updated population assessment to assess viability of fishery in currently open areas within the DPS. | Enforcement of law pertaining to fishery restrictions. | Current sufficient | WDFW |
| 5 | Education needs | Recreational anglers unable to identify species. | Educate anglers on species identification. | Current insufficient | WDFW |

NOTE: Numbers are for reference only and do not reflect priority.

## PACIFIC HERRING – GEORGIA BASIN DPS (*Clupea pallasii*)

### Conservation Status and Concern

A 2006 status assessment determined that ESA listing was not warranted. However, the Cherry Point stock is at critically low abundance, the Squaxin Pass stock is stable, and abundance of all other stocks has fluctuated substantially since the 1970s but exhibits a slight downward trend.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| None | Monitor | Yes | GNR | SNR | Critical/stable | Moderate |

### Biology and Life History

Photo: WDFW

Pacific Herring spawn by depositing eggs on vegetation or other shallow water substrate in lower intertidal and shallow sub-tidal marine zones. Most herring in Washington spawn between mid-January and early April. The Cherry Point stock spawns from April to June. Eggs hatch in 10 to 14 days, depending on water temperature and larvae drift in ocean currents. After metamorphosis to juvenile stage about 3 months after hatching, juveniles of Puget Sound stocks spend at least their first year in Puget Sound. Some Puget Sound stocks are thought to be migratory between continental shelf feeding grounds and Puget Sound spawning grounds. Other stocks are non-migratory, spending entire lives in Puget Sound/Georgia Basin, and some are likely a mix of migratory and non-migratory individuals. Pacific Herring reach sexual maturity at age two or three, can spawn repeatedly and can live 9 or more years. In recent years the majority of Puget Sound spawning herring were 2 to 4 years old, indicating an increase in natural mortality that prevents individuals from recruiting to older age classes. Among sampled stocks, the Cherry Point stock and Squaxin Pass stock were genetically distinct, while all other stocks were indistinguishable from each other. This suggests that, with exception of Cherry Point and Squaxin Pass stocks, sufficient gene flow occurs among Puget Sound herring stocks to suppress meaningful genetic divergence.

### Distribution and Abundance

Pacific Herring are found throughout Washington's marine waters and typically spawn annually at approximately 20 spawning grounds: 2 Pacific coastal locations and 18 locations east of Cape Flattery. The Georgia Basin DPS contains Puget Sound, Strait of Georgia, and Strait of Juan de Fuca stocks. Trends in herring abundance based on results of genetic studies indicate that Washington's Cherry Point stock (southern Strait of Georgia) is critically low, the Squaxin Pass stock (south Puget Sound) is stable, and abundance of all other Puget Sound stocks has declined since the 1970s but is fairly stable. In recent years the Quilcene Bay herring stock has offset losses in some other stocks in the 'other stocks complex' and is currently the largest Pacific Herring spawning population in Puget Sound.

### Habitat

Pacific Herring in this DPS live in Puget Sound and Strait of Georgia and often occur in Pacific coast waters. Prior to spawning, adults form concentrations near their spawning grounds and then move to nearshore areas to deposit their eggs primarily on marine vegetation. Eggs are adhesive and stick to whatever substrate is present, including eelgrass, numerous algal species, and other objects. Juveniles congregate in bays, inlets, and channels in summer, and typically spend at least their first year in Puget

Sound/Strait of Georgia. Juveniles from migratory stocks then move to offshore feeding areas spending late spring, summer and fall months off Washington's west coast and off Vancouver Island, B.C.

**References**

Beacham, T. D., J. F. Schweigert, C. MacConnachie, K. D. Le, and L. Flostrand. 2008. Use of microsatellites to determine population structure and migration of Pacific herring in British Columbia and adjacent regions. Transactions of the American Fisheries Society 137: 1795-1811.

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Small, M. P., J. L. Loxterman, A. E. Frye, J. F. Von Bargen, and C. Bowman. 2005. Temporal and spatial genetic structure among some Pacific herring populations in Puget Sound and the southern Strait of Georgia. Transactions of the American Fisheries Society 134: 1329 – 1341.

Stick, K. C., A. Lindquist and D. Lowry. 2014. 2012 Washington State herring stock status report. Olympia, WA: Washington Department of Fish and Wildlife. FPA 09-05 FPA 09-05. 97pp.

**Pacific Herring - Georgia Basin DPS: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Fish and wildlife habitat loss or degradation | Maintaining viable spawning grounds and water quality in Puget Sound is a challenge to herring management in Washington. | Enforcement of shoreline management regulations; control and monitor pollution in aquatic habitat; minimize risk of oil spills; overall protection of herring spawning grounds. | Current sufficient | Both |
| 2 | Resource information collection needs | An observed increase in non-fishing mortality. | Investigate and evaluate potential sources of adult herring mortality such as disease patterns, predator/prey abundance changes, pollution. | Current insufficient | WDFW |

NOTE: Numbers are for reference only and do not reflect priority.

## PACIFIC SAND LANCE (*Ammodytes hexapterus*)

### Conservation Status and Concern

Pacific Sand Lance abundance and distribution in Washington are almost completely unknown. The species is ubiquitous in beach seining surveys but difficult to capture with most traditional sampling methods.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| None | None | Yes | GNR | SNR | Unknown/unknown | Moderate-high |

### Biology and Life History

Photo: WDFW

Although Pacific Sand Lance is common and widespread in Washington nearshore marine waters, very little is known about its life history or biology. Spawning sites appear to be used year-after-year during the November to February spawning season. Adhesive eggs are deposited on upper intertidal beaches consisting of sand and gravel. Incubating eggs may occur in the same substrate as eggs of surf smelt during winter when the two species' spawning seasons overlap. However, Pacific Sand Lance spawn deposition can be found lower on beach than that of Surf Smelt, between about 5 feet and mean higher high water. Incubation time is approximately one month. Pacific Sand Lance is a key prey species for many predators including birds (especially seabirds), fishes (including halibut, rockfishes, and salmon) and marine mammals because of its high energy content. Its ecological importance in local marine food webs is high. Defense tactics used against predation include burrowing into soft, wet sand in intertidal/subtidal zones and contraction of the fish school into a ball of closely packed fish.

### Distribution and Abundance

Pacific Sand Lance occur in nearshore marine waters throughout Washington. Currently, about 10 percent of the Puget Sound shoreline has been documented as sand lance spawning habitat. Abundance is not known.

### Habitat

Pacific Sand Lance use nearshore and intertidal marine habitats. Upper intertidal sand and sand/gravel spawning sites on Puget Sound beaches are documented as important breeding areas throughout Puget Sound. Spawning substrate is typically finer grained (0.007-0.012 inch diameter range) sand. Burrowing habitat is typically well washed fine sand and fine gravel, free of mud, usually with a strong bottom current keeping oxygen levels high. They prefer well-lighted habitat and are most common at depths less than 165 feet, but may be found at depths to 900 feet. Feeding schools occur in littoral waters within proximity of burrowing habitat. In Alaska, highest abundance was found in burrowing habitat sheltered from onshore wave action and disturbance by winter storms.

**References**

Anthony, J. A., D. D. Robya, and K. R. Turcob. 2000. Lipid content and energy density of forage fishes from the northern Gulf of Alaska. Journal of Experimental Marine Biology and Ecology 248: 53-78.

Emmett, R. L., S. A. Hinton, S. L. Stone, and M. E. Monaco. 1991. Distribution and abundance of fishes and invertebrates in west coast estuaries Volume II: species life history summaries. National Oceanic and Atmospheric Administration. 334pp.

Robards, M. D., M. F. Willson, R. H. Armstrong, and J .F. Piatt, eds. 1999. Sand lance: a review of biology and predator relations and annotated bibliography. In: U.S. Department of Agriculture FS, Pacific Northwest Research Station, editor. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 327pp.

### Pacific Sand Lance: Conservation Threats and Actions

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Resource information collection needs | Need for initial baseline survey to estimate abundance or index of abundance. | Development of techniques to understand species biology and to estimate species abundance. | Nothing current - new action needed | WDFW |
| 2 | Resource information collection needs | Need to evaluate species status. | Development of techniques to evaluate species status. | Nothing current - new action needed | WDFW |
| 3 | Fish and wildlife habitat loss or degradation | Lack of erosional sediment inputs due to shoreline armoring. | Develop appropriate land use planning that adequately protects spawning beaches. | Current insufficient | WDFW |
| 4 | Outreach needs | Lack of erosional sediment inputs due to shoreline armoring. | Partner with/educate other regulatory agencies to support protection of sand lance spawning beaches. | Current insufficient | WDFW |

NOTE: Numbers are for reference only and do not reflect priority.

## SURF SMELT (*Hypomesus pretiosus*)

**Conservation Status and Concern**

Surf Smelt abundance and distribution in Washington are almost completely unknown. The species is ubiquitous in beach seining surveys but has not been sampled comprehensively due to lack of funding and personnel.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| None | None | Yes | G5 | SNR | Unknown/unknown | Moderate-high |

**Biology and Life History**


Photo: WDFW

Little is known about the life history of Surf Smelt, other than the location of spawning activity. Most spawning Surf Smelt are one or two years old, with few older than age four. They do not appear to form large open-water pelagic schools and there is no evidence that they migrate significant distances from their spawning sites. Depending on location, Surf Smelt spawning activity occurs year-round in Washington. Spawning regions are commonly used during summer, fall-winter, or year-round (spawning every month with a seasonal peak). Surf Smelt eggs adhere tightly to beach surface substrates. The thickness of the spawn-bearing substrate layer varies depending on local wave-action and sediment-supply regimes, ranging from 0.4 to 4 inches. Incubation times vary depending on temperature; during the summer, incubation times are about 2 weeks, while during winter it may be 4 to 8 weeks. Larvae are planktonic drifters. Young-of-the-year occur throughout Puget Sound nearshore. Although the occurrence of spawning activity on a spawning beach is generally predictable each year, the degree to which surf smelt may "home" back to their natal beaches is unknown. Genetic studies to date have not shown any significant genetic distinctions among Washington stocks.

**Distribution and Abundance**

Surf Smelt are widespread in Washington marine waters, occurring in the outer coastal estuaries, Olympic Peninsula shorelines, and most of Puget Sound basin from Olympia to US-Canada border. Spawning activity is distributed from southernmost Puget Sound to Olympic Peninsula Pacific coast. Their spawning/spawn incubation zone primarily includes the upper one third of the tidal range, from about 7 feet up to extreme high water. Although not measured, surf smelt spawning distribution and fishery activity suggest that their abundance is stable, or at least not dramatically decreasing.

**Habitat**

Surf Smelt are a common and widespread species found throughout Washington nearshore marine waters. Spawning occurs around high tides on mixed sand-gravel substrates in the upper intertidal zone in a wide variety of wave-exposure regimes, from very sheltered beaches to fully exposed pebble beaches. Spawning substrate grain size is generally a sand-gravel mix, with most material in the 0.04 to 0.28 inches diameter range.

**References**
Fradkin, S. C. 2001. Rialto Beach Surf Smelt Habitat Monitoring: Quillayute River Navigation Project. Olympic National Park. 16pp.
Langness, M., P. Dionne, E. Dilworth, and D. Lowry. 2014. Summary of coastal intertidal forage fish spawning surveys: October 2012-September 2013. Washington Department of Fish and Wildlife, Olympia, WA. FPA 14-01 FPA 14-01. 51pp.
Penttila, D. 2005. WDFW Priority Habitat and Species Management Recommendations: Forage fish spawning habitat. Washington Department of Fish and Wildlife. 19pp.
Penttila, D. 2000. Documented spawning seasons of populations of the surf smelt, *Hypomesus*, in the Puget Sound basin. Washington Department of Fish and Wildlife, Olympia, WA. 36pp.
WDFW. Undated. Washington State Surf Smelt Fact Sheet http://wdfw.wa.gov/publications/01219/wdfw01219.pdf

**Surf Smelt: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Overharvesting of biological resources | A lack of fishery statistics relating to the recreational harvest of Surf Smelt. | Conduct recreational fishery monitoring and fishery-independent net sampling from a variety of surf smelt spawning stocks. | Current insufficient | WDFW |
| 2 | Fish and wildlife habitat loss or degradation | Widespread shoreline armoring practices on Surf Smelt spawning beaches. | A systematic complete inventory of all shoreline areas is needed to document all existing surf smelt spawning beaches in Washington marine waters to fully protect them from development effects. | Current insufficient | WDFW |
| 3 | Fish and wildlife habitat loss or degradation | Shoreline armoring practices. | Develop appropriate land use planning that adequately protects spawning beaches. | Current insufficient | WDFW |
| 4 | Outreach Needs | Shoreline armoring practices. | Partner with/educate other regulatory agencies to support protection of surf smelt spawning beaches. | Current insufficient | WDFW |

NOTE: Numbers are for reference only and do not reflect priority.

## WALLEYE POLLOCK – SOUTH PUGET SOUND (*Gadus chalcogrammus*)

**Conservation Status and Concern**

Walleye Pollock abundance and distribution in South Puget Sound are incompletely known. Declines in encounter rate have led to increased fishery regulation and decreased harvest in recent years, especially in southern Puget Sound.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| None | Candidate | Yes | GNR | SNR | Low/unknown | Moderate |

**Biology and Life History**

Photo: S. Axtell, WDFW

Walleye Pollock is a fast-growing, relatively short-lived fish that lives throughout temperate and sub-arctic North Pacific Ocean. Puget Sound is near the southern limit of their range. They have three dorsal fins, two anal fins, and either no chin barbel or a very small one. Younger pollock form large schools in mid-water whereas older pollock are more common near the seafloor. Pollock have been recorded at depths up to 1,200 feet but are more commonly found in water from 330 to 990 feet deep. In Alaska, Walleye Pollock reach a maximum size of 3.4 feet and live up to 22 years, whereas Puget Sound Walleye Pollock are smaller and shorter-lived, reaching a maximum size of 3 feet and a maximum age of 10 years. Average size of Walleye Pollock in WDFW trawl surveys is 8.7 inches, with the largest captured fish measuring 25 inches. Approximately 50 percent of females are sexually mature at 4 years of age (approximately 16 inches). In Alaska, spawning aggregations form in late winter/early spring and larvae begin settling to the seafloor in late spring. WDFW trawl surveys have captured pollock in all stages of spawning condition during April and May. Larvae and young of the year fish feed on zooplankton such as krill, copepods, mysids and amphipods. Larger fish also utilize these prey and target shrimp, squid and other fish. Adult pollock are cannibalistic, often preying on juveniles.

**Distribution and Abundance**

WDFW trawl surveys have documented Walleye Pollock in every sub-basin of Puget Sound, with the lowest abundances in South Puget Sound, Hood Canal and Whidbey basin. Walleye Pollock once supported a recreational fishery in Puget Sound but catches are now so low that fishing is prohibited except in several small areas around San Juan Islands and in Strait of Juan de Fuca. No abundance estimates have been made for Puget Sound pollock in nearly a decade.

**Habitat**

Juveniles and adults usually occur over soft and unconsolidated substrate habitats although adults can also be found in high relief habitats near rocks. Young juveniles may use relatively shallow nearshore areas. In Puget Sound, most trawl-sampled Walleye Pollock were found at depths from 130 feet and greater.

**References**

Love, M. S. 2011. Certainly More than You Want to Know About the Fishes of the Pacific Coast. Really Big Press. Santa Barbara, CA. 649pp. http://www.adfg.alaska.gov/index.cfm?adfg=walleyepollock.main

Quinnell, S., and C. Schmitt. 1991. Abundance of Puget Sound demersal fishes: 1987 research trawl survey results. Washington Department of Fisheries Prog. Rep. No. 286, 267pp.

**Walleye Pollock – Southern Puget Sound: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Resource information collection needs | Areas used by all life history stages and movement of juveniles before selection of adult habitat are poorly understood and not known. | Need for research on larval distribution. | Current insufficient | WDFW |
| 2 | Resource information collection needs | Need to update existing information. Information from annual trawl survey can be used to conduct population assessments. This information could be augmented with ROV collected data (e.g., 2012 survey) | Continue annual trawl surveys. | Current sufficient | WDFW |
| 3 | Overharvesting of biological resources | By-catch in other fisheries, injuries from barotrauma can be fatal. | Offer fish descender devices and information on how to use them. Offer information on methods to minimize by-catch when fishing. | Current insufficient | WDFW |
| 4 | Overharvesting of biological resources | Walleye Pollock are closed for retention in south Puget Sound. | Enforcement of law pertaining to fishery restrictions. | Current sufficient | WDFW |
| 5 | Education needs | Recreational anglers unable to identify species. | Educate anglers on rockfish identification. | Current insufficient | WDFW |

NOTE: Numbers are for reference only and do not reflect priority.

# ANADROMOUS FISH – NON-SALMONIDS

## EULACHON – SOUTHERN DPS (*Thaleichthys pacificus*)

A complete population assessment for this species is unavailable but precipitous declines in spawner abundance in the Fraser and Columbia rivers led to the Southern DPS being ESA-listed in 2010.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| Threatened | Candidate | Yes | G5 | S4 | Variable/ variable | Moderate-high |

**Biology and Life History**

Photo: WDFW

Eulachon are an anadromous smelt. Adults and juveniles spend most all of their lives in the ocean, returning after 2 to 5 years to freshwater river areas from late fall through winter to spawn. Peak spawning migration occurs during Feb. and March in Washington. Certain sites are utilized each year for spawning, while other sites/rivers are used more sporadically, with occasional heavy use, then less-so for several years. Adults die after spawning. Eggs attach to and incubate in coarse sand substrates. After hatching, larvae immediately wash out to the ocean. Larvae have been detected in the Columbia River from November through June.

**Distribution and Abundance**

Eulachon are endemic to northeastern Pacific Ocean. The Southern DPS extends from Mad River, northern California, northward to British Columbia. In Washington, they occur in lower Columbia River and its tributaries below Bonneville Dam, several Pacific coastal river systems, and Elwha River. Their ocean distribution includes nearshore and offshore areas. Abundance is variable in both time and space, with dramatic population swings depending on ocean conditions. However, since 1993 the species has had extended periods of extremely poor spawning runs coast-wide. Columbia River abundance was extremely low between 2005 and 2010. Moderately strong adult returns occurred from 2001 to 2003 and from 2011 to 2013, and a very large return occurred in 2014.

**Habitat**

Columbia Basin habitats (below Bonneville Dam) support the majority of spawning in Washington. Timing and locations of spawning appear to be highly influenced by river conditions, primarily water temperature and bottom substrate. Eggs incubate in coarse sand until hatching, and larvae drift downstream through freshwater and estuarine habitats and enter ocean waters. Juveniles disperse into continental shelf waters within first year of life. Eulachon have been captured in trawl fisheries targeting marine shrimp over muddy bottom within continental shelf waters.

**References**
Gustafson, R. G., M. J. Ford, D. Teel, and J. S. Drake. 2010. Status review of eulachon (*Thaleichthys pacificus*) in Washington, Oregon, and California. U.S. Dept. Commerce, NOAA Tech. Memo. NMFS-NWFSC-105, 360pp.
NMFS. 2013. Federal Recovery Outline Pacific Eulachon Southern Distinct Population Segment. 24 pp.
NMFS. 2010. Endangered and threatened wildlife and plants: threatened status for Southern Distinct Population Segment of eulachon. Federal Register, 50 CFR Part 223. pp. 13012-13024.
Oregon Department of Fish and Wildlife (ODFW) and WDFW. 2014. Studies of Eulachon Smelt in Oregon and Washington. C. Mallette, editor. Oregon Dept. of Fish and Wildlife and Washington Dept. of Fish and Wildlife project completion report to NOAA Fisheries. 159pp.

### Eulachon – Southern DPS: Conservation Threats and Actions

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Climate change and severe weather | Natural climate variability and anthropogenic-forced climate change on ocean conditions have been identified as posing the greatest risk to Eulachon persistence. | Investigate the causal mechanisms and migration/behavior characteristics affecting survival of larval Eulachon during their first weeks in the Columbia River plume and nearshore ocean environments. | Current insufficient | Both |
| 2 | Climate change and severe weather | Natural climate variability and anthropogenic-forced climate change on ocean conditions have been identified as posing the greatest risk to Eulachon persistence. | Develop an oceanographic indicators ecosystem conditions model to determine the significance of plume and ocean conditions that affect Eulachon survival. | Current insufficient | Both |
| 3 | Overharvesting of biological resources | Bycatch in marine shrimp trawl fisheries has been identified as a major threat to Eulachon persistence. | Develop gear modifications that reduce Eulachon bycatch in pink shrimp fisheries. | Current insufficient | Both |

NOTE: Numbers are for reference only and do not reflect priority.

## PACIFIC LAMPREY (*Entosphenus tridentatus*)

### Conservation Status and Concern

The declining status of Pacific Lamprey led to a west coast-wide joint tribal/federal/state "Pacific Lamprey Conservation Initiative". Limiting factors include passage obstruction and mortality at mainstem dams and tributary water diversion dams and intakes, and low abundance in upper Columbia.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| Species of Concern | Monitor | Yes | G4 | S1 | Unknown/unknown | Moderate-high |

### Biology and Life History

Photo: USFWS

Pacific Lamprey are anadromous. Juveniles spend 4 to 7 years as filter feeders in streams and rivers, and migrate to the ocean to mature. Adults are parasitic on fishes for 1 to 3 years and then migrate back to freshwater between February and June. Adults stop feeding during the return migration, overwinter in freshwater until they spawn the following year, and then die. The timing of migration to spawning streams varies geographically, and different runs may occur in a single river system. Upstream migrations may be as long as a few hundred miles. Degree of homing to natal streams is unknown. Spawning occurs from June to July in Washington. Eggs hatch in 2 or 3 weeks. Ammocoetes (larval filter-feeder life stage) burrow and rear in fine substrate stream beds for 4 to 6 years, then metamorphose into macropthalmia (juvenile parasitic life stage) and migrate to the ocean.

### Distribution and Abundance

In Washington, Pacific Lamprey are distributed throughout streams and rivers of Columbia Basin up to Chief Joseph Dam, and throughout streams and rivers west of the Cascade Mountains. Population abundance data are limited, but the Columbia Basin's Pacific Lamprey appear to be on the decline according to dam counts and anecdotal information. Impassable dams and other made-made barriers have reduced historic distribution in Washington. Conservation actions have included translocation of adults trapped at lower Columbia River dams (Bonneville, The Dalles, John Day and McNary) to upper basin areas with low abundance.

### Habitat

Spawning habitat is similar to that of Pacific salmon, such as gravel substrates at upstream ends of stream riffles. Ammocoetes use stream areas of low velocity and fine substrates (silt, mud). Free-swimming macropthalmia juveniles migrate downstream through freshwater and estuarine areas to enter the ocean. The predatory life stage occurs in marine areas, primarily near stream mouths in estuaries and in ocean coastal zones, but sometimes more offshore. Freshwater-resident populations exist in several areas in British Columbia and elsewhere.

#### References

US Fish and Wildlife Service (USFWS). 2012. Conservation Agreement for Pacific Lamprey (*Entosphenus tridentatus*) in the States of Alaska, Washington, Oregon, Idaho and California. 57pp.

**Pacific Lamprey: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Resource information collection needs | Abundance data are limited and inadequate for trend assessment. | Research, survey or monitoring - fish and wildlife populations. | Current insufficient | Both |
| 2 | Fish and wildlife habitat loss or degradation | Dams impede passage and alter natural flow regimes; culverts, road crossings, and other instream modifications impede passage. | Fish passage facilities. | Current insufficient | External |
| 3 | Fish and wildlife habitat loss or degradation | Further development of hydropower (energy) dams may block or impede passage. | Fish passage facilities. | | Both |
| 4 | Fish and wildlife habitat loss or degradation | Dams impede passage and alter natural flow regimes; culverts, road crossings, and other instream modifications impede passage. | Dam and barrier removal. | Current insufficient | External |

NOTE: Numbers are for reference only and do not reflect priority.

## RIVER LAMPREY (*Lampetra ayresii*)

**Conservation Status and Concern:**
Abundance and distribution information is inadequate for status assessment. Breeding and rearing freshwater habitats are likely at risk throughout much of distribution from land-use degradation; dams and other passage barriers (e.g., culverts) impede or prevent migration.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| Species of Concern | Candidate | Yes | G4 | S2 | Unknown/unknown | Moderate-high |

### Biology and Life History

River Lamprey are anadromous and have three distinct life stages: the ammocoete, an eyeless, filter-feeding, larval stage; the macropthalmia, an eyed, toothed, sub-adult; and adult. The ammocoete stage lasts several years, followed by metamorphosis to the macropthalmia stage. Macropthalmia were observed from February to August in Puget Sound rivers. Once transformation to the adult stage occurs, they migrate to saltwater in late spring/early summer and feed on a variety of fish species. It is likely that adults spend a year or less in saltwater, after which they migrate back to freshwater, spawn from April to June, and die. The degree of adult fidelity to natal streams is unknown.


Photo: USGS, Mike Hayes

### Distribution and Abundance

Species range is Alaska to California. River Lamprey probably historically occurred in most major Washington rivers. Current Washington distribution is not well-known, but includes Pacific coast rivers from Columbia River northward, Puget Sound rivers, and within Columbia Basin, with documentation for the Yakima Basin. Quantitative abundance information for Washington occurrences is not available, and thus no abundance trend estimates exist.

### Habitat

Ammocoetes (larvae) use fine silt and mud substrates in slow current areas of rivers and streams, feeding on algae and microscopic organisms. They burrow and are relatively immobile in these substrates and thus good water quality is required year-round. Adults use estuarine and marine habitats, and appear to use relatively shallow marine waters. Adults spawn in gravel substrates in riffle areas of clear, cool streams, constructing nests by moving substrate materials. Adults and juveniles use river mainstems as migration corridors, with some populations having very long migration distances to and from the sea.

#### References

Hayes, M. C., R. Hays, S. P. Rubin, D. M. Chase, M. Hallock, C. Cook-Tabor, C. W. Luzier and M. L. Moser. 2013. Distribution of Pacific lamprey *Entosphenus tridentatus* in watersheds of Puget Sound based on smolt monitoring data. Northwest Science 87(2): 95-105.

Wydoski, R. S., and R. R. Whitney. 2003. Inland fishes of Washington, 2nd edition. University of Washington Press. Seattle, WA. 322pp.

**River Lamprey: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Resource information collection needs | Abundance and distribution information is inadequate for status assessment. | Research, survey or monitoring - fish and wildlife populations. | Current insufficient | WDFW |
| 2 | Fish and wildlife habitat loss or degradation | Dams, culverts, road crossings, and other instream modifications impede passage. | Dam and barrier removal. | Current insufficient | External |
| 3 | Fish and wildlife habitat loss or degradation | Dams impede passage and alter natural flow regimes; culverts, road crossings, and other instream modifications impede passage. | Fish passage facilities. | Current insufficient | External |

NOTE: Numbers are for reference only and do not reflect priority.

## GREEN STURGEON – SOUTHERN DPS (*Acipenser medirostris*)

**Conservation Status and Concern**

Green Sturgeon-Southern DPS has one spawning population with multiple habitat-related threats, and juvenile production may be declining. Harvest-related risks and estuarine degradation are threats in Washington.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| Threatened | None | Yes | G3 | S2N | Medium/declining | Moderate |

**Biology and Life History**


Photo: B. James, WDFW

Green Sturgeon is an anadromous fish with long life-span (up to 70 years) that reaches maturity at around fifteen years or 5 to 6 feet in length. It spawns infrequently, approximately every 3 to 5 years, in natal streams. Southern DPS Green Sturgeon spawn in upper mainstem Sacramento River, California. Larvae and juveniles migrate downstream to river delta and estuaries where they rear for 1 to 4 years prior to migrating to ocean. Sub-adults and adults of this DPS live in coastal waters from Baja California, Mexico to British Columbia, Canada, and utilize coastal bays and estuaries of Washington, Oregon, and California during summer and fall. Adults/sub-adults feed on benthic fauna such as clams and crustaceans. Fish in spawning condition migrate from these areas and enter San Francisco Bay between mid-February and early-May, and spawn from April to early July. They re-enter ocean from November through January and resume coastal migrations.

**Distribution and Abundance**

The Green Sturgeon Southern DPS includes all spawning populations south and exclusive of Eel River, California, but principally includes the Sacramento River spawning population. Sub-adults and adults of this DPS are distributed in marine waters from Baja California to British Columbia, and in Washington occur in marine and estuarine areas, such as the lower Columbia River, Willapa Bay and Grays Harbor. Green Sturgeon from the northern DPS (federal species of concern) may also be present in these same Washington areas. Current total abundance for the Southern DPS is unknown. A genetic analysis estimated that between 10 to 28 spawners contributed to juvenile production between 2002 and 2006 in the Sacramento River upstream of Red Bluff Diversion Dam. Population modeling has suggested that sub-adults comprise the majority of the population and that annual spawner fish represent a small fraction of census population.

**Habitat**

No spawning habitat for this DPS occurs in Washington. Federally-designated critical habitat within marine waters includes areas within the 360 foot isobath from Monterey Bay to the U.S.-Canada border. Many coastal bays and estuaries are designated as critical habitat, including Willapa Bay and Grays Harbor (Washington) and the lower Columbia River estuary from the mouth to river-mile 46 (Washington and Oregon). Green Sturgeon forage in benthic substrates in marine and estuarine waters.

**References**
Israel, J. A., and B. May. 2010. Indirect genetic estimates of breeding population size in the polyploidy green sturgeon, *Acipenser medirostris*. Molecular Ecology 19:1058-1070.
NMFS, Southwest Region. 2010. Federal Recovery Outline - North American Green Sturgeon, Southern Distinct Population Segment. http://www.westcoast.fisheries.noaa.gov/publications/protected_species/other/green_sturgeon/green_sturgeon_sdps_recovery_outline2010.pdf

### Green Sturgeon-Southern DPS: Conservation Threats and Actions

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Resource information collection needs | Insufficient data on distribution, ecology and abundance for sturgeon in WA areas. | Research, survey or monitoring - fish and wildlife populations. | Current insufficient | WDFW |
| 2 | Fish and wildlife habitat loss or degradation | Coastal bays and estuaries habitat quality may be degraded relative to sturgeon needs. | Preserve estuarine habitat, restore lost estuarine habitat and restore natural functions (e.g. adequate flows and sediment delivery). | Current insufficient | External |
| 3 | Overharvesting of biological resources | Green Sturgeon may be incidentally harvested in various fisheries (bycatch). | Monitor catch and mortality of Green Sturgeon in fisheries targeting other species. | Current insufficient | WDFW |

NOTE: Numbers are for reference only and do not reflect priority.

## WHITE STURGEON – COLUMBIA RIVER (*Acipenser transmontanus pop. 2*)

**Conservation Status and Concern**

Although stable and numerous in lower Columbia River, they are increasingly rare upstream. Dams impede and prevent passage and have negatively impacted spawning habitat.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| None | None | Yes | G4T3T4 | S3B,S4N | Low to abundant/ declining to stable | Moderate |

**Biology and Life History**

Photo: Wikimedia Commons

White Sturgeon is North America's largest freshwater fish, with maximum length about 20 feet, and a maximum mass of 1800 pounds. They are long-lived (over 100 years) and slow growing. They spawn exclusively in freshwater, typically during late spring to early summer when water temperatures reach 54 to 57°F. Spawning may occur later in year and over shorter time periods in upper basin. Males mature between 39 to 60 inches in length and at ages 12 to 25 years, while females typically mature at 47 to 71 inches and at ages 15 to 30 years. They spawn more than once during lifetime, with reproductive periodicity in lower Columbia River ranging between 3 to 5 years for males and females. Larvae hatch from eggs in 1 to 2 weeks. Juveniles typically feed on benthic invertebrates (amphipods, Chironomid larvae, isopods, mysids, snails, freshwater mussels and clams), while larger White Sturgeon are increasingly piscivorous. Inhabitants of lower river reaches can be amphidromous, with individuals moving between fresh and saltwater to feed.

**Distribution and Abundance**

The species ranges from Ensenada, Mexico to Aleutian Islands, Alaska, inhabiting large rivers, estuaries, and nearshore ocean. Riverine range of this Columbia River population includes spawning aggregations in the mainstem from its mouth to confluence with Kootenai River in British Columbia, including extreme lower reaches of its major tributaries except for Snake and Kootenai rivers. Fish in upstream areas may be freshwater-residents, and may be isolated between dams without passage facilities. Fish in lower river reaches utilize fresh and marine waters. Throughout its Columbia River range, population status and recruitment success vary widely. Currently, status is stable at high abundance in free-flowing lower Columbia River. In areas upstream of Bonneville Dam to Priest Rapids Dam, abundance is moderate and trend is stable. Abundance is low, with a declining trend, for wild fish residing in impoundments upstream of Priest Rapids Dam, an area where hatchery supplementation is underway.

**Habitat**

Large, cool rivers are primarily utilized. Sturgeon in spawning condition migrate to spawning sites comprised of a combination of moderate to high water velocities and turbulence over cobble or rock substrate, often in close proximity to deeper, slower-moving staging and resting areas. Such sites are limited to dam tailraces for impounded sub-populations, otherwise are typically located in rapids near large eddies. Spawning sites have been identified at the confluence of the Pend d'Oreille and Columbia rivers and further downstream in the Columbia River. Flow regulation has likely contributed to poor spawning and early-rearing success of White Sturgeon in the upper Columbia River by reducing spring flows and increasing water clarity.

**References**

Columbia Basin White Sturgeon Planning Framework. 2013. Prepared by CRITFC, WDFW and ODFW for the Northwest Power and Conservation Council. R. Beamesderfer and P. Anders (eds). 285pp.

### White Sturgeon – Columbia River: Conservation Threats and Actions

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Fish and wildlife habitat loss or degradation | Habitat fragmentation: downstream dams isolate populations from lower basin populations and anadromous food resources. Upstream dam (Keenleyside) cut off access to historical spawning, rearing and feeding habitats. Former highly diverse and productive riverine ecosystem replaced by homogenous, oligotrophic reservoir that provides marginal habitat. Fragmentation eliminated full spectrum of habitats necessary for resident sturgeon to complete their life cycle. | Investigate using fish from adjacent populations in the supplementation program. | Current sufficient | Both |
| 2 | Fish and wildlife habitat loss or degradation | Flow regulation: Increased storage in upper basin and hydro operation have reduced spring flows. Riverine habitats and seasonal floods provide suitable spawning conditions by dispersing newly hatched free embryos to suitable rearing habitat, floods flush fine sediment and prevent armoring, and increased turbidity provides cover from potential predators. | Investigate habitat modifications, including enhancing spawning substrates. | Current insufficient | Both |
| 3 | Resource information collection needs | Need to monitor population trends and success of restoration actions. | Continue to monitor the status and trends of populations within the recovery areas. | Current sufficient | Both |
| 4 | Management Decision Needs | Need to monitor restoration planning, supplementation program, impacts and success. | Continue supplementation to rebuild abundance and maintain genetic diversity. | Current sufficient | Both |

NOTE: Numbers are for reference only and do not reflect priority.

# SALMONIDS

## LOWER COLUMBIA CHINOOK SALMON ESU (*Oncorhynchus tshawytscha pop. 1*)

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| Threatened | Candidate | Yes | G5T2Q | SNR | Low/stable | Moderate-high |

**Biology and Life History**

Photo: WDFW

The season that adults return to freshwater distinguishes populations. For spring-run populations, adults enter rivers in early March not fully mature and spawn from late August to early October. For fall-run populations, adults enter rivers in early to late August and spawn from mid-September to mid-December. Spawning sites are usually in river's mainstem and large tributaries where flows and gravel sizes are optimal for egg deposition and survival. Most juveniles rear in freshwater for several months, out-migrating to estuary or ocean as fry or subyearlings from late winter to summer, and some may rear for a year before out-migrating. Sub-adults live in coastal Pacific Ocean as far north as southeastern Alaska and off British Columbia, Washington and Oregon, where they are largely piscivorous and grow to maturity for 1 to 6 years before migrating back to natal rivers. Most spawners are ages 2 to 5.

**Distribution and Abundance**

The ESU includes Chinook salmon in Washington and Oregon rivers that are Columbia River tributaries from its mouth up to Hood (Oregon) and White Salmon (Washington) rivers, and includes Willamette River to Willamette Falls, Oregon. Dams in several rivers significantly reduced or eliminated the historical distribution. Of 32 historical populations, 22 are in Washington. Washington's seven spring-run populations are extirpated or at high extinction risk. Of 15 fall-run populations, several are extirpated and most others are at high extinction risk. Chinook in 10 Washington hatchery programs are included in ESU, but introduced Chinook from other ESUs are not included, even if naturally spawning. Abundance remains very low for spring-run Chinook in restoration programs. Most fall-run populations also are at low abundance, especially in terms of wild-origin spawners, and at high extinction risk. The Lewis River late fall-run population is the only one with abundance trend nearing interim recovery goal.

**Habitat**

Adults and juveniles use a variety of riverine habitats depending on life stage. Spawners use pool and riffle areas in channels that have adequate depth, velocity, gravel substrate and temperature. Young juveniles use lower velocity and shallower areas including stream margins and non-mainstem channels, such as those found in natural floodplains. Suitable or optimal freshwater temperatures vary by life stage, but generally range between 41 and 59$^{o}$ F. Temperatures above 68$^{o}$ F may block adult migration and over 75$^{o}$ F may be lethal. Riparian trees are important due to habitat-forming large woody debris contributed to channels, and shading that moderates temperature. Columbia River estuary is an important juvenile rearing habitat. Sub-adults rear in Pacific Ocean continental shelf areas west of southeastern Alaska, British Columbia, Washington and Oregon.

**References**
Ford, M. J. (ed.). 2011. Status review update for Pacific salmon and steelhead listed under the Endangered Species Act: Pacific Northwest. U.S. Dept. Commerce, NOAA Tech. Memo. NMFS-NWFSC-113, 281pp.
Myers, J., C. Busack, D. Rawding, A. Marshall, D. Teel. D. M. Van Doornik, and M. T. Maher. 2006. Historical population structure of Pacific Salmonids in the Willamette River and Lower Columbia River basins. NOAA Tech. Memo. NMFS-NWFSC-73, 311pp.

## Lower Columbia River Chinook Salmon ESU: Conservation Threats and Actions

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Fish and wildlife habitat loss or degradation | Riverine, riparian, floodplain, and estuarine habitats lost, modified or heavily degraded by agricultural, urban and residential development. | Restore natural instream habitat forming processes and hydrological functions, e.g., remove diking, channelization, water diversions; restore riparian vegetation. Restore estuarine habitats and processes. | Current insufficient | External |
| 2 | Agriculture and aquaculture side effects | Percent of hatchery-origin fish on spawning grounds is often higher than management goal. Threat is loss of natural productivity. | Manage and modify hatchery operations to achieve goals for percent hatchery fish on spawning grounds. | Current sufficient | WDFW |
| 3 | Fish and wildlife habitat loss or degradation | Habitat loss and degradation due to dams, transportation crossings, culverts, water diversions, shoreline industrial uses. | Dam and barrier removal. | Current insufficient | External |
| 4 | Energy development and distribution | Threat is from dam operations that modify natural hydrological cycle and flows and restrict or eliminate fish passage. | Restore or maintain optimum flows for fish and maintain adequate passage. | Current insufficient | External |
| 5 | Fish and wildlife habitat loss or degradation | Dams impede and prevent passage of adults and juveniles. | Add or improve fish passage in multiple localities (esp. Cowlitz and Lewis). | Current insufficient | External |

NOTE: Numbers are for reference only and do not reflect priority.

## PUGET SOUND CHINOOK SALMON ESU (*Oncorhynchus tshawytscha pop. 15*)

**Conservation Status and Concern**

All populations in ESU are well below recovery plan target ranges for spawner levels. Risk factors are still present, including high fractions of hatchery fish and widespread habitat loss and degradation.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| Threatened | Candidate | Yes | G5T2Q | SNR | Low/stable | Moderate-high |

**Biology and Life History**

Photo: WDFW

Adults enter rivers from mid-April to mid-September and spawn from late July to early November, with a population's return and spawn timing adapted to their spawning habitat. Spawning sites are usually in mainstem rivers and large tributaries where flows and gravel sizes are optimal for egg deposition and survival. Most juveniles rear in freshwater for several months before transforming to smolts and migrating to saltwater during spring and summer, and some may rear for a year before out-migrating. Juveniles may live in estuaries for a short time before entering marine waters. Sub-adults typically live in Puget Sound and coastal Pacific Ocean off Canada where they are largely piscivorous and grow to maturity for 1 to 6 years before migrating back to their natal rivers. Most spawners are ages 2 to 5 years, with age 4 predominating.

**Distribution and Abundance**

This ESU includes all wild Chinook salmon in rivers flowing into Puget Sound, Hood Canal, and eastern Strait of Juan de Fuca (Elwha River and eastward) in Washington, and hatchery-born Chinook from 26 artificial propagation programs. Currently, of 31 quasi-independent populations identified as historically present, 22 are extant and all of these are monitored annually for adult abundance. Marine distribution includes Puget Sound and coastal Pacific Ocean. Spawner abundance remained fairly constant between 1985 and 2009 but productivity (recruits per spawner) declined. The percentage of naturally spawning hatchery-origin fish averaged greater than 50 percent in one third of populations from 2005 to 2009.

**Habitat**

Adults and juveniles use a variety of riverine habitats depending on life stage. Spawners use pool and riffle areas in channels that have adequate depth, velocity, gravel substrate and temperature. Young juveniles use lower velocity and shallower areas including stream margins and non-mainstem channels, such as those found in natural floodplains. Suitable or optimal freshwater temperatures vary by life stage, but generally range between 41 and 59$^{o}$ F. Temperatures above 68$^{o}$ F may block adult migration and over 75$^{o}$ F may be lethal. Riparian trees are important due to habitat-forming large woody debris contributed to channels, and shading that moderates temperature. Estuaries serve as important rearing habitats, and juveniles use shallow nearshore areas as they migrate through Puget Sound. Sub-adults use deeper, more offshore Puget Sound areas for foraging. Other marine rearing areas include Strait of Georgia and Pacific Ocean continental shelf areas west of Vancouver Island and central British Columbia.

**References**
Ford, M. J. (ed.). 2011. Status review update for Pacific salmon and steelhead listed under the Endangered Species Act: Pacific Northwest. U.S. Dept. Commerce, NOAA Tech. Memo. NMFS-NWFSC-113, 281pp.
Ruckelshaus, M. H., K. P. Currens, W. H. Graeber, R. R. Fuerstenberg, K. Rawson, N. J. Sands, and J. B. Scott. 2006. Independent populations of Chinook salmon in Puget Sound. U.S. Dept. Commerce, NOAA Tech. Memo. NMFS-NWFSC-78, 125pp.

## Puget Sound Chinook Salmon ESU: Conservation Threats and Actions

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Fish and wildlife habitat loss or degradation | Riverine, riparian, floodplain, estuarine, and nearshore-marine habitats lost, modified or heavily degraded by agricultural, urban and residential development. | Restore natural instream habitat forming processes and hydrologic functions, e.g., remove diking, channelization, water diversions; restore riparian vegetation, estuarine and nearshore marine habitats and processes. | Current insufficient | Both |
| 2 | Agriculture and aquaculture side effects | Loss of natural productivity; percent of hatchery-origin fish on spawning grounds is often higher than management goal. | Manage and modify hatchery operations to achieve goals for percent hatchery fish on spawning grounds. | Current sufficient | Both |
| 3 | Fish and wildlife habitat loss or degradation | Habitat loss and degradation due to dams, transportation crossings, culverts, water diversions, shoreline industrial uses. | Dam and barrier removal; add or improve fish passage facilities in some localities. | Current insufficient | External |
| 4 | Energy development and distribution | Dam operations that modify natural hydrological cycle and flows and restrict or eliminate fish passage. | Restore or maintain optimum flows for fish. | Current insufficient | External |
| 5 | Climate change and severe weather | River scour and excessive sedimentation from high flows and bank/hillsides erosion. | Restore and manage forests to protect channels, stream banks, and floodplains, and reduce effects of heavy rains and high flows. | Current insufficient | External |
| 6 | Overharvesting of biological resources | Annual fishery management processes are required. | Species and habitat management planning. | Current sufficient | Both |

NOTE: Numbers are for reference only and do not reflect priority.

## UPPER COLUMBIA RIVER SPRING CHINOOK SALMON ESU (*Oncorhynchus tshawytscha pop. 12*)

**Conservation Status and Concern**

Although there have been increases in natural-origin spawner abundance, average productivity levels remain extremely low. Risks due to relatively high percent of hatchery-origin fish on spawning grounds, habitat degradation, and dam impacts are major concerns.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| Endangered | Candidate | Yes | G5T1Q | SNR | Low/stable | Moderate-high |

**Biology and Life History**

Photo: WDFW

Adults begin entering Columbia River in March and enter their natal upper Columbia tributaries from early May to early August. Spawning occurs from August to mid-September. Juveniles rear for over a year in freshwater and then migrate through Columbia River mainstem to saltwater during spring to early summer. Pacific Ocean areas used by sub-adults for 2 to 3 years of rearing are not well-known, but likely occur offshore of northern continental shelf waters. Most spawners are ages 4 or 5 years. Upper Columbia River spring-run Chinook are part of a highly distinct evolutionary lineage and are genetically well-differentiated from most other Chinook salmon in Washington.

**Distribution and Abundance**

This ESU includes spring-run Chinook salmon in tributaries of upper Columbia River upstream of Yakima River confluence. Three extant populations occur in Wenatchee, Entiat, and Methow rivers, which drain eastside of the Cascades Mountains. Tributaries within these rivers support sub-populations containing important biological diversity (e.g., White River and Twisp River). Historical populations in Okanogan River and in upper Columbia River areas upstream of Grand Coulee Dam are extirpated. Six artificial propagation programs are included in the ESU. Abundance has increased since 1991 but this ESU did not meet viability criteria when last reviewed, and was rated at moderate-to-high extinction risk.

**Habitat**

Adults and juveniles use riverine and stream habitats in Wenatchee, Entiat, and Methow basins. Snow is major form of precipitation and rainfall is low. Snowmelt creates high flows in spring that adults utilize to access spawning habitat. Adequate stream conditions (e.g., flow, temperature, cover, prey) are required year-round because juveniles rear for more than a year before out-migrating. Suitable or optimal freshwater temperatures vary by life stage, but generally range between 41 and 59$^{o}$ F. Temperatures above 68$^{o}$ F may block adult migration and over 75$^{o}$ F may be lethal. Riparian trees are particularly important for moderating water temperature, and for contribution of large woody debris for in-stream habitat formation. Numerous dams in Columbia R. migration corridor negatively affect passage, flow and temperature conditions. Sub-adults rear in the North Pacific Ocean.

**References**

Ford, M. J. (ed.). 2011. Status review update for Pacific salmon and steelhead listed under the Endangered Species Act: Pacific Northwest. U.S. Dept. Commerce, NOAA Tech. Memo. NMFS-NWFSC-113, 281pp.

**Upper Columbia River Spring Chinook ESU: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Fish and wildlife habitat loss or degradation | Riverine, riparian, floodplain, and estuarine habitats lost, modified or heavily degraded by agricultural, urban and residential development. | Restore natural instream habitat forming processes and hydrological functions, e.g., remove diking, channelization, water diversions; restore riparian vegetation. Restore estuarine (lower Columbia River) habitats and processes. | Current insufficient | External |
| 2 | Fish and wildlife habitat loss or degradation | Habitat loss and degradation due to dams, transportation crossings, culverts, water diversions, other water extraction. | Dam and barrier removal. | Current insufficient | External |
| 3 | Energy development and distribution | Dam operations that modify natural hydrological cycle and flows and restrict or eliminate fish passage. | Restore or maintain optimum flows and maintain adequate passage for fish. | Current insufficient | External |
| 4 | Fish and wildlife habitat loss or degradation | Dams impede and prevent passage of adults and juveniles. | Fish passage facilities need to be added or improved in multiple localities | Current insufficient | External |
| 5 | Agriculture and aquaculture side effects | Percent of hatchery-origin fish on spawning grounds need to be well-monitored and managed so that management goals for wild fish productivity are met. Threat is loss of natural productivity and diversity. | Manage and modify hatchery operations to achieve goals for percent hatchery fish on spawning grounds. | Current sufficient | Both |
| 6 | Overharvesting of biological resources | Annual fishery management processes are required. | Species and habitat management planning. | Current sufficient | Both |

NOTE: Numbers are for reference only and do not reflect priority.

## SNAKE RIVER FALL CHINOOK SALMON ESU (*Oncorhynchus tshawytscha pop. 2*)

This ESU includes one extant population. Abundance has improved substantially since ESA-listing, however hatchery-origin spawner proportions are high and dams continue to compromise habitat.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| Threatened | Candidate | Yes | G5T1Q | SNR | Medium/increasing | Moderate-high |

**Biology and Life History**

Photo: WDFW

Adults begin entering Columbia River in August and enter Snake River in September. Spawning occurs from mid-October through mid-December in mainstem and lower areas of Snake River tributaries. Juveniles rear for several months and sometimes over a year in freshwater, and rearing may occur in Snake mainstem reservoirs. Migration to sea through Snake and Columbia rivers' mainstems occurs from spring through summer. Sub-adults rear in Pacific Ocean coastal areas off British Columbia and Washington, and most rear for one to three years before returning to spawn.

**Distribution and Abundance**

Distribution of historical spawning habitat has been significantly altered by Snake River mainstem dams. Habitat upstream of Hells Canyon Dam is inaccessible, and a 108 mile mainstem reach between that dam and upper end of Lower Granite Dam reservoir is remaining primary spawning habitat. Spawning also occurs now in lower areas of Snake River tributaries such as Grande Ronde, Clearwater and Tucannon rivers. Fish in two artificial production programs are included in ESU. Abundance of wild-born fish has increased in recent years due to on-going hatchery supplementation, and majority of naturally spawning fish are hatchery-origin. Returning wild-born adults have been estimated at over 4,000 fish since 2005, with an increasing trend to 2013.

**Habitat**

Adults and juveniles use riverine and reservoir habitats of the Snake River and lower mainstem areas of its tributaries. Habitat available is significantly reduced from historical conditions. Snake Basin rainfall is generally low and snow is major form of precipitation. High spring-time flows are important for successful juvenile outmigration. Natural seasonal hydrology has been altered by dams that control Snake River mainstem and some tributaries' flows. Four dams in lower Snake River and four dams in the Columbia River migration corridor negatively affect passage, flow and temperature conditions needed for adult and juvenile survival. Suitable or optimal freshwater temperatures vary by life stage, but generally range between 41 and 59$^{o}$ F. Temperatures above 68$^{o}$ F may block adult migration and over 75$^{o}$ F may be lethal. Sub-adults rear in the North Pacific Ocean and appear to predominately use British Columbia and Washington coastal areas.

**References**

Ford, M. J. (ed.). 2011. Status review update for Pacific salmon and steelhead listed under the Endangered Species Act: Pacific Northwest. U.S. Dept. Commerce, NOAA Tech. Memo. NMFS-NWFSC-113, 281pp.

Waples, R. S., R. P. Jones, B. R. Beckman and G. A. Swan. 1991 Status Review for Snake River Fall Chinook Salmon. NOAA Technical Memorandum NMFS F/NWC-201, 80pp.

**Snake River Fall Chinook Salmon ESU: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Fish and wildlife habitat loss or degradation | Habitat loss and degradation due to dams, transportation crossings, water diversions, other water extraction. | Dam and barrier removal. | Current insufficient | External |
| 2 | Energy development and distribution | Threat is from dam operations that modify natural hydrological cycle and flows and restrict or eliminate fish passage. | Restore or maintain adequate passage and optimum flows for fish. | Current insufficient | External |
| 3 | Fish and wildlife habitat loss or degradation | Dams impede and prevent passage of adults and juveniles. | Fish passage facilities need to be added or improved in multiple localities. | Current insufficient | External |
| 4 | Agriculture and aquaculture side effects | Percent of hatchery-origin fish on spawning grounds need to be well-monitored and managed so that management goals for wild fish productivity are met. Threat is loss of natural productivity and diversity. | Manage and modify hatchery operations to achieve goals for percent hatchery fish on spawning grounds. | Current sufficient | Both |

NOTE: Numbers are for reference only and do not reflect priority.

# SNAKE RIVER SPRING/SUMMER CHINOOK SALMON ESU (*Oncorhynchus tshawytscha pop. 8*)

**Conservation Status and Concern**

The entire ESU is rated at high extinction risk. Besides low abundance, risks due to percent of hatchery-origin fish on spawning grounds, habitat degradation, and dam impacts are major concerns.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| Threatened | Candidate | Yes | G5T1Q | SNR | Low/increasing | Moderate-high |

**Biology and Life History**

Photo: WDFW

Adults begin entering Columbia River in March and enter their natal Snake River tributaries from April to mid-May. Spawning occurs from August through September. Timing is influenced by spawning habitat elevation. Juveniles rear for over a year in freshwater and then migrate through Snake and Columbia rivers' mainstems to saltwater during spring to early summer. Pacific Ocean areas used by sub-adults for 2 to 3 years of rearing are not well-known, but likely occur offshore of northern continental shelf waters. Most spawners are ages 4 or 5 years. Snake River spring/summer Chinook are part of a highly distinct evolutionary lineage and are genetically well-differentiated from most other Chinook salmon in Washington.

**Distribution and Abundance**

This ESU includes spring/summer-run Chinook salmon in tributaries of the Snake River (Idaho, Oregon and Washington), and 31 historic populations were identified, with 4 being extirpated, in areas that are currently accessible. Numerous historical populations in Idaho were extirpated by Lewiston Dam and in upper Snake Basin by Hells Canyon Dam. Distribution in Washington includes the Tucannon River, Asotin Creek, and part of Wenaha River. The Asotin population is considered extirpated, but hatchery strays may be present. Fifteen artificial propagation programs are included in the ESU, including the Tucannon hatchery program in Washington. Abundance and productivity remain low for Tucannon wild population. Natural spawning abundance in Tucannon River has increased since 2009 but remains well below the minimum abundance threshold.

**Habitat**

Adults and juveniles use riverine and stream habitats of tributaries to the Snake River and occur in relatively high elevation areas. Rainfall is generally low and snow is major form of precipitation. Snowmelt creates high flows in spring that adults utilize to access spawning habitat. Adequate stream conditions (e.g., flow, temperature, cover, prey) are required year-round because juveniles rear for more than a year before out-migrating. Suitable or optimal freshwater temperatures vary by life stage, but generally range between 41 and 59$^{o}$ F. Temperatures above 68$^{o}$ F may block adult migration and over 75$^{o}$ F may be lethal. The Tucannon River includes low elevation habitats within grasslands or agricultural fields and higher elevation habitats within evergreen forests. Riparian trees are particularly important in lower elevation areas for moderating water temperature, and throughout for contribution of large woody debris for in-stream habitat formation. Numerous dams in Snake and Columbia rivers' migration corridors negatively affect passage, flow and temperature conditions. Sub-adults rear in the North Pacific Ocean.

**References**

Ford, M. J. (ed.). 2011. Status review update for Pacific salmon and steelhead listed under the Endangered Species Act: Pacific Northwest. U.S. Dept. Commerce, NOAA Tech. Memo. NMFS-NWFSC-113, 281pp.

### Snake River Spring/Summer Chinook Salmon ESU: Conservation Threats and Actions

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Fish and wildlife habitat loss or degradation | Riverine, riparian, floodplain, and estuarine habitats lost, modified or heavily degraded by agricultural, urban and residential development. | Restore natural instream habitat forming processes and hydrological functions, e.g., remove diking, channelization, water diversions; restore riparian vegetation. Restore estuarine (lower Columbia River) habitats and processes. | Current insufficient | External |
| 2 | Fish and wildlife habitat loss or degradation | Habitat loss and degradation due to dams, transportation crossings, culverts, water diversions, other water extraction. | Dam and barrier removal. | Current insufficient | External |
| 3 | Energy development and distribution | Threat is from dam operations that modify natural hydrological cycle and flows and restrict or eliminate fish passage. | Restore or maintain adequate passage and optimum flows for fish. | Current insufficient | External |
| 4 | Fish and wildlife habitat loss or degradation | Dams impede and prevent passage of adults and juveniles. | Fish passage facilities need to be added or improved in multiple localities. | Current insufficient | External |
| 5 | Agriculture and aquaculture side effects | Percent of hatchery-origin fish on spawning grounds need to be well-monitored and managed so that management goals for wild fish productivity are met. Threat is loss of natural productivity and diversity. | Manage and modify hatchery operations to achieve goals for percent hatchery fish on spawning grounds. | Current sufficient | Both |
| 6 | Overharvesting of biological resources | Annual fishery management processes are required. | Species and habitat management planning. | Current sufficient | Both |

NOTE: Numbers are for reference only and do not reflect priority.

## COLUMBIA RIVER CHUM SALMON ESU (*Oncorhynchus keta pop. 3*)

**Conservation Status and Concern**

After near extirpation, abundance of this ESU remains very low, and extinction risk was rated very high.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| Threatened | Candidate | Yes | G5T2Q | SNR | Low/declining | Moderate |

**Biology and Life History**

Photo: WDFW

Adults return to Columbia River from mid-October to November and reach spawning grounds from late October to early December. Spawning occurs from early November to mid-January in Columbia River mainstem and its tributaries. Early or 'summer' returning chum salmon occur in Cowlitz River, with earlier spawn timing than fall-run chum. Spawners use lower reaches of rivers, tributaries and side-channels from just above tidal influence to upstream areas below where gradients increase and partial natural barriers are more common. They often choose spawning sites with upwelling groundwater or that are spring-fed. Emerged fry spend little time rearing in freshwater and begin seaward migration at relatively small sizes, with an early capability for seawater adaptation. Outmigration occurs from March through May and peaks from mid-April to early May. Juveniles use lower Columbia estuarine areas for feeding and rearing and may be present from February through June. Sub-adults use Pacific Ocean areas for rearing but migration distances and specific distributions over multiple years at sea are not well-known. Returning adults are usually ages 3 to 5 years.

**Distribution and Abundance**

This ESU includes all chum salmon in the Columbia River and its Washington and Oregon tributaries. Of 17 historical populations, 11 are in Washington. Chum salmon from three Washington artificial propagation programs are included in the ESU. Lower Columbia Chum Salmon were nearly extirpated in the 1940's. Among Washington populations, Grays River and Lower Gorge populations are the only ones that have consistently maintained natural spawning and relatively stable abundance. All others are at very low abundance. In 2010 total abundance was less than 12 percent of 1951 estimated abundance. ESU status was rated at very high risk.

**Habitat**

Lower elevation and lower gradient riverine areas of Columbia River tributaries and sections of the Columbia River mainstem below Bonneville Dam are primary spawning habitats. Areas with upwelling groundwater and spring-fed flows are important for spawners. Juveniles use these same areas for a short time. Lower Columbia estuarine habitats are important feeding and rearing areas for juveniles prior to ocean entry. Pacific Ocean habitats used for rearing are likely to be coastal and continental shelf areas but oceanic distribution of sub-adults through their growth period is not well-known.

**References**

Ford, M. J. (ed.). 2011. Status review update for Pacific salmon and steelhead listed under the Endangered Species Act: Pacific Northwest. U.S. Dept. Commerce, NOAA Tech. Memo. NMFS-NWFSC-113, 281pp.

Myers, J., C. Busack, D. Rawding, A. Marshall, D. Teel. D. M. Van Doornik, and M. T. Maher. 2006. Historical population structure of Pacific Salmonids in the Willamette River and Lower Columbia River basins. NOAA Tech. Memo. NMFS-NWFSC-73, 311 p.

**Columbia River Chum Salmon ESU: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Fish and wildlife habitat loss or degradation | Riverine, riparian, floodplain, and estuarine habitats lost, modified or heavily degraded by agricultural, urban and residential development. | Restore natural instream habitat forming processes and hydrological functions, e.g., remove diking, channelization, water diversions; restore riparian vegetation. Restore estuarine habitats and processes. | Current insufficient | External |
| 2 | Fish and wildlife habitat loss or degradation | Habitat loss and degradation due to dams, transportation crossings, culverts, water diversions, shoreline industrial uses. | Remove structures that increase delivery or accumulation of fine sediments, that block or impede passage, or modify flows. | Current insufficient | External |
| 3 | Energy development and distribution | Threat is from dam operations that modify natural hydrological cycle and flows and restrict or eliminate fish passage. | Optimum flows for chum need to be restored or maintained (e.g., mainstem redd de-watering threat), adequate passage maintained and flooded spawning habitat restored. | Current insufficient | External |

NOTE: Numbers are for reference only and do not reflect priority.

## HOOD CANAL SUMMER CHUM SALMON ESU (*Oncorhynchus keta pop. 2*)

**Conservation Status and Concern**

Abundance has improved significantly since time of ESA-listing, but viability conditions have not been met completely. Evaluation of efficacy of habitat improvements and reintroductions is needed.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| Threatened | Candidate | Yes | G5T2Q | SNR | Medium/increasing | Moderate-high |

**Biology and Life History**


Photo: WDFW

Adults return to natal streams from early August into October. Spawn timing ranges from mid-August to late October. Spawners use lower reaches of rivers, their tributaries and side-channels from just above tidal influence to upstream areas below where gradients increase and partial natural barriers are more common. Juvenile emergence from redds (nests) usually begins in February and continues for several months. Their freshwater residence time is short and they move rapidly downstream to rear in nearshore marine waters, including estuaries. As juveniles grow they move to more offshore waters, and during summer migrate to oceanic waters. Sub-adults rear in Pacific Ocean areas and likely migrate to North Pacific off British Columbia and Alaska, but migration distances and rearing localities over their multiple years at sea are not well-known. Adults mature and return to natal streams at ages two to five, but most are age three or four.

**Distribution and Abundance**

This ESU includes summer-run chum salmon in rivers draining to Hood Canal and Strait of Juan de Fuca, westward to and including Dungeness River. Two independent populations exist and each includes multiple sub-populations inhabiting separate rivers or creeks. Some sub-populations had been extirpated and overall abundance was at historically low levels by about 1990. Abundance levels have generally increased since 2000, due to implementation of recovery measures, including harvest management, short-term hatchery supplementation, and reintroduction. Extinction risks are likely relatively low currently, but full recovery has not been achieved yet. Reintroductions appear to be succeeding at re-establishing historic distribution, but those sub-population abundances are low.

**Habitat**

The most downstream and lowest gradient areas of rivers and creeks are primary spawning habitats. Spawners enter rivers during typically low flow periods in late summer and early fall, thus adequate water flow and quality need to be maintained. Juveniles spend very little time in natal stream habitats. Estuaries and nearshore areas of Hood Canal, Admiralty Inlet zone of Puget Sound, and Strait of Juan de Fuca are very important early rearing habitats for juveniles prior to Pacific Ocean entry. Sub-adults likely use Pacific Ocean coastal or continental shelf habitats, but oceanic habitats throughout growth period are not well-known.

**References**

Point No Point Treaty Tribes and Washington Department of Fish and Wildlife. 2014. Summer Chum Salmon Conservation Initiative (SCSCI) Five-year Review: Supplemental Report No. 8 of SCSCI - An Implementation Plan to Recover Summer Chum in the Hood Canal and Strait of Juan de Fuca Region. WDFW, Olympia, WA. 237pp.

**Hood Canal Summer Chum Salmon ESU: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Fish and wildlife habitat loss or degradation | Lower river areas, estuarine, and nearshore-marine habitats to some extent have been lost, modified or degraded by agricultural and residential development, and there is threat of further build-out and development. | Land use planning needs. | Current insufficient | Both |
| 2 | Resource information collection needs | Reintroduction programs in several localities need long-term monitoring. | Research, survey or monitoring - fish and wildlife populations. | Current sufficient | WDFW |
| 3 | Climate change and severe weather | Adequate flows during late summer spawn timing are needed. | Land use planning. | Current insufficient | External |
| 4 | Overharvesting of biological resources | Harvest impacts are currently low, but management for low impacts needs to be maintained. | Species and habitat management planning. | Current sufficient | Both |

NOTE: Numbers are for reference only and do not reflect priority.

## LOWER COLUMBIA COHO SALMON ESU (*Oncorhynchus kisutch pop. 1*)

**Conservation Status and Concern**

Washington coho salmon populations in this ESU are dominated by hatchery-origin spawners, are not demonstrably self-sustaining, and considered at very high extinction risk.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| Threatened | None | Yes | G4T2Q | SNR | Low/unknown | Moderate-high |

**Biology and Life History**

Photo: WDFW

Coho salmon in this ESU exhibit 'early' (mid-August to September) and 'late' (late September to October) adult return timing, with peak spawning occurring in late October and in December to early January, for each type respectively. Spawning can extend through February. Historically, early-returning coho spawned in upper reaches of large rivers in lower Columbia sub-basin and in rivers upstream of Cascade Crest (approximately Bonneville Dam), and late-returning coho spawned in smaller rivers or lower reaches of large rivers, with timing adapted to annual flow regimes and elevation. Juveniles usually rear for over a year (e.g., 18 months) in freshwater and move throughout natal river as they grow; some may leave freshwater early and rear in estuarine areas. Most juveniles migrate seaward from March to June, predominately in April and May, during their second year. Sub-adults typically rear for about 18 months in the ocean, inhabiting coastal waters north and south of Columbia River mouth. Ocean rearing locality may be correlated with early and late return-timing types. Most adults are age three at spawning, and some return at age two after 5 to 7 months at sea.

**Distribution and Abundance**

This ESU includes coho salmon in Columbia River tributaries from its mouth up to and including Big White Salmon and Hood rivers and Clackamas River (Willamette sub-basin). Dams in several rivers significantly reduced or eliminated historical distribution. Of 24 historical populations, 17 are in Washington. Coho salmon from 12 Washington artificial propagation programs are included in the ESU. Data on abundance trends for Washington populations are generally only available from 2010 forward, and these show low abundance for wild-born coho overall.

**Habitat**

Adult coho salmon use mainstem and tributary habitats. They often hold in pools in lower river areas prior to rain events that allow access to smaller tributaries upstream. Spawners use stream reaches where gravel sizes are optimal for redd (nest) construction and egg survival. Coho fry use shallow, low velocity areas for rearing, such as stream edges and side channels. During their long-term freshwater rearing, juveniles may move to higher flow areas and disperse into areas inaccessible to adults. Juveniles most often occur in pool rather than riffle habitat. Intact riparian vegetation, in-stream large woody debris and natural floodplain structure are important for juvenile productivity and survival. Summer low-flow conditions may reduce rearing habitat in area and quality (elevated temperature). Optimal freshwater temperature range is 54 to 57$^{o}$ F and temperatures over 77$^{o}$ F may be lethal. Columbia River estuarine areas are used for feeding during seaward migration. Sub-adults rear in Pacific Ocean continental shelf areas predominately off of Washington and Oregon, and to lesser extent off British Columbia and California.

**References**

Ford, M. J. (ed.). 2011. Status review update for Pacific salmon and steelhead listed under the Endangered Species Act: Pacific Northwest. U.S. Dept. Commerce, NOAA Tech. Memo. NMFS-NWFSC-113, 281pp.

Myers, J., C. Busack, D. Rawding, A. Marshall, D. Teel. D. M. Van Doornik, and M. T. Maher. 2006. Historical population structure of Pacific Salmonids in the Willamette River and Lower Columbia River basins. NOAA Tech. Memo. NMFS-NWFSC-73, 311pp.

### Lower Columbia Coho Salmon ESU: Conservation Threats and Actions

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Fish and wildlife habitat loss or degradation | Riverine, riparian, floodplain, and estuarine habitats lost, modified or heavily degraded by agricultural, urban and residential development. | Restore natural instream habitat forming processes and hydrological functions, e.g., remove diking, channelization, water diversions; restore riparian vegetation. Restore estuarine habitats and processes. | Current insufficient | External |
| 2 | Agriculture and aquaculture side effects | Percent of hatchery-origin fish on spawning grounds is often higher than management goal. Threat is loss of natural productivity. | Manage and modify hatchery operations to achieve goals for percent hatchery fish on spawning grounds. | Current Sufficient | WDFW |
| 3 | Fish and wildlife habitat loss or degradation | Habitat loss and degradation due to dams, transportation crossings, culverts, water diversions, shoreline industrial uses. | Dam and barrier removal. | Current insufficient | External |
| 4 | Energy development and distribution | Threat is from dam operations that modify natural hydrological cycle and flows and restrict or eliminate fish passage. | Restore or maintain adequate passage and optimum flows for fish. | Current insufficient | External |
| 5 | Fish and wildlife habitat loss or degradation | Dams impede and prevent passage of adults and juveniles. | Fish passage facilities need to be added or improved in multiple localities. | Current insufficient | External |
| 6 | Overharvesting of biological resources | Annual fishery management processes are required. | Adequate harvest management planning and monitoring. | Current sufficient | Both |

NOTE: Numbers are for reference only and do not reflect priority.

## OZETTE SOCKEYE SALMON ESU (*Oncorhynchus nerka pop. 2*)

**Conservation Status and Concern**

Ozette sockeye salmon are at very low abundance compared to historic condition, and quantity and quality of adequate lake beach spawning habitat may be declining.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| Threatened | Candidate | Yes | G5T2Q | SNR | Low/stable | Moderate |

**Biology and Life History**

Photo: WDFW

Adult sockeye salmon return to Ozette River from April to July, and hold in Ozette Lake between April and January. Spawning, either on lake's beaches or in river and tributary creeks, occurs from October to January. Following emergence in March and April, juveniles migrate to Ozette Lake, where nearly all rear for about a year and then emigrate to the sea the following March through June. During lake rearing they feed on planktonic crustaceans (e.g. *Daphnia* spp.), benthic invertebrates and insects. Ocean distribution and behavior of sub-adults are not well-known, but young fish may use nearshore ocean areas and move offshore as they growth. Ocean rearing may last from 1 to 3 years, but majority rear for about 2 years before returning to spawn. Adult total age ranges from 3 to 5 years, with most being 4 years of age.

**Distribution and Abundance**

This ESU consists of one sockeye salmon population in Ozette River basin on Washington's Pacific coast. Historical abundance was very large, based on peak harvest values, and minimum viable spawning abundance goal for recovery is 35,500. Lowest abundances likely occurred in the 1960's and 1970's. Abundance estimates have been highly variable and uncertain, but methodologies have improved and average annual abundance of returning adults for a recent ten-year period was over 2,500. Current abundance is very low compared to historical levels.

**Habitat**

Ozette Lake is primary habitat for adults and juveniles. Adults hold in lake and spawn on lakeshore beaches, particularly Allen's Beach and Olsen's Beach. Spawning substrates vary from cobble/large gravel to coarse sand and silt, and groundwater upwelling sites appear to be favored spawning sites. Spawners also use tributaries to the lake (e.g., Umbrella Creek, Big River, Crooked Creek) and spawn in gravel riffles and glides and less commonly in pools and side channels. Juvenile reside and feed in the lake throughout their freshwater rearing stage. Migration distances to and from ocean through Ozette River are relatively short. Ocean rearing areas are not well-known, but nearshore and offshore North Pacific waters are likely used.

**References**
Ford, M. J. (ed.). 2011. Status review update for Pacific salmon and steelhead listed under the Endangered Species Act: Pacific Northwest. U.S. Dept. Commerce, NOAA Tech. Memo. NMFS-NWFSC-113, 281pp.
Haggerty, M. J., A. C. Ritchie, J. G. Shellberg, M. J. Crewson, and J. Jalonen. 2009. Lake Ozette Sockeye Limiting Factors Analysis. Prepared for Makah Indian Tribe and NOAA Fisheries in cooperation with Lake Ozette Sockeye Steering Committee, Port Angeles, WA. 565pp.

### Ozette Sockeye ESU: Conservation Threats and Actions

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Fish and wildlife habitat loss or degradation | No cities or towns impacts, but land use or other factors may be affecting quantity and quality of spawning habitats, such as lake beaches. | Research, survey or monitoring - habitat. | | External |
| 2 | Resource information collection needs | Continue adult and juvenile monitoring. | Research, survey or monitoring - fish and wildlife populations. | | External |
| 3 | Agriculture and aquaculture side effects | Management and monitoring of hatchery restoration program needs to be maintained. | Hatcheries (restoration). | | External |

NOTE: Numbers are for reference only and do not reflect priority.

## LOWER COLUMBIA STEELHEAD DPS (*Oncorhynchus mykiss pop. 14*)

**Conservation Status and Concern**

Most populations are rated at high or very high extinction risk, and dams block several large areas of historic range. Habitat degradation and hatchery-related impacts are other limiting factors.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| Threatened | Candidate | Yes | G5T2Q | SNR | Low/stable | Moderate-high |

**Biology and Life History**

Photo: NOAA

Adults in this DPS exhibit winter and summer adult return timing. Winter-run steelhead in mature condition may begin entering natal rivers in early December; spawning occurs typically from early March to early June, with peak in late April/early May. Summer-run steelhead in immature condition begin entering natal rivers in early May and entry extends to October; they mature in freshwater and spawn in following calendar year from January to June, with peak in late February to early April. Adults usually survive spawning and migrate to sea. Some adults, especially females, spawn more than once. Juveniles rear in freshwater for 1 to 4 years, with most rearing for 2 years. Juveniles that migrate seaward do so predominately from April to June, with peak in May; some mature in freshwater without going to sea, more commonly in males than females. Ocean migration paths are not well-documented but sub-adults may rear in central North Pacific Ocean or Gulf of Alaska; rearing typically occurs for 1 to 3 years, with 2 years the most common. Total age at first return to spawn is usually 4 to 6 years.

**Distribution and Abundance**

This DPS includes steelhead in Washington and Oregon Columbia River tributaries from Cowlitz River up to Hood River. In Washington, there are 14 historical winter-run and five historical summer-run populations. Steelhead from four Washington hatchery propagation programs are included in DPS, but hatchery steelhead from non-native and non-local stocks are not. Dams in several rivers have significantly reduced or eliminated historical distribution. Other man-made barriers and habitat alterations further reduce distribution. Current abundance is low compared to historic. Recent analyses indicated that in Washington, only the Wind River summer-run population was considered viable, and most others were at very high or high risk levels.

**Habitat**

Adults use wide variety of freshwater habitats, spawning or holding in river mainstems and large and small tributaries. They migrate relatively far upstream in natal rivers compared to other salmonids and access is aided by flow conditions during migration timing. Redds (nests) are constructed in riffles and downstream margins of pools in streambeds where gravel sizes are optimal. Instream woody debris, boulders and stream bank structure provide important cover. Newly emerged juveniles use shallow gravel bed areas in riffles, among boulders, or near stream banks. As juveniles grow they move to higher water velocity areas and maintain individual territories for feeding. During long-term rearing, juveniles may move throughout watershed, using differing habitats in response to seasonal flow and temperature conditions. Instream cover is important for overwintering juveniles, and intact riparian vegetation is essential for contributing woody debris, supporting invertebrate prey, and shading. Freshwater temperatures over 77$^{o}$ F are expected to be stressful or lethal. Columbia River mainstem is migration corridor. Central North Pacific Ocean and Gulf of Alaska may be marine rearing habitats.

**References**

Ford, M. J. (ed.). 2011. Status review update for Pacific salmon and steelhead listed under the Endangered Species Act: Pacific Northwest. U.S. Dept. Commerce, NOAA Tech. Memo. NMFS-NWFSC-113, 281pp.

Myers, J., C. Busack, D. Rawding, A. Marshall, D. Teel. D. M. Van Doornik, and M. T. Maher. 2006. Historical population structure of Pacific Salmonids in the Willamette River and Lower Columbia River basins. NOAA Tech. Memo. NMFS-NWFSC-73, 311pp.

### Lower Columbia Steelhead DPS: Conservation Threats and Actions

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Fish and wildlife habitat loss or degradation | Riverine, riparian, floodplain, and estuarine habitats lost, modified or heavily degraded by agricultural, urban and residential development. | Restore natural instream habitat forming processes and hydrological functions, e.g., remove diking, channelization, water diversions; restore riparian vegetation. Restore estuarine habitats and processes. | Current insufficient | External |
| 2 | Agriculture and aquaculture side effects | Percent of hatchery-origin fish on spawning grounds is often unknown, and thus it is uncertain if management goals are being met. Threat is loss of natural productivity and diversity. | Manage and modify hatchery operations to achieve goals for percent hatchery fish on spawning grounds. | Current sufficient | WDFW |
| 3 | Fish and wildlife habitat loss or degradation | Habitat loss and degradation due to dams, transportation crossings, culverts, water diversions, shoreline industrial uses. | Dam and barrier removal. | Current insufficient | External |
| 4 | Energy development and distribution | Threat is from dam operations that modify natural hydrological cycle and flows and restrict or eliminate fish passage. | Restore or maintain adequate passage and optimum flows for fish. | Current insufficient | External |
| 5 | Fish and wildlife habitat loss or degradation | Dams impede and prevent passage of adults and juveniles. | Fish passage facilities need to be added or improved in multiple localities. | Current insufficient | External |

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 6 | Resource information collection needs | Monitoring needed that will ascertain proportion of hatchery-origin spawners in annual spawning escapements. | Research, survey or monitoring - fish and wildlife populations. | Current insufficient | WDFW |

NOTE: Numbers are for reference only and do not reflect priority.

## MIDDLE COLUMBIA STEELHEAD DPS (*Oncorhynchus mykiss pop. 17*)

**Conservation Status and Concern**
Many populations are rated at high extinction risk. Dams impede passage and reduce or modify access to large areas of historic range, and other habitat degradation limits distribution and productivity.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| Threatened | Candidate | Yes | G5T2Q | SNR | Intermediate/stable | Moderate |

**Biology and Life History**

Photo: NOAA

Most adults exhibit summer return timing, but winter return timing occurs in several populations. Summer-run steelhead in immature condition begin entering freshwater in late spring, and travel to and enter natal tributaries through summer and fall; they mature in freshwater and spawn in following calendar year usually from early March to early June. Winter-run steelhead enter freshwater in mature condition and may enter natal rivers by early December; their spawn timing may coincide with that of summer-run steelhead. Adults usually survive spawning and migrate to sea afterwards. Some adults, especially females, spawn more than once. Juveniles rear in freshwater for 1 to 5 years, with most rearing for 2 years. Juveniles that migrate seaward do so predominately from March to June; some mature in freshwater without going to sea, more commonly in males than females. Ocean migration paths are not well-documented but sub-adults may rear in North Pacific Ocean or Gulf of Alaska, typically for 1 to 3 years, with 2 the most common. Age at first return to spawn usually ranges from 3 to 6 years.

**Distribution and Abundance**
Steelhead in this DPS occur in Washington and Oregon Columbia River tributaries upstream and exclusive of Wind River (Washington) and Hood River (Oregon), and downstream of Priest Rapids Dam, but excluding Snake River basin. In Washington, extant populations occur in Yakima, Touchet, Walla Walla, and Klickitat rivers and Rock Creek; a remnant White Salmon River population may recover due to dam removal. Dams in several rivers have significantly reduced or eliminated historical distribution. Distribution also is reduced by other man-made passage barriers and habitat alterations from agriculture and other development. Abundance has increased in some areas (Yakima Basin and Walla Walla River) but is low in others. Recent analyses rated a few populations as viable, but the DPS was rated as not viable overall.

**Habitat**
Adults use wide variety of freshwater habitats, spawning or holding in river mainstems and large and small tributaries. They migrate relatively far upstream in natal rivers compared to other salmonids and access is aided by flow conditions during migration timing. Redds (nests) are constructed in riffles and downstream margins of pools in streambeds where gravel sizes are optimal. Instream woody debris, boulders and stream bank structure provide important cover. Newly emerged juveniles use shallow gravel bed areas in riffles, among boulders, or near stream banks. As juveniles grow they move to higher water velocity areas and maintain individual territories for feeding. During long-term rearing, juveniles may move throughout watershed, using differing habitats in response to seasonal flow and

temperature conditions. Instream cover is important for overwintering juveniles, and intact riparian vegetation is essential for contributing woody debris, supporting invertebrate prey, and shading. Freshwater temperatures over 77$^{o}$ F are expected to be stressful or lethal. Columbia River mainstem is migration corridor and is greatly modified by dams and reservoirs. North Pacific Ocean and Gulf of Alaska may be marine rearing habitats.

**References**

Ford, M. J. (ed.). 2011. Status review update for Pacific salmon and steelhead listed under the Endangered Species Act: Pacific Northwest. U.S. Dept. Commerce, NOAA Tech. Memo. NMFS-NWFSC-113, 281pp.

### Middle Columbia Steelhead DPS: Conservation Threats and Actions

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Fish and wildlife habitat loss or degradation | Riverine, riparian, floodplain, and estuarine habitats lost, modified or heavily degraded by agricultural, urban and residential development. | Restore natural instream habitat forming processes and hydrological functions, e.g., remove diking, channelization, water diversions; restore riparian vegetation. Restore estuarine (lower Columbia River) habitats and processes. | Current insufficient | External |
| 2 | Fish and wildlife habitat loss or degradation | Habitat loss and degradation due to dams, transportation crossings, culverts, water diversions, other water extraction. | Dam and barrier removal. | Current insufficient | External |
| 3 | Energy development and distribution | Threat is from dam operations that modify natural hydrological cycle and flows and restrict or eliminate fish passage. | Restore or maintain adequate passage and optimum flows for fish. | Current insufficient | External |
| 4 | Fish and wildlife habitat loss or degradation | Dams impede and prevent passage of adults and juveniles. | Fish passage facilities need to be added or improved in multiple localities. | Current insufficient | External |

NOTE: Numbers are for reference only and do not reflect priority.

## PUGET SOUND STEELHEAD DPS (*Oncorhynchus mykiss pop. 37*)

**Conservation Status and Concern**

In 2011, most populations showed declining growth rates and extinction risks were relatively high overall, especially for central/south Puget Sound populations. Habitat degradation and poor early marine survival may be impeding productivity.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| Threatened | None | Yes | G5T2Q | SNR | Low/declining | Moderate-high |

**Biology and Life History**

Photo: NOAA

Adults exhibit winter and summer return timing. Winter-run are most common. Winter-run adults in mature condition may begin entering rivers in late November; spawning may occur from February to June with peak spawning in April or May. Summer-run adults return to rivers from May to October and mature in freshwater, with spawning occurring in following calendar year from January to May. Some populations contain adults of both return- types, and which likely overlap in spawn-timing. Other exclusively summer-run populations occur upstream of falls or cascades that exclude fish returning in winter due to flows. Adults usually survive spawning and migrate to sea afterwards. Some adults, especially females, spawn more than once. Juveniles rear in freshwater for 1 to 3 years, with most rearing for 2 years. Juveniles that migrate seaward do so predominately in April and May; some mature in freshwater without going to sea, more commonly in males than females. Juvenile mortality in Puget Sound may be relatively high. Ocean migration paths are not well-documented but sub-adults may rear in central North Pacific Ocean or Gulf of Alaska, typically for 1 to 3 years, with 2 years the most common.

**Distribution and Abundance**

This DPS includes steelhead in Washington watersheds draining to Puget Sound, Hood Canal, and the Strait of Juan de Fuca west to and including Elwha River. It includes 32 historical populations. Steelhead in several hatchery programs based on local wild broodstock are included in the DPS, but hatchery steelhead from non-native and non-local stocks are not. Dams in several rivers significantly reduced or eliminated historical distribution, and other man-made barriers (e.g. culverts) further reduce distribution. Current abundance is at very low level compared to historic estimates. Summer-run populations are generally small due to limited habitat and abundance trends are not well-monitored.

**Habitat**

Adult steelhead use wide variety of freshwater habitats, spawning in river mainstems and large and small tributaries. They migrate relatively far upstream compared to other salmonids and access is aided by flow conditions during their return timing. Redds (nests) are constructed in riffles and downstream margins of pools in streambeds where gravel sizes are optimal. Instream woody debris, boulders and stream bank structure provide important cover. Newly emerged juveniles use shallow gravel bed areas in riffles, among boulders, or near stream banks. As juveniles grow they move to higher water velocity areas and maintain individual territories for feeding. During long-term rearing, juveniles may move throughout watershed and use differing habitats in response to seasonal flow and temperature conditions. Instream cover is important for overwintering juveniles, and intact riparian vegetation is essential for contributing woody debris, supporting invertebrate prey, and shading. Freshwater temperatures over 77$^{o}$ F are expected to be stressful or lethal. Central North Pacific Ocean and Gulf of Alaska are likely marine rearing habitats.

**References**


Ford, M. J. (ed.). 2011. Status review update for Pacific salmon and steelhead listed under the Endangered Species Act: Pacific Northwest. U.S. Dept. Commerce, NOAA Tech. Memo. NMFS-NWFSC-113, 281pp.

Myers, J. M., J. J. Hard, E. J. Connor, R. A. Hayman, R. G. Kope, G. Lucchetti, A. R. Marshall, G. R. Pess, and B. E. Thompson. 2015. Identifying historical populations of steelhead within the Puget Sound distinct population segment. U.S. Dept. Commerce, NOAA Tech. Memo. NMFSNWFSC-128.


### Puget Sound Steelhead DPS: Conservation Threats and Actions

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Fish and wildlife habitat loss or degradation | Riverine, riparian, floodplain, estuarine, and nearshore-marine habitats lost, modified or heavily degraded by agricultural, urban and residential development. | Restore natural instream habitat forming processes and hydrological functions, e.g., remove diking, channelization, water diversions; restore riparian vegetation. Restore estuarine and nearshore marine habitats and processes. | Current insufficient | Both |
| 2 | Agriculture and aquaculture side effects | Percent of hatchery-origin fish on spawning grounds is often higher than management goal. Threat is loss of natural productivity. | Manage and modify hatchery operations to achieve goals for percent hatchery fish on spawning grounds. | Current sufficient | Both |
| 3 | Fish and wildlife habitat loss or degradation | Habitat loss and degradation due to dams, transportation crossings, culverts, water diversions, shoreline industrial uses. | Dam and barrier removal. | Current insufficient | External |
| 4 | Energy development and distribution | Threat is from dam operations that modify natural hydrological cycle and flows and restrict or eliminate fish passage. | Restore or maintain optimum flows for fish. | Current insufficient | External |
| 5 | Fish and wildlife habitat loss or degradation | Dams impede and prevent passage of adults and juveniles. | Fish passage facilities need to be added or improved in some localities. | Current insufficient | External |

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 6 | Climate change and severe weather | River scour and excessive sedimentation are threats from high flows and bank/hillsides erosion. | Restoration of forests and adequate forest management to protect channels, stream banks, and floodplains, and reduce effects of heavy rains and high flows. | Current insufficient | External |

NOTE: Numbers are for reference only and do not reflect priority.

## SNAKE RIVER BASIN STEELHEAD DPS (*Oncorhynchus mykiss pop. 13*)

**Conservation Status and Concern**
Extant populations are at moderate to high extinction risk. Dams impede passage, reduce access to large areas of historic range, and limit productivity. Proportions of hatchery-origin spawners are a concern.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| Threatened | Candidate | Yes | G5T2T3Q | SNR | Low/stable | Moderate-high |

**Biology and Life History**


Photo: NOAA

Adults in this DPS exhibit summer return-timing. They enter freshwater in immature condition in late spring, and travel to and enter natal tributaries through summer, fall, and in following spring if they hold through winter in mainstem reservoirs. They mature in freshwater and spawn from February to May in calendar year following Columbia R. entry. Adults usually survive spawning and migrate to sea afterwards. Some adults, especially females, spawn more than once. Juveniles may rear in freshwater for 1 to 3 years, with most rearing for 2 years. Juveniles that migrate seaward do so predominately from March through June; some mature in freshwater without going to sea, more commonly in males than females. Ocean migration paths are not well-documented but sub-adults may rear in North Pacific Ocean or Gulf of Alaska, typically for 1 to 3 years. Age at first return to spawn usually ranges from 3 to 6 years.

**Distribution and Abundance**
Steelhead in this DPS occur in Snake River tributaries in Washington, Oregon, and Idaho. Of 24 extant populations, two are entirely in Washington and two are in watersheds shared by Washington and Oregon. Historical populations likely occurred upstream of impassable Hells Canyon Dam. Asotin River abundance has been stable, but Tucannon River wild-born fish abundance has been low, and population was rated at high risk. Tucannon steelhead monitoring has revealed high proportions of non-local hatchery-origin and non-local wild-born adults entering river. If these remain and spawn, they may affect abundance and productivity of native population. Also, many Tucannon steelhead were found to bypass river during migration, hold in Snake River upstream of Lower Granite Dam, and a proportion did not return downstream (over two dams) to natal river. Populations partially in Washington were at viable or stable status.

**Habitat**
Adult steelhead use wide variety of freshwater habitats, spawning or holding in river mainstems and large and small tributaries. They migrate relatively far upstream in natal rivers and access is aided by flow conditions during migration timing. Redds (nests) are constructed in riffles and downstream margins of pools in streambeds where gravel sizes are optimal. Instream woody debris, boulders and stream bank structure provide important cover. Newly emerged juveniles use shallow gravel bed areas in riffles, among boulders, or near stream banks. As juveniles grow they move to higher water velocity areas and maintain individual territories for feeding. During long-term rearing, juveniles may move throughout watershed, using differing habitats in response to seasonal flow and temperature conditions. Instream cover is important for overwintering juveniles, and intact riparian vegetation is essential for contributing woody debris, supporting invertebrate prey, and shading. Freshwater

temperatures over 77° F are expected to be stressful or lethal. Columbia and Snake rivers are migration corridors (long distances), and are greatly modified by dams and reservoirs. North Pacific Ocean and Gulf of Alaska may be marine rearing habitats.

**References**


Bumgarner, J. D., and J. T. Dedloff. 2011. Lyons Ferry complex hatchery evaluation: summer steelhead annual report 2008 and 2009 run year. Washington Department of Fish and Wildlife, Olympia, WA.

Ford, M. J. (ed.). 2011. Status review update for Pacific salmon and steelhead listed under the Endangered Species Act: Pacific Northwest. U.S. Dept. Commerce, NOAA Tech. Memo. NMFS-NWFSC-113, 281 pp.


### Snake River Basin Steelhead DPS: Conservation Threats and Actions

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Fish and wildlife habitat loss or degradation | Riverine, riparian, floodplain, and estuarine habitats lost, modified or heavily degraded by agricultural, urban and residential development. | Restore natural instream habitat forming processes and hydrological functions, e.g., remove diking, channelization, water diversions; restore riparian vegetation. Restore estuarine (lower Columbia River) habitats and processes. | Current insufficient | External |
| 2 | Fish and wildlife habitat loss or degradation | Habitat loss and degradation due to dams, transportation crossings, culverts, water diversions, other water extraction. | Dam and barrier removal. | Current insufficient | External |
| 3 | Energy development and distribution | Threat is from dam operations that modify natural hydrological cycle and flows and restrict or eliminate fish passage. | Restore or maintain adequate passage and optimum flows for fish. | Current insufficient | External |
| 4 | Fish and wildlife habitat loss or degradation | Dams impede and prevent passage of adults and juveniles. | Fish passage facilities need to be added or improved in multiple localities. | Current insufficient | External |

| | | | | | |
|---|---|---|---|---|---|
| 5 | Agriculture and aquaculture side effects | Percent of hatchery-origin fish on spawning grounds need to be well-monitored and managed so that management goals for wild fish productivity are met. Threat is loss of natural productivity and diversity. | Manage and modify hatchery operations to achieve goals for percent hatchery fish on spawning grounds. | Current sufficient | Both |

NOTE: Numbers are for reference only and do not reflect priority.

## UPPER COLUMBIA STEELHEAD DPS (*Oncorhynchus mykiss pop. 12*)

**Conservation Status and Concern**

Extant populations are rated at high extinction risk. Dams impede passage and reduce access to large areas of historic range, and limit productivity. Proportions of hatchery-origin spawners are a concern.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| Threatened | Candidate | Yes | G5T2Q | SNR | Low/increasing | Moderate-high |

**Biology and Life History**


Photo: NOAA

Steelhead in this DPS exhibit summer adult return timing. They enter freshwater in immature condition in late spring, and travel to and enter natal tributaries through summer, fall, and in following spring, if they hold through winter in mainstem reservoirs. They mature in freshwater and spawn from early March to mid-July in calendar year following Columbia River entry. Adults usually survive spawning and migrate to sea afterwards. Some adults, especially females, spawn more than once. Juveniles may rear in freshwater for 1 to 5 years, with most rearing for 2 years. Juveniles that migrate seaward do so predominately from March through June; some mature in freshwater without going to sea, more commonly in males than females. Ocean migration paths are not well-documented but sub-adults may rear in North Pacific Ocean or Gulf of Alaska, typically for 1 to 3 years. Total age at first return to spawn usually ranges from 3 to 6 years.

**Distribution and Abundance**

Steelhead in this DPS occur in Columbia River tributaries upstream and exclusive of Yakima River to the U.S./Canada border. Several tributaries upstream of impassable Chief Joseph and Grand Coulee dams could have historically supported additional populations. Steelhead in six artificial propagation programs are included in DPS. Dams, other man-made passage barriers and habitat alterations from land uses significantly reduced, modified or eliminated historical distribution. Barriers and land use impacts (e.g., irrigation) are being corrected in several rivers following Recovery Plan. Although total annual spawner abundance generally has increased in last 10 years, proportions of wild-born adults remain well below recovery goals. The four extant populations were last rated at high extinction risk.

**Habitat**

Adult steelhead use wide variety of freshwater habitats, spawning or holding in river mainstems and large and small tributaries. They migrate relatively far upstream in natal rivers compared to other salmonids and access is aided by flow conditions during migration timing. Redds (nests) are constructed in riffles and downstream margins of pools in streambeds where gravel sizes are optimal. Instream woody debris, boulders and stream bank structure provide important cover. Newly emerged juveniles use shallow gravel bed areas in riffles, among boulders, or near stream banks. As juveniles grow they move to higher water velocity areas and maintain individual territories for feeding. During long-term rearing, juveniles may move throughout watershed, using differing habitats in response to seasonal flow and temperature conditions. Instream cover is important for overwintering juveniles, and intact riparian vegetation is essential for contributing woody debris, supporting invertebrate prey, and shading. Freshwater temperatures over 77$^{o}$ F are expected to be stressful or lethal. Columbia River mainstem is migration corridor (long distance) and is greatly modified by dams and reservoirs. North Pacific Ocean and Gulf of Alaska may be marine rearing habitats.

**References**

Ford, M. J. (ed.). 2011. Status review update for Pacific salmon and steelhead listed under the Endangered Species Act: Pacific Northwest. U.S. Dept. Commerce, NOAA Tech. Memo. NMFS-NWFSC-113, 281pp.

### Upper Columbia Steelhead DPS: Conservation Threats and Actions

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Fish and wildlife habitat loss or degradation | Riverine, riparian, floodplain, and estuarine habitats lost, modified or heavily degraded by agricultural, urban and residential development. | Restore natural instream habitat forming processes and hydrological functions, e.g., remove diking, channelization, water diversions; restore riparian vegetation. Restore estuarine (lower Columbia River) habitats and processes. | Current insufficient | External |
| 2 | Fish and wildlife habitat loss or degradation | Habitat loss and degradation due to dams, transportation crossings, culverts, water diversions, other water extraction. | Dam and barrier removal. | Current insufficient | External |
| 3 | Energy development and distribution | Threat is from dam operations that modify natural hydrological cycle and flows and restrict or eliminate fish passage. | Restore or maintain adequate passage and optimum flows for fish. | Current insufficient | External |
| 4 | Fish and wildlife habitat loss or degradation | Dams impede and prevent passage of adults and juveniles. | Add or improve fish passage facilities in multiple localities. | Current insufficient | External |
| 5 | Agriculture and aquaculture side effects | Percent of hatchery-origin fish on spawning grounds need to be well-monitored and managed so that management goals for wild fish productivity are met. Threat is loss of natural productivity and diversity. | Manage and modify hatchery operations to achieve goals for percent hatchery fish on spawning grounds. | Current sufficient | Both |

NOTE: Numbers are for reference only and do not reflect priority.

## BULL TROUT – COASTAL RECOVERY UNIT (*Salvelinus confluentus pop. 3*)

**Conservation Status and Concern**
Many of the Washington core area populations have unknown status. Bull Trout face threats from habitat degradation and fragmentation, poor water quality, and introduced non-native fish species.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| Threatened | Candidate | Yes | G4T2Q | SNR | Unknown/unknown | Moderate-high |

**Biology and Life History**
Bull Trout in this DPS exhibit migratory (anadromous and amphidromous) and resident (adfluvial and fluvial) life history forms. They spawn in headwater streams and rivers from late summer to late fall, with falling water temperatures between 41 to 48° F., and may spawn each year or in alternate years. Eggs hatch in late winter or early spring. Fry emerge from gravel in April or May. Most information indicates that sexual maturity is attained in 4 to 7 years. They require colder waters than other trout species. Small Bull Trout eat terrestrial and aquatic insects, and shift to preying on fish as they grow larger. Large Bull Trout are primarily fish predators. Resident and migratory forms may be found together, and either form may produce offspring with either life history strategy.

Photo: Roger Tabor, USFWS

**Distribution and Abundance**
Bull Trout in this Recovery Unit occur in Washington and Oregon watersheds west of the Cascade Mountains crest. In Washington, there are 16 core areas (habitat/population units) designated that include multiple populations. One historic core area, White Salmon River, was designated. Most core areas are in Puget Sound and Olympic Peninsula drainages, and two are in Columbia River drainages. Four core areas, Lower Skagit, Upper Skagit, Quinault River, and Lewis River, have been identified as current strongholds and likely have most stable and abundant populations in Recovery Unit. Bull Trout are reported as extirpated from White Salmon, lower Nisqually, and Satsop rivers, but these may not be only Washington extirpated localities in this Unit. Only a few populations are regularly monitored to estimate spawner abundance.

**Habitat**
Habitat includes deep pools in cold rivers and large tributary streams, often in moderate to fast currents, and large, cold lakes and reservoirs. Conditions that favor population persistence include stable channels, relatively stable stream flow, low levels of fine substrate sediments, high channel complexity with various cover types, and temperatures not exceeding about 59° F. Suitable migratory corridors between seasonal habitats and for genetic exchange among populations are needed. Spawning usually occurs in gravel riffles of small tributary streams, including lake inlet streams, with sites often associated with springs and upwelling groundwater. Optimum temperatures for incubation are about 36 to 39° F., and for juvenile rearing, about 45 to 46° F. Abundance of large woody debris and rubble substrate are important for rearing habitat.

**References**

USFWS. 2014. Revised draft recovery plan for the coterminous United States population of bull trout (*Salvelinus confluentus*). Portland, Oregon. xiii + 151pp.

WDFW. 2004. Washington State Salmonid Stock Inventory- Bull Trout/Dolly Varden. Washington Department of Fish and Wildlife, Olympia, WA. 449pp.

**Bull Trout - Coastal Recovery Unit: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Fish and wildlife habitat loss or degradation | Spawning and resident habitat has been destroyed or is threatened by urbanization, fisheries management activities, agriculture practices, mining, residential development, livestock grazing, dams and logging practices. | Even though many protective measures have taken place, currently-used spawning and resident habitat needs to be protected from degradation. | Current sufficient | Both |
| 2 | Invasive and other problematic species and genes | Introgression with hatchery-released eastern brook trout is a primary threat to Bull Trout in some waters. | Hatchery stocking of brook trout in drainages where Bull Trout are known to reside has been curtailed. Reducing existing numbers of brook trout where applicable/possible would be prudent. | Current insufficient | Both |
| 3 | Overharvesting of biological resources | Not 'accidental mortality' but intentional poaching of vulnerable fish during spawning season and other times of the year. | Increase law enforcement patrols of Bull Trout habitat during spawning season and close motor vehicle access to sensitive areas. | Current insufficient | Both |
| 4 | Climate change and severe weather | Potential climate change effects include increased water temperatures, which may have negative temporal and spatial impacts. | Restoration of forests and adequate forest management to protect riparian cover and restore landscape-level hydrology. | | External |

NOTE: Numbers are for reference only and do not reflect priority.

## BULL TROUT – MID-COLUMBIA RECOVERY UNIT (*Salvelinus confluentus pop. 2*)

**Conservation Status and Concern**

Many of the Washington core area populations have unknown status. Bull Trout face threats from habitat degradation and fragmentation, poor water quality, and introduced non-native fishes.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| Threatened | Candidate | Yes | G4T2Q | SNR | Unknown/unknown | Moderate |

**Biology and Life History**

Photo: Roger Tabor, USFWS

Bull Trout in this DPS exhibit resident, adfluvial and fluvial life history forms. They spawn in headwater streams and rivers from late summer to late fall, with falling water temperatures between 41 to 48° F., and may spawn each year or in alternate years. Eggs hatch in late winter or early spring. Fry emerge from gravel in April or May. Most information indicates that sexual maturity is attained in 4 to 7 years. They require colder waters than other trout species. Small Bull Trout eat terrestrial and aquatic insects, and shift to preying on fish as they grow larger. Large Bull Trout are primarily fish predators. Resident and riverine migratory forms may co-occur, and each form produces offspring with either life history strategy.

**Distribution and Abundance**

Bull Trout in this Recovery Unit occur in Washington, Oregon and Idaho watersheds of the Columbia Basin east of the Cascade Mountains crest. In Washington, there are seven core areas (habitat/population units) designated, and Washington shares two other core areas with Oregon. Core areas may include multiple populations. The Okanogan River is recognized as foraging, migrating, and overwintering habitat. Bull Trout have been extirpated from Lake Chelan. The area upstream from Chief Joseph Dam is currently unoccupied by Bull Trout. Asotin Creek core area was as rated one of the least robust (most threatened). Some populations are regularly monitored, especially in the Yakima River core area, for spawner abundance, but total population abundance estimates are not made.

**Habitat**

Habitat includes deep pools in cold rivers and large tributary streams, often in moderate to fast currents, and large, cold lakes and reservoirs. Conditions that favor population persistence include stable channels, relatively stable stream flow, low levels of fine substrate sediments, high channel complexity with various cover types, and temperatures not exceeding about 59° F. Suitable migratory corridors between seasonal habitats and for genetic exchange among populations are needed. Spawning usually occurs in gravel riffles of small tributary streams, including lake inlet streams, with sites often associated with springs and upwelling groundwater. Optimum temperatures for incubation are about 36 to 39° F., and for juvenile rearing, about 45 to 46° F. Abundance of large woody debris and rubble substrate are important for rearing habitat.

**References**
Scholz, A. T. and H. J. McLellan. 2009. Field Guide to the Fishes of Eastern Washington. Eagle Printing, Cheney, Washington. 310pp.
USFWS. 2014. Revised draft recovery plan for the coterminous United States population of bull trout (*Salvelinus confluentus*). Portland, Oregon. xiii + 151pp.
USFWS. 2012. Species Fact Sheet, Bull Trout, *Salvelinus confluentus*. 4pp.
WDFW. 2004. Washington State Salmonid Stock Inventory. Bull Trout/Dolly Varden. Washington Department of Fish and Wildlife, Olympia, WA. 449pp.

### Bull Trout - Mid-Columbia Recovery Unit: Conservation Threats and Actions

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Fish and wildlife habitat loss or degradation | Spawning habitat has been destroyed or is threatened by development, mining and logging practices. | Acquisition of cold headwater spawning habitat could be one solution to protecting it. | Current insufficient | Both |
| 2 | Overharvesting of biological resources | Spawning habitat and spawning fish have been damaged/poached-killed by individuals that have easy (motor vehicle) access to the stream's edge. | Increase law enforcement patrols of Bull Trout habitat during spawning season and close motor vehicle access to sensitive areas. | Current insufficient | Both |
| 3 | Invasive and other problematic species and genes | Introgression with hatchery-released eastern brook trout and brown trout is a primary threat to Bull Trout in some waters. | Hatchery stocking of brook trout and brown trout in drainages where Bull Trout are known to reside has been curtailed. Reducing existing numbers of these nonnatives where applicable/possible would be prudent. | Current insufficient | Both |
| 4 | Climate change and severe weather | Potential climate change effects include increased water temperatures, which may have negative temporal and spatial impacts. | Restoration of forests and adequate forest management to protect riparian cover and restore landscape-level hydrology. | | External |

NOTE: Numbers are for reference only and do not reflect priority.

## INLAND REDBAND TROUT (*Oncorhynchus mykiss gairdneri*)

**Conservation Status and Concern**

Species is widespread, but some populations are at risk from non-native hatchery trout competition and interbreeding. Water quality issues threaten most locations, and barriers fragment populations.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| None | None | Yes | G5T4 | SMR | Unknown/unknown | Moderate-high |

**Biology and Life History**


Photo: Courtesy USFWS

Inland Redband Trout have three history forms; resident, fluvial, and adfluvial. The resident form tends to live out its life in small tributaries and headwater streams. The fluvial form lives most of its life cycle in large rivers and streams before returning to its natal small tributary or headwater stream to spawn. The adfluvial form spends most of its life cycle in a lake or reservoir before returning to its natal headwater stream or tributary to spawn. One to three years after hatching, the juveniles will migrate to the lake or reservoir to mature. Fluvial Inland Redband Trout will migrate to overwintering areas within their streams in the fall. Spawning normally occurs between February and June, depending on the water temperature and location. Diet consists of zooplankton, benthic macroinvertebrates, fish eggs, and occasionally other fishes, depending on life history form and life stage.

**Distribution and Abundance**

Inland Redband Trout historically occurred in the mid- and upper-Columbia River drainages east of the Cascade Mountains crest from above Celilo Falls (now submerged) to barrier falls on the Snake, Spokane and Pend Oreille rivers. It has been reported that current distribution in Washington is approximately 11 percent of the former range. Although population sizes are unknown for most of their Washington distribution, they are presumed stable. Several populations have been identified in northeastern Washington but a comprehensive inventory has not been completed.

**Habitat**

Inland Redband Trout prefer the clear, clean, cold water of headwater streams, creeks, small to large rivers, and lakes with lots of dissolved oxygen. Prime habitat consists of an array of riffles, pools, submerged wood, boulders, undercut banks, and aquatic vegetation. Winter habitat includes deep pools with extensive amounts of cover in third-order mountain streams. Summer surveys indicated that low-gradient, medium-elevation reaches with an abundance of complex pools are critical areas for production.

**References**


Behnke, R. J. 1992. Native trout of western North America. American Fisheries Society Monograph 6, Bethesda, MD. 275pp.

May, B. E., B. J. Writer, and S. Albeke. 2012. Redband Status Update Summary. Prepared by Wild Trout Enterprises, LLC, Bozeman, MT.

Muhlfeld, C. C., D. H. Bennett, and B. Marotz. 2001. Fall and winter habitat use by Columbia River redband trout in a small stream in Montana. N. Amer. Jour. Fisheries Management 21:170-177.

Scholz, A. T. and H. J. McLellan. 2009. Field Guide to the Fishes of Eastern Washington. Eagle Printing, Cheney, WA. 310pp.
Staley, K and J. Mueller. 2000. Rainbow trout (*Oncorhynchus mykiss)*. Fish and Wildlife Habitat Management Leaflet. Number 13.
Wydoski, R. S. and R. R. Whitney 2003. Inland Fishes of Washington, second edition. University of Washington Press, Seattle, WA. 322 pp.

**Inland Redband Trout: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Resource information collection needs | Although there are distribution data available, more are needed to accurately assess current status. Western Native Trout Initiative (WNTI) holds the communal database. | Continued survey data and genetic samples need to be collected. | Current insufficient | Both |
| 2 | Coordination/ Administration Needs | Complacency with both the current understanding of redband trout and the coordination of all agencies collecting data on redband trout could be considered a threat. | Continued and expanded coordination between agencies and tribes that collect redband trout data. | Current insufficient | Both |
| 3 | Invasive and other problematic species and genes | Introgression with hatchery-released non-native rainbow trout is a primary threat to Inland Redband Trout genetic integrity. | Stop hatchery stocking in waters where Inland Redband Trout are known to reside. | Current insufficient | Both |
| 4 | Agriculture and aquaculture side effects | Habitat degradation due to farming practices and crop production. | Farmer-targeted outreach to see if new crop culture practices could help reduce impact to fish populations. | Current insufficient | Both |
| 5 | Agriculture and aquaculture side effects | Habitat degradation due to ranching and stock-grazing practices. | Work with ranchers to fence riparian areas to prevent stock animals and waste from entering streams. | Current insufficient | Both |
| 6 | Energy development and distribution | Habitat loss due to dam construction. | Dam removal is unlikely. We identified the problem but there might not be a solution to this one. | Current insufficient | Both |

| | | | | | |
|---|---|---|---|---|---|
| 7 | Agriculture and aquaculture side effects | Habitat degradation due to farming practices and crop production. | Use existing plant culture practices that reduce impact to local fish populations. | Current insufficient | Both |

NOTE: Numbers are for reference only and do not reflect priority.

## WESTSLOPE CUTTHROAT TROUT (*Oncorhynchus clarkii lewisi*)

**Conservation Status and Concern**
Westslope Cutthroat Trout is stable and abundant in its range, but faces threats to its habitat and threats from genetic introgression.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| Species of Concern | None | Yes | G4T3 | SNR | Medium/stable | Low-moderate |

**Biology and Life History**


Photo: Courtesy USGS

Westslope Cutthroat Trout have three life-history forms- adfluvial, fluvial, and resident, and all forms may occur within a single basin. Adfluvial fish live in lakes and spawn in its tributaries. They will occupy all lake habitats if no other trout species are present, otherwise, they segregate in nearshore, littoral areas. Fluvial fish reside in rivers and migrate to tributaries to spawn. Resident fish spend entire life in tributaries. Spawning occurs mainly in small headwater tributaries from March to July at water temperatures near 50°F. Fish tend to spawn in their natal stream. Fluvial and adfluvial forms usually return to rivers or lakes, but some remain in tributaries during summer. Juveniles begin to mature at age 3 years, but usually spawn for first time at age 4 or 5 years. Maturing adfluvial fish move to vicinity of tributaries in fall and winter, and begin to migrate upstream in spring. Adults and juveniles are opportunistic feeders, but primarily forage on insects and invertebrates.

**Distribution and Abundance**
In Washington, this species historically occurred in Lake Chelan and Methow River basins and in headwaters of Pend Oreille River, and was abundant in Lake Chelan Basin and Pend Oreille River. Naturally self-sustaining populations were found in almost every eastern-draining Cascade Mountain Columbia River subbasin (e.g., Yakima, Wenatchee, and Entiat) above 3,000 feet during 1990s surveys. Some of these may be due to stocking of hatchery fish into barren alpine lakes and streams. In western Washington, they have been reported in a few western Cascade Mountains drainages, such as tributaries to Skagit River and North Fork Skykomish River, South Fork Tolt River, and tributaries in Cowlitz Basin, but it is thought these resulted from releases of an eastern Washington hatchery stock. This species is abundant and stable in Washington.

**Habitat**
Habitats include small mountain streams, mainstem rivers, and large natural lakes. In rivers, adults prefer large pools and slow velocity areas. Stream reaches with numerous pools and some form of cover generally have highest densities. In lakes they often occur near shoreline areas. Preferred spawning habitat is small gravel substrates and mean water depths from 6.7 to 7.9 inches. Many fry disperse downstream after emergence. Juveniles of migratory populations may spend 1 to 4 years in natal streams, then move to a mainstem river or lake where they remain until they spawn. Juveniles tend to overwinter in interstitial spaces in stream substrates. Larger individuals congregate in deeper pools in winter. Resident fish tend to inhabit tributary shoreline areas in summer and overwinter in pools. Cool, clean, well-oxygenated water is essential.

**References**


Behnke, R. J. 1992. Native trout of western North America. American Fisheries Society Monograph 6. 275pp.

McIntyre, J. D. and B. E. Rieman. 1995. Westslope cutthroat trout. Pages 1-15 in Young, M. K., editor. Conservation assessment for inland cutthroat trout. USDA, Forest Service, Rocky Mountain Forest and Range Experiment Station General Technical Report RM-256, Fort Collins, CO.

Williams, K. R. 1999. Washington westslope cutthroat status report. Washington Department of Fish and Wildlife, Olympia, WA. 14pp. plus Appendices.

Wydoski, R. S. and R. R. Whitney. 2003. Inland Fishes of Washington, second edition, University of Washington Press, Seattle, WA. 322pp.


## Westslope Cutthroat Trout: Conservation Threats and Actions

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Coordination/ administration needs | Complacency with both current understanding of species, and the coordination of all agencies collecting data on it could be considered a threat. | Continue to expand the distribution, habitat and genetic database for this species, with all interested agencies and tribes. | Current insufficient | Both |
| 2 | Invasive and other problematic species and genes | Even though many populations are stable, introgression with hatchery-released fish is a primary threat to species. | Stop hatchery stocking in waters where species is known to reside. | Current insufficient | Both |
| 3 | Fish and wildlife habitat loss or degradation | As with the other species, habitat fragmentation and degradation, due to various types of development is a constant threat to Westslope Cutthroat Trout. | Continued stewardship of spawning and residential habitat is needed to maintain current population rigor. | Current insufficient | Both |

NOTE: Numbers are for reference only and do not reflect priority.

# FRESHWATER FISH

## BURBOT (*Lota lota*)

**Conservation Status and Concern**

Burbot are restricted to only 11 deep, cold-water lakes in Washington. Little is known about abundance, age structure, or productivity of any of the populations.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| None | None | No | G5 | S3 | Unknown/unknown | Moderate |

**Biology and Life History**

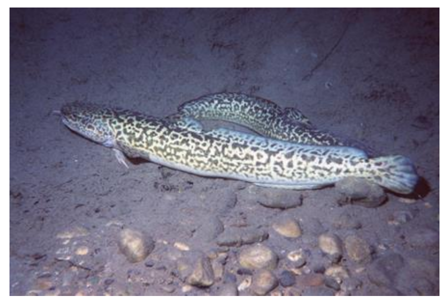

Photo: E. Keeley

Burbot is the only member of codfish family (*Gadidae*) inhabiting freshwater. Spawning occurs in late winter/early spring in Washington lakes when water temperature is about 35$^{o}$F. Individuals spawn annually or in alternate years. Eggs hatch in about a month. Young eat mainly immature aquatic insects, crayfish, mollusks, and other deepwater invertebrates. Larger individuals feed mostly on fishes. They usually become sexually mature in 3 to 4 years (males) or 4 to 5 years (females). Burbot are large with maximum length up to 33 inches, and maximum weight up to 33 pounds. The oldest Burbot recorded in Washington (gill net caught in Keechelus Lake, upper Yakima Basin) was age 19 years and was 29 inches long. Burbot over age 10 are common in Washington lakes. Little is known about population-specific abundance, age structure, or productivity.

**Distribution and Abundance**

Burbot are restricted to only 11 deep, cold-water lakes in Washington. Six lakes/reservoirs are in northern Columbia Basin (Osoyoos, Palmer, Chelan, Rufus Woods, Banks, and Roosevelt). Three lakes/reservoirs constructed on ancestral lakes are in upper Yakima Basin (Keechelus, Kachess and Cle Elum), and two lakes are in Pend Oreille region (Sullivan, Bead). No Burbot have been documented in western Washington. Of the eleven Washington lake populations evaluated in 1997, only one (Lake Roosevelt) was rated as “healthy”, nine were rated as “unknown” status (relative to abundance and productivity), and one (Banks Lake) was rated “critical”. This assessment 17 years ago did not provide adequate population trend data, or other data (size/age structure, productivity) needed for fishery management.

**Habitat**

In Washington, Burbot are found in deep (200 feet and greater), cold waters of lakes, reservoirs, and large rivers. In summer, stays close to the bottom in deep, cold waters, but may move into shallower water at night. Moves into shallow water in the winter when lakes are homothermous. In spawning, Burbot broadcast eggs usually over sand or gravel (sometimes silt) substrates in up to about 10 feet of water.

**References**
Bonar, S. A., L. G. Brown, P. E. Mongillo and K. Williams. 1997. Status of Burbot in Washington State. Wash. Dept. of Fish and Wildlife Research Report. 51pp.
NatureServe Explorer http://explorer.natureserve.org
Wydoski, R. S., and R. R. Whitney. 2003. Inland Fishes of Washington. 2nd edition. University of Washington Press, Seattle, WA. 322pp.

**Burbot: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Resource information collection needs | Inadequate data for population trend, size range, age structure, and productivity. | Research, survey or monitoring - fish and wildlife populations. | Current insufficient | WDFW |
| 2 | Fish and wildlife habitat loss or degradation | Reservoir water and habitat management effects on Burbot are unknown. | Research whether Burbot are entrained and killed by dam and reservoir facilities or management of those facilities and determine the effect of lack of fish passage on Burbot. | | External |
| 3 | Overharvesting of biological resources | Burbot are harvested but no harvest assessment of impacts to populations are done. | Research, survey or monitoring - utilization. | Current insufficient | WDFW |

NOTE: Numbers are for reference only and do not reflect priority.

## LAKE CHUB (*Couesius plumbeus*)

### Conservation Status and Concern
The status of this species is unknown and its major threat is habitat alteration.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| None | Candidate | Yes | G5 | S2S3 | Unknown/unknown | Moderate |

### Biology and Life History
The Lake Chub spawns in spring and summer. Eggs hatch in about 10 days. They become sexually mature in their third or fourth year. They sometimes occur in large schools. This species may migrate up to 1 mile between separate spawning and non-spawning habitats. Lake Chub probably do not live more than 5 years and may grow as large as 6 inches.


Photo: K. P. Schmidt, National Park Service

### Distribution and Abundance
In Washington, Lake Chub are found in the Columbia River system. They have been found in Cedar Lake (Stevens County) and the North Fork of Beaver Creek (Okanogan County). There was a documented occurrence west of the Cascade mountains in Twin Lake (Snohomish County) in the 1950s, but it is has likely been extirpated. Its distribution appears to be sparse in Washington and its status is unknown.

### Habitat
This species occurs in varied habitats, including standing or flowing water, and large or small bodies of water. It is most common in gravel-bottomed pools and stream reaches, and along rocky lake margins. It is more common in lakes in the southern part of the range, mostly in rivers in the north (but in lakes if available). Often it occurs in shallows but may move into deeper parts of lakes in summer. Spawning occurs in river shallows, along rocky shores, in shoals of lakes.

#### References

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Wydoski, R. S., and R. R. Whitney. 2003. Inland Fishes of Washington. 2nd edition. University of Washington Press, Seattle, WA. 322pp.

**Lake Chub: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Resource information collection needs | Listed as a "State Candidate Species" in Washington. Spotty distribution makes it vulnerable to population decline. Not enough data on distribution and status. | Periodic surveys to monitor status: increasing or declining. | Current insufficient | WDFW |
| 2 | Fish and wildlife habitat loss or degradation | Loss of habitat from human development merits further surveys and protection of some kind. | Periodic surveys to determine what habitat is currently being used and to document rate of habitat loss. | Current insufficient | WDFW |
| 3 | Resource information collection needs | A paucity of current information on distribution, status, and type of habitat use. | Field surveys are needed to determine current distribution, status and habitat use. | Current insufficient | WDFW |

NOTE: Numbers are for reference only and do not reflect priority.

## TUI CHUB (*Siphateles bicolor*)

### Conservation Status and Concern
This species is confined to a small part of the Columbia Basin and its biggest threat is predation by non-native predators.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| None | None | No | G4 | S2S3 | Unknown/unknown | Low-moderate |

### Biology and Life History


Photo: USDA Forest Service

Adult fish of all ages and sizes school together, while juveniles of same year class often school together. They inhabit lakes and slow-moving streams. They migrate to shallow water in the spring, but stay in deeper water in winter. Tui Chub first spawn at age 3 years and spawning takes place during late April to late June in areas with abundant aquatic vegetation. Multiple spawning by one female may be common. Eggs hatch in 10 to 12 days. Juveniles feed first on diatoms, rotifers, desmids, and other plankton, then transition to larger zooplankton. Adults feed on plankton, insects, crustaceans, and fish larvae and fry (including their own). In streams they will prey on various benthic organisms. Young fish are prey of large trout and introduced warm-water fish species.

### Distribution and Abundance
Tui Chub are native to the Columbia Basin in central Washington, which is northernmost part of the species' range. In Washington, Tui Chub are confined to reservoirs, ponds, potholes, and warm, slow-moving reaches of lower Crab Creek, an upper Columbia River tributary. They are common to abundant in several Adams County interconnected lakes (McMannaman, Morgan, Half Moon, Hutchinson, and Shiner).

### Habitat
This species usually occurs in weedy shallows of lakes or in mud- or sand-bottomed pools of slow-moving headwaters, creeks, and small to medium rivers. In lakes, Tui Chub spend winter in deep water, and move to shallow water in spring. In summer, this chub also occurs in deep water and in surface waters over deep water. Spawning usually occurs in shallow water where eggs settle to the bottom or adhere to aquatic vegetation. Young remain close to shore near heavy vegetation for most of summer.

#### References

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**Tui Chub: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Fish and wildlife habitat loss or degradation | Even though Tui Chub is known to overpopulate in some cases, lake rehabilitations have lowered numbers in Hutchinson and Shiner Lakes. | Need assessment surveys near Crab Creek and discontinue rehabilitations in waters where they are found. | Current insufficient | WDFW |
| 2 | Invasive and other problematic species and genes | Because of limited distribution, predation by non-native fish could have a significant impact in Washington. | It is difficult to control predation. Action unknown at this time. | Current insufficient | WDFW |

NOTE: Numbers are for reference only and do not reflect priority.

## LEOPARD DACE (*Rhinichthys falcatus*)

**Conservation Status and Concern**

The status of this species is unknown and it faces threats to its habitat.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| None | Candidate | Yes | G4 | S2S3 | Unknown/unknown | Moderate-high |

**Biology and Life History**

Photo: from Wydoski and Whitney 2003

Leopard Dace spawn between May and July. Several males may spawn with one female. The average life span is probably 3 to 4 years, but could be as long as 7 years. The spawning habitat is probably similar to that of other dace that spawn in stream riffles. Young-of-the year feed on aquatic insect larvae. Yearlings feed on aquatic insects during the summer and in the fall switch to terrestrial insects. Adults feed on aquatic insect larvae, terrestrial insects, and earthworms.

**Distribution and Abundance**

Population size and status are unknown. Distribution is spotty within the Columbia River Basin, and in Washington it is found in lower, mid, and upper Columbia River mainstem and tributaries, such as Yakima and Similkameen rivers, and in Snake River.

**Habitat**

Leopard Dace are usually found in streams, but can also occur in lakes. In streams, it prefers slow to moderate current and is associated with stone substrate covered by fine sediments. In creeks and small to medium rivers, the preferred habitat is flowing pools and gravel runs. They are usually found in slow-moving current, but in greater currents than used by Umatilla Dace, and in slower, deeper water than used by longnose dace. In lakes, Leopard Dace prefer rocky margins.

**References**


Page, L. M., and B. M. Burr. 1991. A field guide to freshwater fishes. Houghton Mifflin Co., Boston, MA. 432pp.

Wydoski, R. S., and R. R. Whitney. 2003. Inland Fishes of Washington. 2nd edition. University of Washington Press, Seattle, WA. 322pp.

**Leopard Dace: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Resource information collection needs | Listed as a "State Candidate Species" in Washington. Spotty distribution makes it vulnerable to population decline. Not enough data on distribution and status. | Periodic surveys to monitor status: increasing or declining. | Current insufficient | WDFW |
| 2 | Fish and wildlife habitat loss or degradation | Loss of habitat from human development merits further surveys and protection of some kind. | Periodic surveys to determine what habitat is currently being used and to document rate of habitat loss. | Current insufficient | WDFW |
| 3 | Resource information collection needs | A paucity of current information on distribution, status, and type of habitat use. | Field surveys are needed to determine current distribution, status and habitat use. | Current insufficient | WDFW |

NOTE: Numbers are for reference only and do not reflect priority.

## UMATILLA DACE (*Rhinichthys umatilla*)

**Conservation Status and Concern**

This species' status is unknown and it faces threats from human development and habitat alterations.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| None | Candidate | Yes | G4 | S2 | Unknown/unknown | Moderate |

**Biology and Life History**

Spawning probably takes place in early to mid-July. Food preferences are unknown, but presumed to be similar to other dace that feed primarily on insect larvae. The closely-related *R. osculus* is a benthic feeder and its young are primarily planktivores, while adults feed mainly on aquatic insects, fresh-water shrimp, plant material and zooplankton. Maximum size Umatilla dace can reach is about is 3 inches, and average life span is probably 3 to 4 years, but could be as long as 8 years.

Photo: Paul Mongillo, WDFW

**Distribution and Abundance**

This species occurs in Columbia Basin, east of Cascade Mountains crest. In Washington, it has been reported in the Columbia, Yakima, Okanogan, Similkameen, Kettle, Colville, and Snake rivers, and also may occur in the Methow and Wenatchee rivers. This species has experienced extensive habitat loss due to hydroelectric dams.

**Habitat**

Umatilla Dace are benthic fish that occur in relatively productive, lower elevation streams. They seem to prefer cover provided by cobbles and larger stones where current is fast enough to prevent siltation. They are most often captured along river banks at depths less than 3 feet, but larger fish tend to occupy deeper habitats. The species is absent from colder, mountain tributaries. They have been found in reservoirs where there is a rocky bottom and a noticeable current. Like Leopard Dace, Umatilla Dace usually occupy habitats with slower water velocity than those used by longnose dace, and Umatilla Dace adults use lower water velocities habitats than those used by Leopard Dace.

**References**


Hass, G. R. 1999. Personal communication. University of British Columbia, Vancouver. Cited in Wydoski and Whitney 2003.

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Peden, A. E., and G. W. Hughes. 1988. Sympatry in four species of *Rhinichthys* (Pisces), including the first documented occurrences of *R. umatilla* in the Canadian drainages of the Columbia River. Canadian Journal of Zoology 66:1846-1856.

Wydoski, R. S., and R. R. Whitney. 2003. Inland Fishes of Washington. 2nd edition. University of Washington Press, Seattle, WA. 322pp.

**Umatilla Dace: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Resource information collection needs | Listed as a "State Candidate Species" in Washington. Spotty distribution makes it vulnerable to population decline. Not enough data on distribution and status. | Need more assessment surveys to determine current distribution and status and whether it merits a change in listed status. | Current insufficient | WDFW |
| 2 | Fish and wildlife habitat loss or degradation | Human-altered habitat has had a negative impact. Needs flowing water sufficient to maintain interspaces in rubble/cobble. | Need more assessment surveys to determine current distribution and type of habitat usage in Washington. | Current insufficient | WDFW |

NOTE: Numbers are for reference only and do not reflect priority.

## OLYMPIC MUDMINNOW (*Novumbra hubbsi*)

### Conservation Status and Concern

Populations of this endemic species are confined to a very small lowland portion of western Washington and its biggest threat is loss of habitat.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| None | Sensitive | Yes | G3 | S2S3 | Unknown/unknown | Moderate |

### Biology and Life History

Olympic Mudminnows are small, average length approximately 2.1 inches, and are not selective feeders, consuming annelids, crustaceans, insects, and mollusks. Spawning begins in late November, subsides during the winter months, then resumes in March and lasts until mid-June. Spawning sites are in shallow, low flow areas such as flooded areas adjacent to streams. Males maintain breeding territories. Eggs are adhesive and are deposited on aquatic vegetation; no parental care is given. Fry attach themselves to vegetation, using "gluing" head glands.


Photo: Julie Tyson, WDFW

### Distribution and Abundance

The Olympic Mudminnow occurs only in Washington and its current range includes the southern and western lowlands of the Olympic Peninsula, Chehalis River Basin, lower Deschutes River drainage, and south Puget Sound west of the Nisqually River. Populations have also been observed in King and Snohomish counties within the Cherry Creek drainage, Peoples Creek drainage, and Issaquah Creek.

### Habitat

This species has three main habitat requirements: water with little to no flow, several inches of soft mud substrate, and abundant aquatic vegetation. Its preferred habitat includes quiet waters with mud or dark bottoms, usually well-vegetated areas and areas under overhanging banks, especially in marshy streams and brownish water of bogs and swamps. They can also be found in low-lying marshes, roadside ditches, and vegetation-choked streams at lower elevations (sea level to 459 feet), but are intolerant of saltwater. This species does not occur in otherwise suitable areas that have introduced spiny-rayed fishes.

#### References


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**Olympic Mudminnow: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Fish and wildlife habitat loss or degradation | Classified as a "Sensitive Species" in Washington because of its restricted range, endemic to Washington and its habitat, vulnerable to destruction or negative change. | Continued surveys to confirm distribution and habitat use. | Current insufficient | WDFW |
| 2 | Fish and wildlife habitat loss or degradation | Loss of habitat from human development merits further surveys and protection of some kind. | Due to the amount of time passed since regular surveys, updated surveys to determine what habitat is currently being used and to document rate of habitat loss. | Current insufficient | WDFW |
| 3 | Resource information collection needs | Over ten years since the last surveys to determine distribution, status information, and type of habitat use. | More field surveys are needed to determine current distribution, habitat use and status. | Current insufficient | WDFW |

NOTE: Numbers are for reference only and do not reflect priority.

## MARGINED SCULPIN (*Cottus marginatus*)

**Conservation Status and Concern**

This species is confined to three rivers in southeastern Washington and faces threats to its habitat.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| Species of Concern | Sensitive | Yes | G3 | S1? | Medium/unknown | Moderate |

**Biology and Life History**

Margined Sculpin is a benthic stream dwelling species. Spawning takes place in May to June. Eggs are deposited under rocks and the males actively guard the nest. Adults may reach about 2.5 inches in length. Food habits are unknown, but most sculpins feed on a variety of invertebrates, including aquatic invertebrates, terrestrial insects, and earthworms, and on young fish and fish eggs.

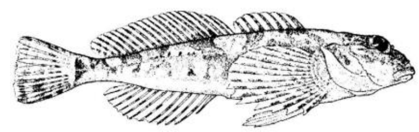

Image: WDFW

**Distribution and Abundance**

This species is endemic to Oregon and Washington, and occurs in headwater tributaries of Columbia Basin drainages in the Blue Mountains (northeastern Oregon and southeastern Washington). In Washington it occurs in headwaters of the Walla Walla, Touchet, and Tucannon rivers.

**Habitat**

Margined Sculpin primarily inhabit pools and slow-moving glides in headwater tributaries where water temperatures normally are less than 66$^{o}$F. Adults are usually found in deeper and faster water than juveniles. They are generally found in habitats with small gravel and silt substrates and avoid larger substrates (large gravel, cobble, boulders). However, this sculpin appears adaptable to a wide variety of currents and substrates. In areas where it is not competing with other sculpin species, it is found typically in moderate to rapid current on a rubble or gravel substrate.

**References**

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Wydoski, R. S., and R. R. Whitney. 2003. Inland Fishes of Washington. 2nd edition. University of Washington Press. Seattle, WA. 322pp.

### Margined Sculpin: Conservation Threats and Actions

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Resource information collection needs | Listed as a "Sensitive Species" in Washington. Spotty distribution makes it vulnerable to population decline. Not enough data on distribution and status. | Periodic surveys to monitor status: likely declining. | Current insufficient | WDFW |
| 2 | Fish and wildlife habitat loss or degradation | Loss of habitat from human development merits further surveys and protection of some kind. | Periodic surveys to determine what habitat is currently being used and to document rate of habitat loss. | Current insufficient | WDFW |
| 3 | Resource information collection needs | Because of its very limited distribution in SE Washington, data on current population status, distribution and type of habitat use are lacking. | Field surveys are needed to determine current distribution, status, and habitat use. | Current insufficient | WDFW |

NOTE: Numbers are for reference only and do not reflect priority.

## MOUNTAIN SUCKER (*Catostomus platyrhynchus*)

**Conservation Status and Concern**

The status of this species is unknown and it faces threats to its habitat.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| None | Candidate | Yes | G5 | S2S3 | Unknown/unknown | Low-moderate |

**Biology and Life History**

Mountain Suckers are mostly riverine and spawn in riffles below pools in late spring-early summer when the water temperature is 52 to 66°F. Limited upstream spawning migrations may occur. Their diet is almost entirely algae and diatoms and they scrape food from rocks with their cartilaginous lower jaws. They, especially juveniles, also consume some invertebrates. They form schools, sometimes with other sucker species. Mountain Suckers are small and may reach a total maximum length of 9 inches.


Photo: from Wydoski and Whitney 2003

**Distribution and Abundance**

In Washington, this species is restricted to the Columbia River system. Mountain Suckers have been found in the Hanford Reach of Columbia River mainstem, and in Cowlitz, Yakima, Wenatchee, Palouse and Snake rivers. Population size and status are unknown.

**Habitat**

Mountain Suckers utilize river and stream areas of slow to moderate current and pools. Spawning occurs over gravel riffles. This sucker appears to prefer clear, cold creeks and small to medium rivers with clean rubble, gravel or sand substrate. It may favor pool-like habitats in some areas, and faster water in other regions. They are rarely found in lakes. Young fish usually inhabit slower moving waters in side channels, or weedy backwaters. In some areas, juveniles tend to occur closer to reservoirs than do adults. The species is most abundant where there is some form of cover in the water (used as daytime refuge). This sucker's presence may be a sensitive indicator of native fish and invertebrate assemblages.

**References**


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Wydoski, R. S. and R. R. Whitney. 2003. Inland Fishes of Washington. 2nd edition. University of Washington Press. Seattle, WA. 322pp.

**Mountain Sucker: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Resource information collection needs | Listed as a "State Candidate Species" in Washington. Spotty distribution makes it vulnerable to population decline. Not enough data on distribution and status. | Periodic surveys to monitor status: increasing or declining and to confirm current distribution. | Current insufficient | WDFW |
| 2 | Fish and wildlife habitat loss or degradation | Loss of habitat from human development merits further surveys and protection of some kind. | Periodic surveys to determine what habitat is currently being used and to document rate of habitat loss. | Current insufficient | WDFW |
| 3 | Resource information collection needs | A paucity of current information on distribution, status, and type of habitat use. | Field surveys are needed to determine current distribution, status and habitat use. | Current insufficient | WDFW |

NOTE: Numbers are for reference only and do not reflect priority.

## SALISH SUCKER (*Catostomus sp. 4*)

**Conservation Status and Concern**

This species is only found in western Washington and faces threats from loss of habitat and degradation to water quality.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| None | Monitor | No | G1 | S1 | Unknown/unknown | Moderate-high |

**Biology and Life History**


Photo: Paul Mongillo, WDFW

Salish Suckers begin spawning in March or April, depending on the water temperature, and spawning can be prolonged until late August. Individuals first spawn at the end of their second year. This species is similar to other species of suckers in that it is a broadcast spawner and it deposits its eggs in riffles. Its life span is only 4 to 5 years in British Columbia, but older individuals are known from Washington. In British Columbia, the species typically co-occurs with juvenile coho salmon, cutthroat trout, and prickly sculpin. All of these species are capable of being significant predators of young Salish Suckers. Little is known about their diet, especially diet of juveniles. However, they probably have a diet similar to longnose suckers, which consists of a variety of benthic-dwelling aquatic invertebrates and occasionally fish eggs.

**Distribution and Abundance**

Salish Suckers are currently found only in western Washington and a few streams in British Columbia's lower Frazer Valley. In Washington, they have been found in six watersheds draining to Puget Sound (including Hood Canal), from Nooksack River to Lake Cushman in North Fork Skokomish River. Localities they have been reported in include several Nooksack Basin lowland creeks, Whatcom Lake, Skagit Basin including Sauk and Suiattle rivers, Stillaguamish Basin, including Twin, Chitwood, and Trout lakes, Deep Creek in Snohomish Basin, Green River, and Lake Cushman. Population size and status are unknown.

**Habitat**

Salish Suckers are benthic dwellers, and mainly found in lowland streams and associated ponds, and in off-channel sloughs and marshes of big rivers, as well as in lakes. They inhabit a variety of water velocities over silt and sand substrates, often in areas with instream vegetation and over-hanging riparian vegetation. They have a preference for slow-moving water in streams and most likely seek off-channel habitats during high stream-flows in winter and spring.

**References**


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**Salish Sucker: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Resource information collection needs | Loss of habitat from human development merits further surveys and protection of some kind. | Periodic surveys to monitor status: increasing or declining. | Current insufficient | WDFW |
| 2 | Agriculture and aquaculture side effects | Studies show fencing off streams will protect habitat from grazing animals. | B.C. studies show habitat enhancement, fencing and riparian plantings would be helpful. | Current insufficient | WDFW |
| 3 | Fish and wildlife habitat loss or degradation | Data show loss of habitat is causing population declines. | B.C. studies show habitat enhancement, fencing and riparian plantings would be helpful. | Current insufficient | WDFW |

NOTE: Numbers are for reference only and do not reflect priority.

## PYGMY WHITEFISH (*Prosopium coulteri*)

### Conservation Status and Concern

Pygmy Whitefish status in Washington is unknown and it faces threats to habitat and water quality.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| Species of Concern | Sensitive | Yes | G5 | S1S2 | Unknown/unknown | Low-moderate |

### Biology and Life History

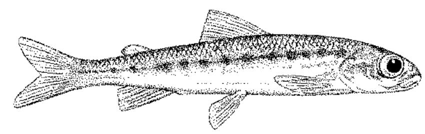

Image: WDFW

Slow growth, low fecundity and short life cycle characterize Pygmy Whitefish. They frequently are found in large schools of several thousand fish in both rivers and lakes. They spawn at night from late summer to early winter depending on the geographic location and elevation. Spawning occurs in stream riffles or along lake shorelines. Female fecundity ranges from 200 to 1,000 eggs. Average life span is 4 to 7 years, and size is usually less than 6 inches long. In general, males mature earlier and die earlier than females. Diet is primarily zooplankton, but may include macroinvertebrates, crustaceans and fish eggs. This species is considered a glacial relict, is one of the most primitive of coregonines, and has greatest discontinuous range of any North American freshwater fish.

### Distribution and Abundance

Washington is at the southern end of Pygmy Whitefish's range. Historically they were known to have occurred in 15 Washington lakes. They currently inhabit nine lakes: Lake Chelan (Chelan County), Crescent Lake (Clallam County), Lake Chester Morse (King County), Lake Cle Elum, Lake Kachess, and Keechelus Lake (Kittitas County), Lake Osoyoos (Okanogan County), and Bead Lake and Lake Sullivan (Pend Oreille County). The six lakes they have been extirpated from are: North Twin Lake (Ferry County), Buffalo Lake (Okanogan County), Diamond Lake, Horseshoe Lake, and Marshall Lake (Pend Oreille County), and Little Pend Oreille Lakes (Stevens County). Population sizes and trends are unknown. They may co-occur with other whitefish species.

### Habitat

Pygmy Whitefish normally occupy deep, unproductive lakes where the water temperatures are 50°F or lower, but there have been a few cases where this species was found in small shallow and more productive lakes, and they can also be found in streams. Common in lakes and flowing waters of clear or silted rivers in mountain areas; in western lakes, occurs in waters usually less than 20 feet deep, not changing depth seasonally. Spawners use coarse gravel substrates in shallow areas of streams or lakes.

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**Pygmy Whitefish: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Resource information collection needs | Classified as a "Sensitive Species" in Washington. | Periodic surveys to monitor status: increasing or declining. | Current sufficient | WDFW |
| 2 | Invasive and other problematic species and genes | It is likely that non-native fish are partially responsible for decline in numbers. | Collection of diet data from other species would help confirm or deny predation on species. | Current insufficient | WDFW |

NOTE: Numbers are for reference only and do not reflect priority.

# REFERENCES

## SECTION A: Alphabetical list of species

## SECTION B: Explanation of Terms

**Conservation Status Table**

**Federal Status**
Refers to legal designations under the Federal Endangered Species Act (listed as Endangered, Threatened, or Candidate species, or designated as a Sensitive species).

**State Status**
The Washington Fish and Wildlife Commission has classified 46 species as Endangered, Threatened or Sensitive, under WAC 232-12-014 and WAC 232-12-011. Other designations include Candidate and Monitor.

**PHS (Priority Habitats and Species Program)**
A species listed under the PHS program is considered to be a priority for conservation and management and requires protective measures for survival due to population status, sensitivity to habitat alteration and/or tribal, recreational or commercial importance. Management recommendations have been developed for PHS species and habitats, and can assist landowners, managers and others in conducting land use activities in a manner that incorporates the needs of fish and wildlife.

**Global (G) and State (S) Rankings:** Refers to NatureServe status rankings provided by the Natural Heritage Program. These conservation status ranks complement legal status designations and are based on a one to five scale, ranging from critically imperiled (1) to demonstrably secure (5). The global (G) and state (S) geographic scales were used for the SGCN species fact sheets. For more on the methodology used for these assessments, please see: Methodology for Assigning Ranks - NatureServe.

**State Rank:** characterizes the relative rarity or endangerment within the state of Washington.
**S1** = Critically imperiled
**S2** = Imperiled
**S3** = Rare or uncommon in the state – vulnerable
**S4** = Widespread, abundant, and apparently secure i
**S5** = Demonstrably widespread, abundant, and secure in the State
**SA** = Accidental in the state.
**SE** = An exotic species that has become established in the state.
**SH** = Historical occurrences only are known, perhaps not verified in the past 20 years, but the taxon is suspected to still exist in the state.
**SNR** or = Not yet ranked. Sufficient time and effort have not yet been devoted to ranking of this taxon.
**SP** = Potential for occurrence of the taxon in the state but no occurrences have been documented.
**SR** = Reported in the state but without persuasive documentation which would provide a basis for either accepting or rejecting the report (e.g., misidentified specimen).
**SRF** = Reported falsely in the state but the error persists in the literature.
**SU**= Unrankable. Possibly in peril in the state, but status is uncertain. More information is need.
**SX** = Believed to be extirpated from the state with little likelihood that it will be rediscovered.

**SZ** = Not of conservation concern in the state.

Qualifiers are sometimes used in conjunction with the State Ranks described above:
**B** - Rank of the breeding population in the state.
**N** - Rank of the non-breeding population in the state.

**Global Rank:** characterizes the relative rarity or endangerment of the element world-wide.
**G1** = Critically imperiled globally
**G2** = Imperiled globally
**G3** = Either very rare and local throughout its range or found locally (even abundantly at some of its locations) in a restricted range - vulnerable
**G4** = Widespread, abundant, and apparently secure globally
**G5** = Demonstrably widespread, abundant, and secure globally, though it may be quite rare in parts of its range
**GH** = Historical occurrences only are known, perhaps not verified in the past 20 years, but the taxon is suspected to still exist somewhere in its former range.
**GNR** = Not yet ranked. Sufficient time and effort have not yet been devoted to ranking of this taxon.
**GU** = Unrankable. Possibly in peril range-wide but status uncertain. More information is needed.
**GX** = Believed to be extinct and there is little likelihood that it will be rediscovered.

Qualifiers are used in conjunction with the Global Ranks described above:

**Tn** Where n is a number or letter similar to those for Gn ranks, above, but indicating subspecies or variety rank. For example, G3TH indicates a species that is ranked G3 with this subspecies ranked as historic.

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State Wildlife Action Plan Update

# Appendix A-5

## Species of Greatest Conservation Need

## Fact Sheets

# INVERTEBRATES

**Conservation Status and Concern**

**Biology and Life History**

**Distribution and Abundance**

**Habitat Needs**

**Stressors**

**Conservation Actions Needed**

Washington Department of Fish and Wildlife
2015

# Appendix A-5

## SGCN Invertebrates – Fact Sheets

# Table of Contents

# What is Included in Appendix A-5

**Introduction**
Appendix A-5 is one component of the State Wildlife Action Plan (SWAP) Update, and contains information about invertebrates included in our Species of Greatest Conservation Need (SGCN) list for 2015. Included are fact sheets for each of the invertebrates identified as Species of Greatest Conservation Need in the 2015 SWAP. The information provided includes a summary of the conservation concern and conservation status, description distribution and habitat, climate change sensitivity and an overview of key threats and conservation actions needed.

**What it means to be an SGCN**
The SGCN list includes both animals that have some form of official protection status and those which may be in decline, but are not yet listed as part of either the Federal or State Endangered Species program. One of the purposes of the SWAP is to direct conservation attention to species and habitats *before* they become imperiled and recovery becomes more difficult and costly. Presence on this list does not necessarily mean that conservation attention will be directed towards the animal; rather, that conservation actions for the species are *eligible* for State Wildlife Grants funding, and may be more competitive for other grant programs. It also raises the profile of an animal to a wide audience of conservation partners and may encourage other organizations to initiate projects that may benefit the species.

**Climate Vulnerability**
Please see Chapter 5 for an explanation of the methodology used to assess climate vulnerability. For a full list of all the SGCN ranks, including a narrative description of sensitivity and references, please see Appendix C.

**Explanation of terms used in the document**
Please see Section B (page 113) for a description of terms and abbreviations used in this document.

**Alphabetical List of Species**
For an alphabetical list of all the invertebrates included, please see Section A (page 110).

**References**
References are provided separately with each fact sheet, and also collectively for all SGCN invertebrates in the REFERENCES section at the end of this document.

# MILLIPEDE

## LESCHI'S MILLIPEDE (*Leschius mcallisteri*)

**Conservation Status and Concern**

Very little is known of this cryptic species, which was discovered and identified in 2004. It has only been detected within a small area in Thurston County.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| None | Candidate | Yes | GNR | SNR | Unknown/unknown | N/A |

**Biology and Life History**

This species was discovered and designated as a new genus and species in early 2004. No studies have been conducted.

Photo: W. Leonard

**Distribution and Abundance**

Six males and seven female paratypes were collected in February 2004 at and close by McAllister Springs near Olympia, WA. The collection area is located upstream of the Nisqually Wildlife Refuge and just downslope of a housing development situated on a bluff. More recent surveys at the type locality detected several individuals of the species. Actual total distribution of the species is unclear. It has not been detected elsewhere, but the species is cryptic and may be more widely distributed.

**Habitat**

Specimens were collected in leaf litter along a steep, east-facing slope in the lower Nisqually River Valley. The site was vegetated by mature second-growth forest dominated by bigleaf maple (*Acer macrophylum*), red alder (*Alnus rubrum*), western red-cedar (*Thuja plicata*), and western swordfern (*Polystichum munitum*). It appears to be limited to leaf litter in forest bottoms and perennial springs.

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W. Leonard, WSDOT, pers.comm.

K. McAllister, WSDOT, pers.comm.

**Leschi's Millipede: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Resource information collection needs | Only a handful of individuals have been found in a localized area with a specific combination of habitat features | Need to establish baseline survey effort beyond current known locations in areas with similar habitat features | Nothing current - new action needed | Both |
| 2 | Fish and wildlife habitat loss or degradation | Development on bluff above site location in Nisqually Valley. Area in which *L. mcallisteri* was found is probably private land | Investigate possibility of extending area protectio | Nothing current - new action needed | External |

NOTE: Numbers are for reference only and do not reflect priority.

# MAYFLIES

## MAYFLIES (Ephemeroptera)

**Conservation Status and Concern**

These mayfly species are generally rare and have very restricted distributions.  Mayflies are very sensitive to pollution, and as such are usually only found at high quality, minimally polluted sites.  Mayflies are a commonly used index of water quality and aquatic ecosystem health.

| COMMON NAME (Scientific name) | Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend |
|---|---|---|---|---|---|---|
| **[unnamed]** (*Cinygmula gartrelli*) | None | None | No | G2G3 | SNR | Low/unknown |
| **[unnamed]** (*Paraleptophlebia falcula*) | None | None | No | G1G2 | SNR | Low/unknown |
| **[unnamed]** (*Paraleptophlebia jenseni*) | None | None | No | G2G4 | SNR | Low/unknown |
| **[unnamed]** (*Siphlonurus autumnalis*) | None | None | No | G2G4 | SNR | Low/unknown |

| CLIMATE VULNERABILITY RANKING | |
|---|---|
| **Common Name** (Scientific name) | Ranking |
| **[unnamed]** (*Cinygmula gartrelli*) | Low-moderate |
| **[unnamed]** (*Paraleptophlebia falcula*) | Low-moderate |
| **[unnamed]** (*Paraleptophlebia jenseni*) | Low-moderate |
| **[unnamed]** *(Siphlonurus autumnalis)* | Low |

**Biology and Life History**

All mayflies are aquatic in their developmental stages.  Their lifespan is spent almost entirely undergoing numerous molts. Larval existence is usually 3 to 6 months, but can be as short as 2 weeks or as long as 2 years.  The nymphs are generalists, moving over stones and weeds to graze off bacteria, collecting from sediments or feeding on detritus.  Most species are feeders or scrapers.  Adults do not eat; they have nonfunctional digestive systems.  Unlike most insects, the mayfly typically has two winged stages.  It is the only existing insect that molts after getting functional wings.  The first stage, the subimago, is a subadult stage typically found perched on shoreline vegetation; it lasts from 4 minutes to 48 hours (correlated with the lifespan of the species' adult stage).  Soon after it is formed (in most species), the subimago molts to form the imago, the true adult or

*Siphlonurus lacustris*, a close relative of S. autumnalis. Photo: Hectonichus reproductive stage. Both subimagos and adults tend to remain along banks at emergence sites. Mayfly eggs are eaten by snails and caddisfly larvae. The nymphs may be eaten by fish, frogs, birds, flies, or water beetles. The subimagos are eaten by fish, birds, dragonflies, water beetles, or other predatory insects. Mating occurs in a swarm, and the eggs are laid as the female skims the water. The eggs sink to the bottom, and develop sticky substances or adhesive disks, depending on the species. Some species are parthenogenic. Adults of most species are short-lived (less than 2 hours to 3 days). Some species emerge in the spring while others dominate in autumn. Mayfly dispersal is limited in the larval stage by drainage systems and in adult stages by relatively short life spans and weak flying ability of gravid females. Dispersal at the population level has been little studied. Adult dispersal ability has not been extensively studied; however, several characteristics appear to limit occurrences to a short distance, including weak flying ability, extremely short life cycle, and tendency to remain in the area of emergence. This may partly account for the wide range of variability in some species, since once a population becomes established there is little opportunity for exchange of genetic materials with populations in other drainage systems.

### Distribution and Abundance

***Cinygmula gartrelli*:** In Washington, this species occurs in the Ohanapecosh River, Mt. Rainier National Park, Lewis County; and Huckleberry Creek and Ipsut Falls in Mt. Rainier National Park, Pierce County. It was also recently found in Oregon in the Etolius River, Jefferson County.

***Paraleptophlebia falcula*:** In Washington, this rare species occurs in the South Fork Walla Walla River. In Oregon, it occurs in few historical sites in Benton and Union Counties with new localities in South Fork Walla Walla River, Umatilla County.

***Paraleptophlebia jenseni*:** This species is only known from Badger Gulch, Holter Gulch, and Rock Creeks in Klickitat County.

***Siphlonurus autumnalis*:** In Washington, this species occurred historically in Clallam, Grays Harbor, Jefferson, Lewis, and Pierce Counties; it was recently collected in Clallam County.

### Habitat

Some mayflies species have very specific requirements. They are most commonly found on firm substrate in streams and lake littoral zones, but some are adapted for soft substrate. Mayfly nymphs are usually microhabitat specialists. Each species survives best on a specific substrate at a certain depth under water with a certain amount of wave action. Some species generally live in medium to large streams. Other species burrow into soft areas where flow is slower, or in areas of lakes and rivers where deposits occur; the particular substrate and burrow depends on the genus. The primitive habitat of mayflies is lentic (still water), even though most extant mayflies live in lotic (flowing water) environments.

***C. gartrelli*:** This species was found at high-altitude creeks, falls, and rivers in Mt. Rainier National Park.

***P. falcula*:** The genus often prefers moderate to fast streams with sand, gravel and detritus substrates.

***P. jenseni*:** *P. jenseni* is rare and has only been found in one substantial, fast running creek and two of its small, rocky, transient tributaries.

***S. autumnalis*:** This species is associated with medium to large rivers, and has been taken from rocky but somewhat quiet edgewaters along relatively large rivers in the Northwest. It has also been collected at a cold, spring brook in Montana.

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**Mayflies: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Resource information collection needs | Lack of data on current status and distribution | Determine distribution, population status | Current insufficient | Both |
| 2 | Climate change and severe weather | Potential for streams drying up | Determine distribution, population status | Current insufficient | Both |
| 3 | Fish and wildlife habitat loss or degradation | Water quality is of extreme importance to aquatic insects | Protect riparian habitats | Current insufficient | Both |

NOTE: Numbers are for reference only and do not reflect priority.

# DRAGONFLIES and DAMSELFLIES

## Family Gomphidae: CLUBTAIL DRAGONFLIES

**Conservation Status and Concern**

These three dragonflies in the Gomphidae family are SGCN in Washington due to the small number of isolated populations and continued threats to their habitat.

| COMMON NAME (Scientific name) | Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend |
|---|---|---|---|---|---|---|
| **Columbia Clubtail** (*Gomphus lynnae*) | None | Candidate | Yes | G1 | S1 | Low/unknown |
| **Pacific Clubtail** (*Gomphus kurilis*) | None | Candidate | Yes | G4 | S1 | Critical/declining |
| **White-belted Ringtail** (*Erpetogomphus compositus*) | None | Candidate | No | G5 | S1 | Low/unknown |
| | Climate vulnerability: Moderate-high | | | | | |

**Biology and Life History**

White-belted Ringtail
Photo: W. Leonard

Clubtail dragonflies complete a life cycle composed of two main phases: a flightless aquatic larva (nymph stage), which may be continuous for 1 to 2 winters, and the adult flight (reproductive stage). They inhabit sites year-round as egg, larval nymph, and adult, typically moving within only a few to several hundred meters of their natal locations. Adults do not seasonally migrate, and die soon after their reproductive summer. Both life stages are predatory; the majority of life cycle is spent as aquatic larvae. Nymphs feed on aquatic invertebrates and possibly small vertebrates (fish, frog and salamander larva). After multiple aquatic instars (gradual metamorphosis) over 1 or 2 winters, mature nymphs crawl onto rocks or vegetation and shed their exoskeleton to become a new adult (teneral) in late spring and summer. Adults are aerial predators of smaller insects and similar sized butterflies and moths (Lepidoptera), as well as smaller Odonates. Water temperature influences the timing of emergence from within a year or over 2 years. Weather influences flight period duration, with wet or cold conditions potentially shortening the flight period and warm, dry conditions promoting the duration and later occurrence dates of the flight period. Male Clubtails seek mates by patrolling a territory that coincides with optimal aquatic habitat for female egg-laying, and hence for larvae. There is usually no courtship behavior. After copulation, females usually hover just above the water of slow moving or gentle current stretches and close to shore while periodically dipping the tail to deposit multiple eggs.

**Distribution and Abundance**

These species occur in low numbers of small isolated populations (Table 1). For the Columbia Clubtail, only a single population is known in Washington. Only three localities in Washington are known for the Pacific Clubtail, and confirmation is needed for the Thurston County location; a historical record exists from Lake Washington (King County, 1933). The White-belted Ringtail is more widespread throughout the western U.S., but restricted to two known locales in Washington, the extreme northern end of its range.

Table 1. Overall range, counties and estimated number of extant populations in Washington for Dragonfly SGCN.

| Species | Range Overall | WA Counties | Populations |
|---|---|---|---|
| Columbia Clubtail | Highly disjunct: E WA; John Day, Owyhee, Malheur rivers in OR | Benton - Yakima River Horn, north of Benton City (1000') | 1 |
| Pacific Clubtail | Restricted to N CA–OR Pacific coast and mountains - north to S Puget Trough | Skamania - Bass, Ice House Lakes; Thurston - Black Lake | 3? |
| White-belted Ringtail | Local in S part of Columbia Basin (1000'); CA, ID, OR, NV, AZ, NM, UT, TX | Grant - Crab Creek<br>Benton - Yakima River. | 2 |

**Habitat**

Research is needed to quantify specific habitat requirements for these species, including aquatic larval substrates, river and stream, or lake and pond characteristics, and other key habitat features.

**Columbia Clubtail**: Over its range, uses slower-moving, open sandy to muddy, rivers with gravelly rapids in sagebrush-riparian woodland; may be more widespread in Washington.

**Pacific Clubtail**: At large ponds and lakes in western Washington; in other parts of range, streams and rivers with good currents, sandy to muddy bottoms.

**White-belted Ringtail**: Open sandy streams/rivers, irrigation ditches, occasionally sink holes; typically in desert country, sagebrush-riparian woodland.

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**Family Gomphidae: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Agriculture and aquaculture side effects | Pesticide and fertilizer runoff into streams | Monitor occurrence waters for chemical contaminants | Nothing current - new action needed | Both |
| 2 | Agriculture and aquaculture side effects | Siltation and degradation of stream and bottom habitat used by developing larvae by unsustainable grazing, commercial or recreational uses | Work to improve unsustainable grazing and commercial use practices in waters of known occurrence | Nothing current - new action needed | Both |
| 3 | Climate change and severe weather | Increased environmental temperatures may affect life history with unknown consequences | Monitor streams in context of climate changes | Nothing current - new action needed | Both |
| 4 | Fish and wildlife habitat loss or degradation | Vulnerable mostly because of extreme rarity of any known populations | Efforts that protect water quality most important to larval development. Use land acquisitions, conservation easements and landowner agreements to protect significant shoreline areas from degradation | Nothing current - new action needed | Both |
| 5 | Fish and wildlife habitat loss or degradation | Loss of riparian vegetation that provide shade and perch sites; ameliorates stream temps. | Monitor vegetation around know occurrence sites | Nothing current - new action needed | Both |
| 6 | Invasive and other problematic species | Introduced predatory fish species that may not have co-evolved with these species | Monitor streams in context of non-native aquatic species | Nothing current - new action needed | Both |

NOTE: Numbers are for reference only and do not reflect priority.

## SUBARCTIC BLUET (*Coenagrion interrogatum*)

### Conservation Status and Concern

The Subarctic Bluet is a species of damselfly that is restricted to boreal fens and bogs in the northeastern corner of the state. Only two populations of Subarctic Bluet have been located in Washington.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| None | None | No | G5 | S1 | Low/unknown | Moderate-high |

### Biology and Life History


Photo: M. Reese

The Subarctic Bluet is a damselfly in the pond damsel family (Coenagrionidae). Adults mate in dense vegetation; females lay eggs in small slits they cut in aquatic plants and have been observed egg-laying in floating sedge and grass leaves and stems, and emergent grass stems. Eggs develop quickly, and the resulting larvae are aquatic and feed on other aquatic invertebrates. This species overwinters in the larval stage. Adults are also predators that specialize on flying insects. The adult period for this species may be relatively short; adults have been detected at Washington sites in July.

### Distribution and Abundance

The Subarctic Bluet is a boreal species, and ranges across most of Canada and into the western United States in northern Washington and Montana. The species is known from only two sites in Washington, in Ferry and Pend Oreille Counties, between 4500 to 5000 feet in elevation. It may occur in additional boreal bogs and fens in this region. There is no information on population size from either Washington locality.

### Habitat

This species depends on boreal bogs and fens, rare habitat types that are restricted to the northeast corner of the state. Within these rare wetlands, Subarctic Bluets use dense sedge and moss mats, and adults also use the shrub ecotone. These habitats are sensitive to disturbance and many activities that impact local hydrology.

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**Subarctic Bluet: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Agriculture and aquaculture side effects | Bog/fen obligate; habitat and species are vulnerable to alteration of local hydrology from logging and road building | Identify bog/fen sites and landowners within species range and develop plans to conserve | Nothing current - new action needed | Both |
| 2 | Resource information collection needs | Lack of data on current status and distribution | Determine distribution, population status | Current insufficient | Both |

NOTE: Numbers are for reference only and do not reflect priority.

# STONEFLIES

## STONEFLIES (Plecoptera)

**Conservation Status and Concern**
Stoneflies generally require cold, clear, running water and are especially sensitive to human disturbance; they are excellent indicators of water quality. An estimated 43 percent of North American stoneflies are vulnerable to extinction, imperiled, or extinct. Adults are weak fliers, and there is a high level of endemism; four of these specie shave only been found in Washington. Some of these species are restricted to glacier-fed streams, at risk due to climate change.

| **Common Name** (Scientific name) | Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend |
|---|---|---|---|---|---|---|
| **Sasquatch Snowfly** (*Bolshecapnia sasquatchi*) | None | None | No | G2 | SNR | Low/unknown |
| **Northern Forestfly** (*Lednia borealis*) | Candidate | None | No | G3G4 | S3S4 | Low/unknown |
| **Wenatchee Forestfly** (*Malenka wenatchee*) | None | None | No | G2 | SU | Low/unknown |
| **Pacific Needlefly** *(Megaleuctra complicata)* | None | None | No | G3 | SU | Low/unknown |
| **Cascades Needlefly** *(Megaleuctra kincaidi)* | None | None | No | G2 | SU | Low/unknown |
| **Yosemite Springfly** *(Megarcys yosemite)* | None | None | No | G2 | SNR | Low/unknown |
| **Talol Springfly** *(Pictetiella lechleitneri)* | None | None | No | G1G3 | SNR | Low/unknown |
| **Rainier Roachfly** *(Soliperla fenderi)* | Species of Concern | None | No | G2 | S1S2 | Low/unknown |

| CLIMATE VULNERABILITY RANKING | |
|---|---|
| **Common Name** (Scientific name) | Ranking |
| **Sasquatch Snowfly** (*Bolshecapnia sasquatchi*) | Moderate-high |
| **Northern Forestfly** (*Lednia borealis*) | High |
| **Wenatchee Forestfly** (*Malenka wenatchee*) | Moderate-high |
| **Pacific Needlefly** *(Megaleuctra complicata)* | Moderate-high |
| **Cascades Needlefly** *(Megaleuctra kincaidi)* | Moderate-high |
| **Yosemite Springfly** *(Megarcys yosemite)* | High |
| **Talol Springfly** *(Pictetiella lechleitneri)* | Moderate |
| **Rainier Roachfly** *(Soliperla fenderi)* | Moderate-high |

**Taxonomic note**: The Northern Forestfly (*Lednia borealis*) was recently described from specimens originally identified as *L. tumana*, a Candidate for listing under the Endangered Species Act (ESA). The Talol Springfly (*Pictetiella lechleitneri*) was described by Stark and Kondratieff (2004). Baumann and Potter (2007) determined that *Bolshecapnia sasquatchi* is restricted to British Columbia and Washington; Montana specimens, previously assigned to this species, were described as *B. missiona.* *Soliperla* specimens from Mt. Adams, Skamania County, were originally thought to be *S. fenderi*, but have been reclassified as the type specimens of a new species, *S. cowlitz*.

**Biology and Life History**


*Soliperla sierra*, a close relative of *S. fenderi*
Photo: B. Stark

Stoneflies usually live in areas with running water, and are important predators and shredders in aquatic ecosystems. The females lay hundreds or even thousands of eggs in a ball which they initially carry on their abdomens, and later deposit into the water. The eggs typically hatch in 2 to 3 weeks, but some species undergo diapause as eggs during the dry season. The nymphs physically resemble wingless adults, but often have external gills, which may be present on almost any part of the body. The nymphs (technically, "naiads") are aquatic and live in the benthic zone of well-oxygenated creeks and lakes. In early stages (called instars), stoneflies tend to be herbivores or detritivores, feeding on plant material such as algae, leaves, and other fresh or decaying vegetation; in later instars, the nymphs of many species shift to being omnivores or carnivores, and some species become predators on other aquatic invertebrates. The insects remain in the nymphal form for one to four years, depending on species, and undergo from 12 to 33 molts before emerging and becoming terrestrial as adults. Stonefly adults are generally weak fliers and stay close to stream, river, or lake margins where the nymphs are likely to be found. The adults emerge only during specific times of the year and only survive 1 to 4 weeks. As adults, very few stonefly species feed but those that do, feed on algae and lichens, nectar, or pollen.

**Distribution and Abundance**

**Sasquatch Snowfly:** This species' range includes Washington and British Columbia. In Washington, it is known from Lewis and Whatcom Counties (Ohanapecosh River, Mt. Rainier

National Park, and Razor Hone Creek, near Mt. Baker). British Columbia records are from the Fraser River near Agassiz, and the Similkameen and Skagit rivers in Manning Provincial Park.

**Northern Forestfly:** The Northern Forestfly, a Washington endemic, is only known from high elevation glacial-fed streams in the Cascades, including Mt Rainier and North Cascades National Parks, and Mt. Baker-Snoqualmie National Forest.

**Wenatchee Forestfly**: This species is known only from springs draining into Lake Wenatchee in Chelan County, Washington.

**Pacific Needlefly**: Megaleuctra species are "always rare". This species is found in the Cascades in Washington, Oregon, and northern California. Washington records include King, Pierce, Lewis, Skamania, and Cowlitz Counties.

**Cascades Needlefly:** This species is known from a few dozen occurrences from Oregon and Washington. An additional record is available from Lolo Pass, Clearwater County, Idaho and the Flathead River basin in western Montana.

**Yosemite Springfly**: It is known from Mt Rainier National Park (Fryingpan Creek at Sunrise Road Bridge, Pierce County), Mt. Hood, Oregon, and Mt. Lyell, (Yosemite National Park) California.

**Talol Springfly**: This species is only known from Carbon River, Mt. Rainier National Park, Pierce County, Washington.

**Rainier Roachfly**: This species is known from around fifteen occurrences within Mt. Rainier National Park, Pierce County, Washington. The species is presently known only from the Mt. Rainier National Park, but may occur elsewhere.

**Habitat**

Adults are terrestrial and can be found near aquatic habitats with running water, resting on rocks, debris, and vegetation. As nymphs, stoneflies live in aquatic habitats, mainly along the bottom of cool, clean, flowing waters with relatively high oxygen concentrations, mainly on rocky, stony, or gravel substrates. A few species are found in cold ponds and lakes at high elevations and northern latitudes.

**Sasquatch Snowfly**: This species is associated with creeks and rivers.

**Northern Forestfly**: This species has been collected from springs draining into alpine lakes.

**Needleflies**: These species are restricted to springs, seeps and rheocrenes (springs that flow from a defined opening into a confined channel). *Megaleuctra* species are usually associated with spring seeps and rheocrenes. They inhabit exclusively spring habitats, ranging from small seeps to large flowing springs. Even when it occurs in large springs, it is usually found along the edges instead of out in the area of flow. Water quality must be consistently good and the temperature cold. The nymphs are often found in small, consistently wet seepage areas some distance from nearest the creek, river or lake habitat. The essential habitat for the nymphs is springs or seeps that might not even be visibly flowing.

**Wenatchee Forestfly**: The Wenatchee Forestfly is found in springs draining into a large lake.

**Yosemite Springfly**: This species is reported from glacier-fed streams.

**Talol Springfly**: This species is reported from glacier-fed streams.

**Rainier Roachfly**: This species occurs in spring-fed seeps and streams (rheocrenes). Nymphs in this genus are generally collected in seeps and in the splash zones of small springs and streams.

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**Stoneflies: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| Cascades Needlefly, Northern Forestfly, Pacific Needlefly, Rainier Roachfly, Wenatchee Forestfly | | | | | |
| 1 | Resource information collection needs | Lack of data on current status and distribution | Determine distribution, population status | Current insufficient | Both |
| 2 | Climate change and severe weather | Potential for springs to dry up | Monitor spring/seep habitats | Current insufficient | Both |
| Sasquatch Snowfly | | | | | |
| 1 | Resource information collection needs | Lack of data on current status and distribution | Determine distribution, population status | Current insufficient | Both |
| Talol Springfly | | | | | |
| 1 | Resource information collection needs | Lack of data on current status and distribution | Determine distribution, population status | Current insufficient | Both |
| 2 | Resource information collection needs | Little life history information | Investigate life history, ecology | Nothing current - new action needed | External |
| 3 | Climate change and severe weather | Potential for glacial-fed habitat to dry up | Monitor glacial-fed river habitat | Current insufficient | External |
| Yosemite Springfly | | | | | |
| 1 | Resource Information Collection Needs | Lack of data on current status and distribution | Determine distribution, population status | Current insufficient | Both |

NOTE: Numbers are for reference only and do not reflect priority.

# BEETLES

## HATCH'S CLICK BEETLE (*Eanus hatchi*)

**Conservation Status and Concern**

Hatch's Click Beetle is a SGCN due to its small number of isolated populations, highly limited distribution and range, and use of specialized, highly restricted, and threatened *Sphagnum* moss bog habitat.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| Species of Concern | Candidate | Yes | G1 | S1 | Low/declining | Moderate-high |

**Biology and Life History**

Photo: T. Loh

Click beetles (Elateridae) have a unique prothorax anatomy that allows them to suddenly flip into the air, emitting a 'click' sound. This behavior is used to right the beetle when on its back and to escape predators. Adult Hatch's Click Beetles are active in the spring, typically on floating mats of Sphagnum moss. Elaterid adults and larvae are known to be carnivorous as well as herbivorous; however, no studies of adult or larval *E. hatchi* diets have been reported. Adults are thought to feed within flowers on honey dew, pollen, nectar, and the flowers themselves. Larvae appear to inhabit *Sphagnum* moss mats, and likely predate small insects and require multiple years to develop.

**Distribution and Abundance**

Known from only four bogs in lowland King and Snohomish Counties; one of these sites is now highly degraded and unlikely to support this beetle. Extensive searches have been made for Hatch's Click Beetle; however, additional surveys in the Puget Trough region are needed. No populations of this species have been estimated.

**Habitat**

Hatch's Click Beetle is a *Sphagnum* bog obligate species, inhabiting bogs between 0 to 1640 feet in elevation. *Sphagnum* bogs are unique, peat-forming wetlands with vegetation dominated by *Sphagnum* mosses. Bogs are typically small in size and situated in closed depressions within small watersheds, and thus geographically isolated. An ancient habitat, today bogs persist in relict patches that thousands of years ago were part of more broadly occurring muskeg-like vegetation following the retreat of the glaciers at the end of the last ice age. *Sphagnum* bogs make up only 3 percent of the wetlands in western Washington. Adults have been collected in low, floating *Sphagnum* mats and also encountered in bog shrubs and trees. Larvae have been found near bog margins, above the water line. No formal habitat studies have been conducted for this rare beetle.

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### Hatch's Click Beetle: Conservation Threats and Actions

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Fish and wildlife habitat loss or degradation | Bog/fen obligate; habitat and species are vulnerable to alteration of local hydrology from development | Designation of sites as having unique and important value to fish and wildlife | Current insufficient | Both |

NOTE: Numbers are for reference only and do not reflect priority.

## Family Carabidae: GROUND AND TIGER BEETLES

### Conservation Status and Concern

These four beetle species are SGCN due to the small number of isolated populations, highly limited distribution and range, and dependence on specialized, restricted and threatened habitats.

| **Common Name** (Scientific name) | Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend |
|---|---|---|---|---|---|---|
| **Mann's Mollusk-eating Ground Beetle** (*Scaphinotus mannii*) | None | Candidate | Yes | GNR | SNR | Low/unknown |
| **Beller's Ground Beetle** (*Agonum belleri*) | Species of Concern | Candidate | Yes | G3 | S3 | Low/unknown |
| **Columbia River Tiger Beetle** (*Cicindela columbica*) | None | Candidate | Yes | G2 | SH | Extirpated? |
| **Siuslaw Sand Tiger Beetle** (*Cicindela hirticollis siuslawensis*) | None | Monitor | No | G5T1T2 | S1 | Critical/unknown |

| **CLIMATE VULNERABILITY RANKING** | |
|---|---|
| **Common Name** (Scientific name) | Ranking |
| **Mann's Mollusk-eating Ground Beetle** *(Scaphinotus mannii)* | Moderate-high |
| **Beller's Ground Beetle** *(Agonum belleri)* | Moderate-high |
| **Columbia River Tiger Beetle** *(Cicindela columbica)* | Moderate |
| **Siuslaw Sand Tiger Beetle** *(Cicindela hirticollis siuslawensis)* | Moderate-high |

### Biology and Life History


Siuslaw Sand Tiger Beetle
Photo: R. Lyons, Xerxes Society

Four Carabidae beetles are designated as SGCN in Washington; two are ground beetles (subfamily Carabinae) and two are tiger beetles (subfamily Cicindelinae). Carabid beetles live on and in the soil; carabid SGCN depend on a narrow range of soil conditions within rare habitat types. Carabids are key predators of the insect world; as both larvae and adults they feed on other insects and, to a lesser extent, plant material. Adults hunt by sight and are fast runners that can quickly subdue their prey. Siuslaw Sand Tiger Beetle, Columbia River Tiger Beetle, and Beller's Ground Beetle adults generally forage during the day, and at night burrow into soil, sand, or other substrate. Mann's Mollusk-eating Ground Beetle is a slug and snail feeding specialist; adults hunt at night, taking cover under stones during the day. Carabids undergo complete metamorphosis, which means they have egg, larval, pupal, and adult life stages. Females create shallow burrows in the soil with their ovipositor, where they lay eggs singly; larvae feed and develop, pupation occurs, and adults emerge from these tunnel-like burrows. Thus, soil condition, including texture, moisture, and temperature is a vital element of habitat quality. Carabid beetles typically reproduce annually; adults can live for several years, and larvae may require multiple years for complete development. Mann's Mollusk-eating Ground Beetle and Beller's Ground Beetle are flightless species with highly limited dispersal capability. Adults of both tiger beetle SGCN can fly, but these species too are highly localized and sedentary. All four carabid SGCN inhabit their sites year-round (as egg, larva, pupa and adult).

**Distribution and Abundance**

Carabid beetle SGCN have restricted ranges and distributions within Washington (summarized in Table 1). Distribution is limited in part by a combination of their dependence on restricted ecological niches, and those niches' location within rare habitat types. Their distribution and abundance is characterized by small numbers of isolated populations. Limited surveys have been conducted in Washington to determine the current distribution of Mann's Mollusk-eating Ground Beetle, Beller's Ground Beetle, and Columbia River Tiger Beetle. However, further surveys are needed to determine their distributions, and locate any extant Washington populations of Columbia River Tiger Beetle and Siuslaw Sand Tiger Beetle. Population sizes have not been determined for these species on any site.

Overall range, WA counties and estimated number of extant populations for carabid beetle SGCN.

| Species | Range Overall | Washington Counties | Populations |
|---|---|---|---|
| Mann's Mollusk-eating Ground Beetle | SE WA and NE Oregon: Snake River tributaries | Asotin, Whitman | <10 |
| Beller's Ground Beetle | Disjunct: Queen Charlotte Islands, SW British Columbia (Canada); Puget Sound lowlands, WA; NW Oregon | King, Kitsap, Mason, Skagit, Snohomish, Thurston | 20-30 |
| Columbia River Tiger Beetle | SE WA, NE Oregon, Idaho: along the Columbia, Snake, and Salmon Rivers Recent detection: Idaho only | Asotin, Benton, Columbia, Franklin, Garfield, Walla Walla | Extant? |
| Siuslaw Sand Tiger Beetle | Coastal beaches SW WA south to N California. Recent detections: Oregon only | Pacific | Extant? |

**Habitat**

Carabid beetles occupy a wide variety of habitat types and ecological niches. The four Washington carabid SGCN are habitat specialists; they require soil and substrate texture, temperature, and moisture within narrow ranges, and those conditions must be found within rare habitat types, for example *Sphagnum* bogs or undisturbed and uniquely situated riverine or coastal sands.

**Mann's Mollusk-eating Ground Beetle:** This species uses shaded moist ground in low elevation (less than 2600 feet) forest and shrub-vegetated springs and damp canyons within the Snake River drainage that are not subject to periodic inundation of water from dams.

**Beller's Ground Beetle**: This species occurs only in low to mid-elevation (less than 3280 feet) Puget Trough *Sphagnum* bogs; unique, peat-forming wetlands with vegetation dominated by

*Sphagnum* genus mosses. *Sphagnum* bogs are typically small in size and situated in closed depressions within small watersheds, and thus are geographically isolated. An ancient habitat, today bogs persist in relict patches that thousands of years ago were part of more broadly occurring muskeg-like vegetation. *Sphagnum* bogs make up only 3 percent of the wetlands in western Washington.

**Columbia River Tiger Beetle:** This beetle uses well-established riverine sandbars and dunes along the Columbia and Snake River systems that are not inundated by spring floods or high water levels resulting from dam management. These sand habitats are open and only sparsely vegetated with shrubs and herbaceous species.

**Siuslaw Sand Tiger Beetle:** Inhabits a narrow ecological niche: unvegetated sands at the edge of freshwater outflows on Pacific Coast beaches. A study of this species' habitat in Oregon found adult beetles using firm, flat, moist sand at and near the freshwater edge, including areas upstream of the river mouth and along backwater lagoons and wetlands; and the sloping edge of dryer dunes just above the river's high water mark.

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**Family Carabidae: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| Columbia River Tiger Beetle | | | | | |
| 1 | Energy development and distribution | Requires narrow range of soil texture and moisture: threatened by inundation of reservoirs on Columbia/Snake Rivers | Where dams remain in rivers, develop timing and duration water level control best management practices to support species | Nothing current - new action needed | Both |
| 2 | Resource information collection needs | Knowledge of current distribution is incomplete | Conduct baseline inventory on Snake River, and revisit historic locales and potential habitat on Columbia | Nothing current - new action needed | Resource Information Collection Needs |
| Mann's Mollusk-eating Ground Beetle | | | | | |
| 1 | Energy development and distribution | Requires riparian forest areas threatened by inundation of reservoirs on Snake River | Where dams remain in rivers, develop timing and duration water level control best management practices to support species | Nothing current - new action needed | Both |
| 2 | Agriculture and aquaculture side effects | Intensive livestock use may trample the beetle or reduce riparian vegetation and compact soil | Install fencing to carefully manage or prohibit livestock access to occupied riparian areas | Nothing current - new action needed | Both |
| 3 | Resource information collection needs | Lacking information on complete species distribution in WA, ID, and OR | Conduct baseline inventory along Snake River | Nothing current - new action needed | Both |
| Beller's Ground Beetle | | | | | |
| 1 | Fish and wildlife habitat loss or degradation | Bog/fen obligate; habitat and species are vulnerable to alteration of local hydrology from development | Designation of sites as having unique and important value to fish and wildlife | Current insufficient | Both |
| 2 | Agriculture and aquaculture side effects | Bog/fen obligate; habitat and species are vulnerable to alteration of local hydrology from logging and road building | Leading or participating in land use planning for rural, urban, and forestry lands | Current insufficient | Both |
| 3 | Resource information collection needs | Knowledge of current distribution is incomplete | Baseline survey and inventory to understand distribution of fish and wildlife populations | Current insufficient | Both |

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| Siuslaw Sand Tiger Beetle | | | | | |
| 1 | Invasive and other problematic species | Invasive plants, those currently here, and many yet to come in the future, establish in habitat and stabilize soil, thereby making habitat unsuitable | Using herbicide and mechanical methods to maintain open ground and appropriate soil condition | Nothing current - new action needed | Both |
| 2 | Resource Information Collection Needs | Need to determine where extant in WA | Revisit historic locales and search for new populations | Current insufficient | Both |

NOTE: Numbers are for reference only and do not reflect priority.

# CADDISFLIES

## CADDISFLIES (Trichoptera)

**Conservation Status and Concern**

Caddisflies are aquatic insects. They are very sensitive to water quality and changes in water flow. Certain species have been used as biotic indicators of pollution.

| **Common Name** (Scientific name) | Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend |
|---|---|---|---|---|---|---|
| **[unnamed]** (*Allomyia acanthis*) | None | None | No | G2G3 | SNR | Low/unknown |
| **[unnamed]** (*Goereilla baumanni*) | None | None | No | G2 | SNR | Low/unknown |
| **[unnamed]** *(Limnephilus flavastellus)* | None | None | No | G2 | SNR | Low/unknown |
| **[unnamed]** *(Psychoglypha browni)* | None | None | No | G2G4 | SNR | Low/unknown |
| **[unnamed]** *(Rhyacophila pichaca)* | None | None | No | G2G3 | SNR | Low/unknown |
| **[unnamed]** *(Rhyacophila vetina)* | None | None | No | G2 | SNR | Low/unknown |

| **CLIMATE VULNERABILITY RANKING** | |
|---|---|
| **Common Name** (Scientific name) | Ranking |
| **[unnamed]** (*Allomyia acanthis)* | High |
| **[unnamed]** *(Goereilla baumanni)* | High |
| **[unnamed]** (*Limnephilus flavastellus)* | Moderate-high |
| **[unnamed]** (*Psychoglypha browni)* | Moderate-high |
| **[unnamed]** (*Rhyacophila pichaca)* | Moderate |
| **[unnamed]** (*Rhyacophila vetina)* | High |

**Biology and Life History**

Caddisflies are closely related to the Lepidoptera (moths and butterflies). They are aquatic in the immature stages. During the day, adults hide in cool, moist environments such as the vegetation along river banks. Few species have actually been observed feeding; they imbibe nectar. The body and wings are covered with long silky hairs (setae) – a distinctive characteristic of the order. Adults live several weeks and usually mate on vegetation or rocks surrounding water. There is generally one complete generation per year, although some species require two years for development and some less than a year. Eggs, in masses numbering up to 800, are laid within a jelly that swells on contact with water. A female may wash off a partially extruded egg mass by dipping her abdomen into water during flight, or she may place the mass on stones in the water or on aquatic plants just above the water. Young larvae hatch within a few days and most species progress through five instars before emerging as a winged adult. Although most larvae feed on aquatic plants, algae, diatoms, or plant debris, a few are predatory on other aquatic insects, crustaceans, and mollusks, and a few are omnivorous. The larvae play an important role in the aquatic community, reducing plant growth and disposing of animal and plant debris. In some species the larvae form webs of debris for protection, while others form a funnel-like web between stones in running water to catch food. Some protect their bodies with cases, whereas others spin protective lairs or are free-living. They produce silk from glands on the lower lip (labium), and many herbivorous species spin tubular protective cases that are open at both ends and enlarge as the larvae grow. Sand grains, pebbles, bits of wood or vegetation are added to cases to provide protection and rigidity. In case-bearing forms, the head and thorax protrude from the case, which is pulled along by the abdomen. The larva pupates inside the larval case, which then becomes a cocoon, or inside a specially constructed cocoon. After 2 or 3 weeks the pupa bites its way out of the cocoon and swims or crawls to the water surface, using its hair-fringed middle pair of legs. Caddisfly adults sometimes emerge in large numbers, often forming swarms. Adults tend to remain somewhat near the emergence site where oviposition occurs. They tend to disperse shorter distances in dense forest compared with more open vegetation. Although dispersal flights are common, such flights are relatively short and only occur immediately following emergence. Large river caddisflies have been collected over 3 miles from water.


*Rhyacophila acutiloba* – a caddisfly in the Rhyacophila genus.
Photo: T. Murray

**Distribution and Abundance**

***Allomyia acanthis***: Adults of this species are known from the Cascade Range in Washington and Oregon. Reported from Paradise Ice Caves, Mt. Rainier National Park, Pierce County, Washington. Larvae are undescribed/unknown. *Allomyia* species occur in very small, localized populations, with many isolated mountains inhabited by a single endemic species, and many species in this genus remain undescribed or undiscovered.

***Goereilla baumanni***: In Washington, this species is known from streams in the Big Spring Picnic Ground on Mt. Spokane, Spokane County. Also reported from spring seepage areas in Montana and Idaho. In all three states, it is always reported in very low abundance.

***Limnephilus flavastellus***: This species has been recorded in Mason County, and was recently reported from Mt. Rainier National Park, Pierce County, Washington. It is also found in British Columbia, Oregon (Douglas, Klamath, Yamhill Counties). The larvae are undescribed/unknown.

***Psychoglypha browni***: Recently reported from Mt. Rainier National Park, Pierce County, Washington. Adults are known from Oregon (Clackamas, Klamath, and Lane Counties). The larvae are undescribed/unknown.

***Rhyacophila pichaca***: This species is recorded from Olympic Hot Springs, Boulder Lake, Washington, Clallam County. Also known from Cascade Head Experimental Forest, Tillamook County, near Otis, Oregon.

***Rhyacophila vetina*:** This species is uncommon in the high Cascades of Washington. It was recently reported from Mt. Rainier National Park, Lewis and Pierce Counties. It has also been reported in Clackamas County, Oregon.

**Habitat**

Most North American caddisfly species occur in cool, running freshwater, but some also occur in most types of freshwater habitats: spring streams and seepage areas, rivers, lakes, marshes, and temporary pools.

***A. acanthis*:** This species is normally found in very cold, high altitude springs, seeps, and small spring streams up to 6 feet across. They are often found grazing on the surface or sides of larger rocks in open, sunny areas.

***G. baumanni*:** *G. baumanni* appears to inhabit organic muck in spring areas. It is currently known from higher altitudes.

***L. flavastellus*:** This species has a broad altitudinal range from low altitude valley ponds to high mountain ponds and lakes, and is tolerant of large temperature variations. It is most abundant in waters without salmonids.

***P. browni*:** This species inhabits depositional areas of streams and large springs in mid- and high altitude localities.

***R. pichaca*:** This species has been found at low and high altitude lakes, possibly along tributaries. Specific habitat information has not been described.

***R. vetina*:** This species is associated with cold springs and spring channels at mid- to high altitudes.

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**Caddisflies: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Resource information collection needs | Lack of data on current status and distribution | Determine distribution, population status | Current insufficient | Both |
| 2 | Climate change and severe weather | Drying of streams | Determine distribution, population status | Current insufficient | Both |
| 3 | Fish and wildlife habitat loss or degradation | Water quality is of extreme importance to aquatic insects. | Protect riparian habitats | Current insufficient | Both |

NOTE: Numbers are for reference only and do not reflect priority.

# MOTHS

## Genus *Copablepharon*

**Conservation Status and Concern**

These four *Copablepharon* moths (Family Noctuidae) are imperiled due to rare habitat types, small number of isolated populations, extremely limited range, and known threats to their habitats. The Sand Verbena Moth was petitioned for listing under the ESA, and the US Fish and Wildlife Service (USFWS) found "the petition presents substantial information indicating that listing the Sand Verbena Moth may be warranted."

| **Common Name** (Scientific name) | Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend |
|---|---|---|---|---|---|---|
| **Sand Verbena Moth** (*Copablepharon fuscum*) | In review | Candidate | Yes | G1G2 | S1 | Low/unknown |
| **[unnamed]** *(Copablepharon columbia)* | None | None | No | GNR | SNR | Critical/declining |
| **[unnamed]** ***(****Copablepharon mutans)* | None | None | No | GNR | SNR | Critical/declining |
| **[unnamed]** *(Copablepharon viridisparsa hopfingeri)* | None | None | No | GNR | SNR | Critical/declining |

| CLIMATE VULNERABILITY RANKING | |
|---|---|
| **Common Name** (Scientific name) | Ranking |
| **Sand Verbena Moth** *(Copablepharon fuscum)* | Moderate-high |
| **[unnamed]** *(Copablepharon columbia)* | Moderate |
| **[unnamed]** (*Copablepharon mutans)* | Moderate |
| **[unnamed]** *(Copablepharon viridisparsa hopfingeri)* | Moderate |

**Biology and Life History**

The Sand Verbena Moth was discovered on a few coastal beach sites on Vancouver Island, British Columbia, Canada, and Whidbey Island, in northwestern Washington, and described as a new species in 1995. The three additional *Copablepharon* moth species were described in 2004. They inhabit small, geographically isolated sand dune complexes in the Columbia River Basin of eastern Washington, rare ecological systems that are threatened by several factors. There has been little study of the biology and life history of these species. Sand Verbena Moth has received some attention from Pacific Northwest biologists; however, even

Sand Verbena Moth larva feeding on host flowers.
Photo: N. Page

host plants are not confirmed for the other three species. *Copablepharon* moths complete a single life cycle annually (univoltine). They are sedentary, nocturnal moths that do not stray far from their restricted habitats and host plants. Specialists of well-drained and sandy soils, the larvae burrow into the soil, emerging at night to feed on vegetation. Sand Verbena Moth larvae feed on only a single plant, yellow sand verbena (*Abronia latifolia*) (Family Nyctaginaceae), a regionally rare, perennial species found on coastal dunes and beaches. Adult moths nectar primarily from this plant as well and females lay eggs directly on the flowers. Larvae feed on both flowers and leaves. Adults are present from mid-May through early July, and usually fly during dusk and early evening. Larvae are dormant, burrowed in the sand during winter, reemerging in early-spring to feed and then pupate. *C. columbia* adults occur in early-June; *C. mutans* adults in late August and early September; and *C. viridisparsa hopfingeri* flies in July and August.

**Distribution and Abundance**

The distributions of these species are limited by their dependence on rare and highly restricted ecological systems. An endemic of Salish Sea sandy coastal sites, the Sand Verbena Moth is known from only 10 sites; five on Vancouver Island, British Columbia, Canada, and five in Washington along the eastern edge of the Straits of Juan de Fuca (San Juan, Island, Jefferson, and Clallam Counties). Sand Verbena Moth is the only *Copablepharon* species known from west of the Cascades Mountains. Recent efforts have been made to locate additional populations within and outside of this area.

*C. columbia, C. mutans, and C. viridisparsa hopfingeri* are each restricted to a small number of sand dune sites in the semiarid Columbia Basin in eastern Washington. *C. columbia* is known from only a single sand dune complex, located on the southwest shore of Moses Lake (Grant County), and despite extensive sampling in this region, most specimens have been collected from a single dune within this site. *C. mutans* has been found in two sand dune areas along the Columbia River: near the Wanapum Dam (Grant County) and within the US Department of Energy Hanford site (Benton County). *C. viridisparsa hopfingeri* historically occurred in sand dunes along the Columbia River from Trail, British Columbia, Canada to Wenatchee, Washington. However, the only recent records are from Bridgeport State Park (Okanogan County) and Fort Spokane State Park (Lincoln County).

**Habitat**

*Copablepharon* moths are habitat specialists that rely on loose, well-drained soils, especially sand. They are restricted to active (non-stabilized) sandy sites, coastal sand beaches and spits for Sand Verbena Moth, and for the three other taxa, inland sand dunes in an arid shrub-steppe setting. The sands in all cases are glacially derived, and wind action provides soil disturbance that supports native vegetation. Beach and sand dune sites that have been stabilized from introduced plants or by other actions typically lose much of their native vegetation. These sand substrate habitats are rare in the Pacific Northwest. Additional habitat parameters are known for Sand Verbena Moth, which has received some study; this moth persists only on sites with large, dense, flowering patches of yellow sand verbena.

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### Genus Copablepharon: Conservation Threats and Actions

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| Sand Verbena Moth | | | | | |
| 1 | Climate change and severe weather | Populations located adjacent to marine waters- that are rising | Evaluate landscape and develop plan to increase habitat area and habitat heterogeneity in currently occupied sites and within occupied landscapes | Nothing current - new action needed | Both |
| 2 | Invasive and other problematic species | Invasive plants, those currently here, and many yet to come in the future, out-compete natives and otherwise make habitat unsuitable | Using herbicide and mechanical methods to maintain open sand dunes | Nothing current - new action needed | Both |
| *Copablepharon columbia* | | | | | |
| 1 | Invasive and other problematic species | Sand dune obligate: dunes are being stabilized by invasive species, especially cheatgrass | Eradicate cheatgrass and other invasive plants from dune systems | Nothing current - new action needed | Both |
| *Copablepharon mutans* | | | | | |
| 1 | Invasive and other problematic species | Sand dune obligate: dunes are being stabilized by invasive species, especially cheatgrass | Eradicate cheatgrass and other invasive plants from dune systems | Nothing current - new action needed | Both |
| *Copablepharon viridisparsa hopfingeri* | | | | | |
| 1 | Invasive and other problematic species | Sand dune obligate: dunes are being stabilized by invasive species, especially cheatgrass | Eradicate cheatgrass and other invasive plants from dune systems | Nothing current - new action needed | Both |

NOTE: Numbers are for reference only and do not reflect priority.

# BUTTERFLIES

## GREAT ARCTIC *(Oeneis nevadensis gigas)*

**Conservation Status and Concern**

A Pacific Northwest endemic, this butterfly has been found on a single site within the United States, in northwestern Washington; it also occurs in southwestern British Columbia, and may occur on other sites with similar habitat. It is a SGCN due to its restricted range, distribution, and habitat, and many threats to its grassland-forest edge habitat.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| None | Candidate | Yes | G5TU | SH | Critical/unknown | Low-moderate |

**Biology and Life History**

Photo: M. Patterson

The Great Arctic, a member of the Satyr (Satyrinae) butterfly subfamily, is a large tawny brown butterfly with a bark-like patterned ventral hindwing, such that when perched they are quite camouflaged. Great Arctic belongs to a group of butterflies, the arctics and alpines, that inhabit far northern and alpine climes. One unusual aspect of their life history is a life cycle, from egg to adult that spans 2 years. The life history of Great Artic is not well known. Adults are present in June and July, and females lay eggs on unknown species of grasses where larvae develop over two years; the timing and location of larval and pupal stages are unknown. This 2-year life cycle is synchronized amongst individuals and results in adults mostly occurring in even-numbered years. Males exhibit territorial flight behaviors of perching and patrolling, and are known to congregate on ridges and hilltops, a behavior called “hilltopping”. This butterfly’s habits of jerky flights through open forest and perching on trees where they are concealed makes them difficult to detect.

**Distribution and Abundance**

The species occurs in British Columbia, primarily on Vancouver Island, with a few sites in the mainland Coast Range, and a single site known from Washington, on Orcas Island (San Juan County) in the northwestern portion of the state. Recent efforts to relocate Great Arctic on Orcas Island have been inconclusive; WDFW surveyors had fleeting observations of unidentified but similar looking butterflies, and located additional potential habitat for future survey. If this butterfly persists in Washington, population sizes are likely small.

**Habitat**

The Great Arctic inhabits forest openings, meadow edges, and rocky slopes and outcrops from sea level to mid-elevations. Aside from dependence on specific but unknown grasses and forest edge ecotone, little is known of their habitat requirements.

**References**
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Pyle, R. 1989. Washington butterfly conservation status plan. WDFW. Olympia. 216pp.

### Great Arctic: Conservation Threats and Actions

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Resource information collection Needs | Current status and distribution in WA unknown | Survey historic locale and other potential sites | Current insufficient | WDFW |
| 2 | Invasive and other problematic species | Forest encroachment due to long-term fire suppression has reduced amount and quality of habitat. Host plant is a grass, and species utilizes open forest and forest edge | Remove invading trees and shrubs | Nothing current - new action needed | Both |

NOTE: Numbers are for reference only and do not reflect priority.

## ISLAND MARBLE (*Euchloe ausonides insulanus*)

**Conservation Status and Concern**

The Island Marble is a rare butterfly, restricted to two San Juan Islands. Petitioned for listing under the ESA in 2012, the USFWS found "listing the island marble butterfly as an endangered species may be warranted.".

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| In review | Candidate | Yes | G5T1 | S1 | Critical/declining | Moderate-high |

**Biology and Life History**

Photo: T. Hanson

The Island Marble is a univoltine butterfly; the adult flight period extends from approximately mid-April through late June. Adults feed on floral nectar, and more than 10 plant species have been documented as nectar sources, primarily of the mustard family (Brassicaceae). Species that serve as larval hosts include field mustard (*Brassica campestris)*, tall tumble-mustard (*Sisymbrium altissimum)*, and Menzies pepper-grass (*Lepidium virginicum* var. menziesii*).* Adults regularly travel from their natal patches and have been observed flying a mile or more. Island Marble females lay eggs on the flowers of specific mustard species, and when egg-laying are selective about individual plants, location within mustard patches, and at the micro-scale, flower phenology and the location on plants. Larvae feed on flowers, pedicels and developing fruits through five growth stages (instars) before leaving the host plant and making their way through the plant canopy in search of pupation sites. Pupation sites are located above the ground on senesced grasses or other low vegetation, within 25 feet of their hostplant. This species spends the majority of its annual life cycle (July to April), including winter as a pupa (chrysalis). Larval survival is low (6 percent to fifth instar), with threats including predation (especially by spiders), browsing deer, human disturbance, and weather events.

**Distribution and Abundance**

The Island Marble was found in a total of four distinct populations at 52 sites on San Juan and Lopez islands. It was originally known from only 14 specimens collected on Vancouver and Gabriola Islands in southwestern British Columbia, between 1861 and 1908. It was believed extinct, and then rediscovered at the San Juan Island National Historical Park in 1998, and formally described in 2001. WDFW surveys found that most Island Marble sites and populations discovered early on are now extinct. The sole definitively extant population persists with an estimated 50 to 100 adults on the south end of San Juan Island.

**Habitat**

The Island Marble inhabits open grasslands, disturbed sites, and herbaceous or sparsely vegetated habitats including native prairie, fields and pastures, sand dunes, gravel pits, and marine beach and lagoon margins where their annual hostplants persist. Extensive research has been conducted on the host patch characteristics selected by females for egg-laying.

**References**

Fleckenstein, J. and A. Potter. 1999. 1997, 1998 Project summary Puget prairie butterfly surveys. Washington Department of Natural Resources and Washington Department of Fish and Wildlife, Olympia, WA.

Guppy, C. and J. Shepard. 2001. Butterflies of British Columbia: including Western Alberta, Southern Yukon, The Alaska Panhandle, Washington, Northern Oregon, Northern Idaho, and Northwestern Montana. University of British Columbia Press, Vancouver, B.C.

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Xerces –The Xerces Society for Invertebrate Conservation. 2012. Petition to list the island marble butterfly, *Euchloe ausonides* insulanus (Guppy and Shepard, 2001) as an endangered species under the US endangered species act. Portland, OR. Submitted August 22, 2012.

## Island Marble: Conservation Threats and Actions

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Invasive and other problematic species | Black-tailed deer abundance and extensive herbivory of hostplants and eggs/larvae | Erect deer-exclusion fences in areas of habitat | Current insufficient | Both |
| 2 | Agriculture and aquaculture side effects | Development of commercial fields of butterfly's host within area occupied, that serve as ecological traps | Consider planning for zones that would exclude large-scale farming of hostplant as a crop | Nothing current - new action needed | Both |

NOTE: Numbers are for reference only and do not reflect priority.

## MONARCH BUTTERFLY (*Danaus plexippus*)

**Conservation Status and Concern**
The Monarch butterfly faces significant threats in both summer and winter habitats, and action is needed to restore populations. Western Monarchs, including those breeding within Washington, have declined by more than 50 percent since 1997.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| In review | None | No | G4 | S4 | Low/declining | Moderate |

**Biology and Life History**


Photo: D. Ramsev

Monarchs, once common throughout the United States, undertake a spectacular multi-generational migration of thousands of miles between their northern breeding areas and overwintering areas in interior montane Mexico and coastal California. Most Monarchs that breed west of the Rocky Mountains, including in Washington State, overwinter in California. The life cycle of the Monarch butterfly is directly intertwined with their milkweed host (genus *Asclepias*). Monarchs lay their eggs on milkweed species, and resulting larvae and pupae develop on these plants. The milkweed plants' chemical defense compounds are accumulated in Monarch larvae, pupae, and adults and used to defend against their predators. The duration of complete development (from egg to adult) is dependent on weather conditions and can vary from 25 days to 7 weeks. Like most butterflies, Monarch adults rely on floral nectar for nutrition. Although Monarchs are dependent on temperate zones for reproduction, the adults cannot survive freezing temperatures. Late summer adults undergo a physiological transformation to fat-storing, non-reproductive butterflies. They commence movements south (often in groups) to overwintering sites, covering an average of 25 to 30 miles per day, stopping at night, to feed, and during inclement weather. During spring migration, Monarchs typically do not travel in groups. They make their way north through subsequent generations until late summer.

**Distribution and Abundance**
Monarchs occur throughout most of the United States, southern Canada, and northern Mexico. In Washington, they are found east of the Cascades where milkweed occurs. Estimates of the historic California wintering population range from 1 million to 10 million butterflies. Monarchs have undergone an enormous decline in numbers in both eastern and western populations. The California overwintering population dropped from an estimated 1.2 million butterflies in 1997 to 200,000 in 2013. The number of Monarchs in Washington State is relatively low. Milkweeds are patchily distributed within the Columbia Basin. Monarchs migrating south through Washington often concentrate along the large river courses of the Columbia and Snake Rivers.

**Habitat**
Monarchs breed and travel through Washington but do not overwinter in the state. Monarchs require secure patches of milkweed and nectar resources during breeding, roosting sites and safe travel corridors for migration. Milkweeds and Monarchs in Washington occur in weedy fields and sparsely vegetated habitats, typically near wetlands or riparian areas. Southbound travel corridors, often river courses, need abundant late season nectar and trees for roosting at night and during periods of inclement weather.

**References**
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Oberhauser, K. and M. Solensky, eds. 2004. The Monarch Butterfly: Biology and Conservation. Cornell University Press.
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### Monarch Butterfly: Conservation Threats and Actions

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Resource information collection needs | Out of date and incomplete information on distribution | Conduct inventory and revisit historic locales (E WA) | Nothing current - new action needed | Both |
| 2 | Education needs | Hostplants are often targeted for removal by herbicide and mechanical methods | Habitat management planning | Nothing current - new action needed | Both |

NOTE: Numbers are for reference only and do not reflect priority.

## TAYLOR'S CHECKERSPOT (*Euphydryas editha taylori*)

*See Appendix B for a range and potential habitat distribution map

**Conservation Status and Concern**

This subspecies is currently restricted to a small scattering of eight populations in Washington, a single population in British Columbia, and two populations in Oregon. The decline of Taylor's Checkerspot has accompanied the loss of open prairie and grassland habitats. Taylor's Checkerspot was listed by the Washington Fish and Wildlife Commission as endangered in 2006, and listed endangered federally by the USFWS in 2013.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| Endangered | Endangered | Yes | G5T1 | S1 | Critical/stable | Moderate-high |

**Biology and Life History**


Photo: WDFW

Taylor's Checkerspot, a subspecies of Edith's Checkerspot, is a medium-sized butterfly with a striking checkered pattern of orange to brick red, black and cream. They complete one life cycle each year, and inhabit their sites year-round as eggs, larvae, pupae and adults. Adults emerge from pupation in the spring and feed on floral nectar from a variety of plants, often specializing on a few plant species. Adults mate and females subsequently lay eggs in clusters on plants in the family Plantaginaceae, primarily English plantain (*Plantago lanceolata)* and members of the Scrophulariaceae, primarily harsh paintbrush (*Castilleja hispida).* Eggs hatch in 8 to 9 days, and the resulting caterpillars (larvae) create webbing and feed communally through the spring on the hostplant species. Larvae enter a dormant phase (diapause) in late June to early August (exact timing dependent upon site conditions) when hostplants are no longer palatable. Larvae often diapause in a sheltered location under rocks, logs, or litter. The diapause phase lasts from summer until late winter (late January to late March). Upon breaking diapause, Checkerspot larvae resume feeding more broadly on oviposition plants and additional food sources (including sea blush (*Plectritis congesta*) and blue-eyed Mary (*Collinsia parviflora*). After spending 9 to 10 months as larvae, they progress into pupae in late March through early May. Adults emerge 2 weeks later and live for a few days to 2 weeks.

**Distribution and Abundance**

In Washington, the species was historically found on over 80 grassland sites from southeastern Vancouver Island, British Columbia through the southern Willamette Valley in Oregon. Taylor's Checkerspot is now restricted to a handful of populations; six populations are found in Clallam County on the northeastern Olympic Peninsula, and a single population persists in the south Puget Sound region, located on the Joint Base Lewis-McChord (JBLM). Efforts are currently underway to reestablish the butterfly on three south Sound sites. The Clallam County sites have populations of 1,000 or more butterflies on two sites, with more modest numbers at four others. The JBLM site has been estimated at >10,000 individuals.

**Habitat**

Taylor's Checkerspot inhabits short-stature grasslands in low-elevation prairies and meadows, old forest clearings, coastal meadows and stabilized dunes, and montane meadows, and balds. A study in Oregon found that Taylor's Checkerspots selected habitat for egg-laying that occurred within high cover of short-stature native bunchgrasses and adult nectar resources, indicating that females select egg-laying sites based on habitat condition. The British Columbia study population had multiple hostplant species available and females' selection of egg-laying sites in this environment was influenced by hostplant phenology and condition. Characteristics of egg-laying habitat consistently identified in the British Columbia and three Olympic Peninsula populations were abundance (number or percent cover) and density of hostplants.

**References**


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Severns. P. M and D. Grosboll. 2010. Patterns of reproduction in four Washington State populations of Taylor's checkerspot (*Euphydryas editha taylori*) during the spring 2010. Report submitted to the Nature Conservancy. 81 pp.

Stinson, D. W. 2005. Washington State status report for the Mazama pocket gopher, streaked horned lark, and Taylor's Checkerspot. Washington Department of Fish and Wildlife, Olympia, Washington. 129 pp.

USFWS. 2013. Endangered and threatened wildlife and plants; determination of endangered status for Taylor's Checkerspot butterfly and threatened status for the streaked horned lark; final rule. Federal Register 78 (192):61451-61503.

**Taylor's Checkerspot: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Invasive and other problematic species | Invasive plants, those currently here, and many yet to come in the future, out-compete native grassland species, and otherwise make habitat unsuitable | Using herbicide, fire, and mechanical methods to restore native prairie | Current insufficient | Both |
| 2 | Invasive and other problematic species | Invasive plants, those currently here, and many yet to come in the future, out-compete native grassland species, and otherwise make habitat unsuitable | Planting/seeding native prairie species | Current insufficient | Both |
| 3 | Invasive and other problematic species | Trees and shrubs encroaching on habitat in forest matrix sites, primarily within Clallam Co, due to long-term fire suppression | Remove invading trees and shrubs | Current insufficient | Both |
| 4 | Fish and wildlife habitat loss or degradation | Only a few, small and disjunct populations remain in the south Sound region. | Reintroduce at restored prairie sites | Current sufficient | WDFW |
| 5 | Fish and wildlife habitat loss or degradation | Military training on JBLM that is poorly timed or placed and significantly impacts populations | Develop best management practices for areas occupied by butterfly within JBLM | Current insufficient | Both |

NOTE: Numbers are for reference only and do not reflect priority.

## Family Lycaenidae: GOSSAMER WING BUTTERFLIES

**Conservation Status and Concern**

Seven lycaenid butterflies were recognized as SGCN due to their rare and restricted hostplants and habitat types, small number of isolated populations, highly limited range and distribution, and threats to their habitat.

| **Common Name** (Scientific name) | Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend |
|---|---|---|---|---|---|---|
| **Makah Copper** (*Lycaena mariposa charlottensis*) | None | Candidate | Yes | G5T5 | S2 | Low/declining |
| **Golden Hairstreak** (*Habrodais grunus herri*) | None | Candidate | Yes | G4G5 | S1 | Critical/declining |
| **Johnson's Hairstreak** (*Callophrys johnsoni*) | None | Candidate | Yes | G3G4 | S2S3 | Low/unknown |
| **Juniper Hairstreak** (*Callophrys gryneus* Columbia Basin segregate) | None | Candidate | Yes | G5TU | S2? | Low/unknown |
| **Hoary Elfin** (*Callophrys polios* Puget Trough segregate) | None | Monitor | No | G5T2T3 | S2S3 | Critical/declining |
| **Puget (Blackmore's) Blue** (*Icaricia icarioides blackmorei*) | None | Candidate | Yes | G5T3 | S2 | Low/declining |
| **Straits Acmon Blue** (*Icaricia acmon sp.*) | None | None | No | G5T? | SNR | Critical/declining |

| CLIMATE VULNERABILITY RANKING | |
|---|---|
| **Common Name** (Scientific name) | Ranking |
| **Makah Copper** *(Lycaena mariposa charlottensis)* | Moderate-high |
| **Golden Hairstreak** *(Habrodais grunus herri)* | N/A |
| **Johnson's Hairstreak** *(Callophrys johnsoni)* | Moderate-high |
| **Juniper Hairstreak** *(Callophrys gryneus Columbia Basin segregate)* | Moderate |
| **Hoary Elfin** *(Callophrys polios Puget Trough segregate)* | Low-moderate |
| **Puget (Blackmore's) Blue** *(Icaricia icarioides blackmorei)* | Alpine populations - High<br>Low elevation populations - Low-moderate |
| **Straits Acmon Blue** (*Icaricia acmon sp.)* | Moderate-high |

**Taxonomic note:** Genera synonyms: Hairstreak *Callophrys* = *Mitoura*; Elfin *Callophrys* = *Incisalia*; Blue *Icaricia* = *Plebejus*; Straits Acmon Blue was discovered in 2005.

**Biology and Life History**

Hoary Elfin perched in kinnikinnick on south Puget Sound prairie. Photo: R. Gilbert

The Lycaenidae butterfly family consists of small and often brightly colored species with the common names: copper, hairstreak, elfin, and blue. Lycaenid butterfly SGCN complete a single life cycle annually (univoltine), except Straits Acmon Blue which has two generations per year (spring and late summer). All are sedentary butterflies and do not migrate; instead, the species inhabits sites year-round (as egg, larva, pupa and adult), typically moving within only a few hundred yards of their natal locations. Adults emerge from their chrysalids (pupae) during species-specific time periods (See Table 1). Males begin emergence first, followed by females; late season individuals are primarily or solely females. Weather influences butterfly emergence and the flight period duration, with wet or cold conditions potentially delaying emergence, and warm, dry conditions promoting earlier emergence. Male lycaenids seek mates using patrolling patterned flight or perching on vegetation in select spots and darting out to inspect passing butterflies. Females search for egg-laying sites by slowly flying and hovering above hostplant vegetation, and then landing and crawling to inspect vegetation before depositing eggs singly. Both males and females feed by using their long proboscis to sip floral nectar. Males of most species require salts, which they obtain from evaporated puddles and moist soil and animal urine and feces. Larvae are slug-like in appearance and highly camouflaged in their host species. Many lycaenid larvae engage in mutualistic relationships with ants, known as myrmecophily, which typically consists of ants tending and milking larvae, obtaining nutrition in the form of a nectar-like substance (honeydew) in the process, and also protecting larvae from predators and parasitoids; in some situations the ants move butterfly larvae or pupae into ground chambers, including their nests. Ant interactions have been observed with Golden Hairstreak and Puget Blue; however, more study is needed to determine the extent of interaction and ecological significance of ant-larval relationships in these species. The overwintering stage varies by species: Makah Copper and Golden Hairstreak overwinter as eggs; Puget Blue as larvae; and Johnson's and Juniper Hairstreaks, and Hoary Elfins as pupae. The overwintering stage is not known for Straits Acmon Blue.

Key life history attributes for Washington populations of lycaenid butterfly SGCN.

| Species | Adult Period | Hostplants | Primary Nectar Plants |
|---|---|---|---|
| Makah Copper | Jul-Aug | Bog cranberry (*Vaccinium oxycoccos*) | Swamp gentian (*Gentiana douglasiana*) |
| Golden Hairstreak | Aug-Sep | Golden chinquapin (*Chrysolepis chrysophylla*) | Late-summer flowers in tree canopy and herbaceous forest edge |
| Johnson's Hairstreak | Jun-Jul | Western dwarf mistletoe (*Arceuthobium campylopodum)* | Variety of herbaceous and shrub, mid-summer flowering plants |
| Juniper Hairstreak | Apr-May | Western juniper (*Juniperus occidentalis*) | Unknown |
| Hoary Elfin | Apr-May | Kinnikinnick (*Arctostaphylos uva-ursi*) | Kinnikinnick |
| Puget (Blackmore's) Blue | Jun-Jul | Sickle-keeled lupine, broadleaf lupine (*Lupinus albicaulis, L. latifolius*) | Host lupine |
| Straits Acmon Blue | May-Jun; Aug | Black knotweed (*Polygonum paronychia*) | Unknown |

**Distribution and Abundance**

The distributions of these species are limited in part by a combination of their dependence on rare hostplant occurrence within rare habitat types. Their distribution and abundance in Washington is characterized by small numbers of small isolated populations. Recent survey efforts have been undertaken in Washington to determine the current distribution of Makah Copper, Golden Hairstreak, Johnson's Hairstreak, Hoary Elfin, Puget Blue, and Straits Acmon Blue. Still, little is known of the current distribution of Johnson's Hairstreak and Juniper Hairstreak, and of Hoary Elfin on the Kitsap Peninsula. Species overall range in Washington and estimated number of populations are summarized in Table 2.

Overall range; Washington counties and estimated number of extant populations for lycaenid butterfly SGCN.

| Species | Range-Overall | Counties in WA | Est # Pop in WA |
|---|---|---|---|
| Makah Copper | Outer coast and low-elevation Olympic Peninsula, WA | Clallam, Grays Harbor, Jefferson, Mason, | 10-15 |
| Golden Hairstreak | Disjunct, and limited by chinquapin host: N Oregon Cascades; small area in Oregon Coast Range; small area in S WA Cascades | Skamania | 1-2 |
| Johnson's Hairstreak | Mature forests in SW British Columbia; western WA; W Oregon and N California | Jefferson, Lewis, Mason, Pierce, Skamania, Snohomish | 5-10? Few recent detections |
| Juniper Hairstreak | Scattered in central Columbia Basin: SE WA; NE Oregon | Asotin, Columbia, Douglas, Franklin, Garfield, Grant, Klickitat | 5-10? Few recent detections |

| | | | |
|---|---|---|---|
| Hoary Elfin | South Puget Sound region | Kitsap, Mason, Pierce, Thurston | 10-15 |
| Puget (Blackmore's) Blue | S Vancouver Is, British Columbia; eastern Olympic Mountain range, south Puget Sound region, WA | Clallam, Grays Harbor, Jefferson, Mason, Pierce, Thurston | 7-10 (S Puget Sound), 30-40 (Olympic Mountains) |
| Straits Acmon Blue | Coastal WA: Straits of Juan de Fuca | Clallam | 3 |

**Habitat**

These species inhabit a wide diversity of ecological systems, from forests to prairies, all of which are rare and declining. Hostplants for these butterflies are also rare, uncommon, or ecologically restricted. This species group includes butterflies that use tree or tree-growing (mistletoe) hostplants and inhabit the forest canopy (Golden Hairstreak, Johnson's Hairstreak, Juniper Hairstreak), as well as prostrate, woody shrub-dependent species (Makah Copper, Hoary Elfin, Straits Acmon Blue), and an herbaceous plant (lupine) feeder (Puget Blue) (see Table 1). Research is needed on all species to understand their life history and quantify specific habitat requirements including vegetation structure, food plant size and density, and key habitat features.

**Makah Copper:** A coastal *Sphagnum* bog obligate, this butterfly's hostplant is bog cranberry, a prostrate, vine-like, dwarf evergreen shrub. Both butterfly and host occur within 20 miles of the outer coast and Salish Sea. Bogs in this region are small, low elevation patches dominated by *Sphagnum* mosses and other bog-specific herbaceous plants and shrubs within an otherwise heavily forested landscape.

**Golden Hairstreak:** Confined to the few small patches of golden chinquapin, a broadleaf evergreen tree that occurs in low to middle elevations in southern Skamania County, the northern extent of the species' range. The Golden Hairstreak spends much of its adult life, and all of its egg, larval, and pupal life stages in the open forest canopy of chinquapins. Small, adjacent forest openings in this landscape often provide additional floral nectar sources and puddling sites. Beyond their chinquapin host requirement, little is known of their habitat needs.

**Johnson's Hairstreak:** This butterfly depends on western dwarf mistletoe, a plant that parasitizes old-growth western hemlock (*Tsuga heterophylla*) trees. Eggs are laid and larvae feed on western dwarf mistletoe, which typically grows high up in its host tree. Western hemlock occurs in low to middle elevations; Johnson's Hairstreak has been found in western Washington forests from 100 to 2500 feet in elevation. Small, adjacent forest openings in this landscape often provide additional floral nectar sources and puddling sites.

**Juniper Hairstreak:** Inhabits low to middle elevation, Columbia River Basin shrub-steppe where stands of its host western juniper, a short evergreen tree, occur. Nectaring occurs on spring flowering shrub-steppe plants in close proximity to host junipers. The Juniper Dunes Wilderness (Bureau of Land Management) in Franklin County is one of the few Washington locations where the species can reliably be found. Beyond their juniper host need, little is known of their habitat requirements.

**Hoary Elfin:** This species' hostplant, kinnikinnick, is a short, prostrate, evergreen woody shrub, relatively common at most elevations in western Washington; however the butterfly occurs only at low elevations on glacial outwash prairies and forest opening balds in the south Puget Sound region and early successional scrub-heath habitats (including forest clearings) on the Kitsap Peninsula. Hoary Elfin habitat across all regions is open or located at forest edge.

**Puget (Blackmore's) Blue:** Inhabits low elevation grasslands (prairies) in south Puget Sound, and sub-alpine meadows in the Olympic Mountains. The perennial sickle-keeled lupine is the larval host and primary adult nectar source for the Puget Blue on two south Sound prairies. The butterfly's dependence on sickle-keeled lupine limits their habitat to areas and sites that support significant patches of this plant. Density of host lupine across two Puget Blue varied between years and sites from 0.08-0.48 plants per square yard. Another important habitat feature is bare ground depressions where water collects and evaporates during the adult flight period; males rely on these sites to obtain minerals (puddling). There have been no studies of habitat requirements for sub-alpine Olympic Mountain Puget Blue populations.

**Straits Acmon Blue:** This Acmon Blue subspecies is restricted to a few coastal sand spits and beaches along the southern shores of the Straits of Juan de Fuca, in Clallam County where it uses the semi-shrubby, prostrate, black knotweed for its host. Beyond their host need and sand spit and beach occurrence, little is known of their habitat requirements.

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**Family Lycaenidae: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| Makah Copper | | | | | |
| 1 | Agriculture and aquaculture side effects | Bog/fen obligate; habitat and species are vulnerable to alteration of local hydrology from logging and road building | Leading or participating in land use planning for rural, urban, and forestry lands | Current insufficient | Both |
| 2 | Resource information collection needs | Species in WA likely distinct subspecies | Genetic study to determine if WA populations are distinct subspecies | Nothing current - new action needed | Both |
| Golden Hairstreak | | | | | |
| 1 | Agriculture and aquaculture side effects | Habitat and hostplant, a rare tree/shrub occurs in areas with active logging practices | Develop plan with landowners to manage sites for butterfly, host, and habitat | Nothing current - new action needed | Both |
| 2 | Resource information collection needs | Current distribution unknown | Identify host patches and survey for butterfly | Current insufficient | Both |
| 3 | Resource information collection needs | Need to identify habitat needs, including optimal canopy cover in order to manage for species | Study habitat selection and requirements and use this information to develop management plans | Nothing current - new action needed | Both |
| Johnson's Hairstreak | | | | | |
| 1 | Agriculture and aquaculture side effects | Species habitat is low-elevation, old-growth forest that has been impacted by logging | Habitat management planning that recognizes importance of forest type and mistletoe species | Current insufficient | External |
| 2 | Resource information collection needs | Lacking information on current status of known sites and distribution | inventory; status assessment | Current insufficient | Both |
| Juniper Hairstreak | | | | | |
| 1 | Resource information collection needs | Lacking information on current status of known sites and distribution | Inventory; status assessment | Nothing current - new action needed | WDFW |
| 2 | Fish and wildlife habitat loss or degradation | Juniper woodlands are threatened with development, unsustainable grazing practices, ORV use, etc. | Habitat management planning that recognizes importance of juniper woodlands | Current insufficient | External |
| Hoary Elfin | | | | | |
| 1 | Fish and wildlife habitat loss or degradation | Development destroying prairie habitat | Species and habitat management plans for occupied sites | Current insufficient | Both |

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 2 | Fish and wildlife habitat loss or degradation | Development destroying prairie habitat, including highway building | Purchase and protect prairie sites | Current insufficient | Both |
| 3 | Invasive and other problematic species | Invasive plants, those currently here, and many yet to come in the future, out-compete native grassland species, and otherwise make habitat unsuitable | Using herbicide, fire, and mechanical methods to restore native prairie | Current insufficient | Both |
| 4 | Invasive and other problematic species | Invasive plants, those currently here, and many yet to come in the future, out-compete native grassland species, and otherwise make habitat unsuitable | Planting/seeding native prairie species | Current insufficient | Both |
| 5 | Resource information collection needs | Knowledge of current distribution is incomplete | Conduct surveys to determine current status and distribution of populations, especially needed on the Kitsap Peninsula | Nothing current - new action needed | WDFW |
| Puget (Blackmore's) Blue | | | | | |
| 1 | Resource information collection needs | Knowledge of current distribution is incomplete | Conduct surveys to determine current status and distribution of populations, primarily needed on the Kitsap Peninsula and northeast Olympic Peninsula | Nothing current - new action needed | Both |
| 2 | Invasive and other problematic species | Invasive plants, those currently here, and many yet to come in the future, out-compete native grassland species, and otherwise make habitat unsuitable | Using herbicide, fire, and mechanical methods to restore native prairie | Current insufficient | Both |
| 3 | Invasive and other problematic species | Invasive plants, those currently here, and many yet to come in the future, out-compete native grassland species, and otherwise make habitat unsuitable | Planting/seeding native prairie species | Current insufficient | Both |
| Straits Acmon Blue | | | | | |

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Climate change and severe weather | Populations located adjacent to marine waters- that are rising | Evaluate landscape and develop plan to increase habitat area and habitat heterogeneity in currently occupied sites and within occupied landscapes | Nothing current - new action needed | Both |
| 2 | Invasive and other problematic species | Invasive plants, those currently here, and many yet to come in the future, out-compete natives and otherwise make habitat unsuitable | Using herbicide and mechanical methods to maintain open condition of vegetation | Nothing current - new action needed | Both |

NOTE: Numbers are for reference only and do not reflect priority.

## Subfamily Heliconiinae: FRITILLARY BUTTERFLIES

*See Appendix B for range and potential habitat distribution maps for the Oregon and Valley Silverspots

### Conservation Status and Concern

These species were recognized as SGCN in Washington due to their rare and restricted hostplants and habitat types, small number of isolated populations, limited range and distribution, and known threats to their habitats.

| **Common Name** (Scientific name) | Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend |
|---|---|---|---|---|---|---|
| **Puget Sound Fritillary** (*Speyeria cybele pugetensis*) | None | None | No | G5TU | S3? | Low/declining |
| **Valley Silverspot** (*Speyeria zerene bremnerii*) | None | Candidate | Yes | G5T3T4 | S2S3 | Critical/declining |
| **Oregon Silverspot (Speyeria zerene** *hippolyta***)** | Threatened | Endangered | Yes | G5T1 | SX | Extirpated |
| **Meadow Fritillary** (*Boloria bellona toddi*) | None | None | No | GNR | SNR | Low/declining |
| **Silver-bordered Fritillary** (*Boloria selene atrocostalis*) | None | Candidate | Yes | GNR | SNR | Low/declining |

| CLIMATE VULNERABILITY RANKING | |
|---|---|
| **Common Name** (Scientific name) | Ranking |
| **Puget Sound Fritillary** *(Speyeria cybele pugetensis)* | Low-moderate |
| **Valley Silverspot** (*Speyeria zerene bremnerii)* | Low-moderate |
| **Oregon Silverspot** (*Speyeria zerene hippolyta)* | Moderate |
| **Meadow Fritillary** (*Boloria bellona toddi)* | Low-moderate |
| **Silver-bordered Fritillary** (*Boloria selene atrocostalis)* | Moderate-high |

**Biology and Life History**

Puget Sound Fritillary
Photo: R. Gilbert

The Heliconiinae (Fritillary) subfamily consists of medium and large sized butterflies with distinctive black line and dot patterning on bright orange dorsally, and a heavily-patterned ventrum with silvery orbs (genus *Speyeria:* greater fritillaries) or muted colored triangles (genus *Boloria*: lesser fritillaries). The greater fritillaries (genus *Speyeria*) complete a single life cycle annually (univoltine), while the lesser fritillaries (genus *Boloria*) have two generations per year (spring and late summer). All are sedentary butterflies and do not migrate; instead, the species inhabits sites year-round (as egg, larva, pupa and adult). Adults emerge from their chrysalids (pupae) during species-specific time periods; typically early-to-late summer for *Speyeria,* and both spring and late summer for *Boloria*. Males begin emergence first, followed by females; late season individuals are primarily or solely females. Weather influences butterfly emergence and flight period duration, with wet or cold conditions potentially delaying emergence. Male fritillaries seek mates using rapid patrolling and searching flight behavior. Females search for egg-laying sites by slowly flying and hovering above hostplants and then landing and crawling to inspect vegetation before depositing eggs singly. Both males and females feed by using their long proboscis to sip floral nectar. Research on other *Speyeria* spp. suggests that nectar availability affects the number of eggs laid by females. These species depend on violets (genus *Viola*) for their hostplants. *Speyeria* fritillaries lay eggs late in the summer. A tiny larva hatches within a few weeks and seeks shelter to overwinter, but does not feed until the following spring. In *Boloria* fritillaries, the first (spring) generation of eggs mostly develops quickly, resulting in the second (summer) generation. Larvae from this second generation develop slowly and are the overwintering form for these butterflies. Fritillary larvae are generally dark with many bristled spines, and feed nocturnally; these characteristics, along with a gland that secretes defensive chemicals, protect larvae from predators.

**Distribution and Abundance**

The distribution of these species is limited in part by their dependence on rare habitat types. Their distribution and abundance in Washington is characterized by low numbers of small isolated populations. The Oregon Silverspot has been extirpated from Washington, though habitat has been restored and plans have been made to reintroduce this species. Declines in both the number and size of populations have been documented for the other four species. Surveys were recently conducted to determine the current distribution of the Puget Sound Fritillary and Valley Silverspot in the south Puget Sound region, and Meadow and Silver-bordered Fritillary in northeastern Washington. Little is known of the current status and distribution of these species in other portions of their range within the state. Species overall range, Washington counties, and estimated number of populations are summarized in Table 1.

Table 1. Overall range; Washington counties and estimated number of extant populations for fritillary butterfly SGCN.

| Species | Range-Overall | Counties in WA | Est # Pop in WA |
|---|---|---|---|
| Puget Sound Fritillary | Scattered populations: W Oregon; SW WA; montane NE Olympic Mountains, WA | Clallam, Clark, Cowlitz, Lewis, Mason, Pierce, Skamania, Thurston | 15-20 |
| Valley Silverspot | Scattered populations: SW WA; south Puget Sound region, WA; montane NE Olympic Mountains, WA; San Juan Islands, WA; southern Vancouver Island, Canada.<br>Extirpated from Oregon. | Clallam, Cowlitz, Jefferson, Lewis, Pierce, Thurston | 10-15 |
| Oregon Silverspot | Coastal Oregon and Northern CA | Grays Harbor, Pacific | Extirpated from WA |
| Meadow Fritillary | Okanogan Highlands: British Columbia, Canada and northeastern WA | Ferry, Okanogan<br>*possible* Stevens, Pend Oreille | 5-10<br>(few recent detections) |
| Silver-bordered Fritillary | Scattered populations: E Oregon; E WA; N Idaho; NW Montana; E British Columbia; W Alberta | Grant, Lincoln, Okanogan, Pend Oreille, Stevens, Whitman | 15-20<br>(few recent detections) |

**Habitat**

These species inhabit a wide diversity of ecological systems, from coastal dunes to native prairies, boreal bogs, and aspen meadows, all of which are rare and declining. Research is especially needed for the Meadow and Silver-bordered Fritillaries to understand and quantify specific habitat requirements including vegetation structure, food plant size and density, and key habitat features.

**Puget Sound Fritillary:** Relies on open habitats in western Washington where its host violets grow, including montane meadows in the northeastern Olympic Mountains, and low-elevation river and creek courses, forest openings, and native grasslands. Egg-laying has been observed in the south Puget Sound region on two violet species (*V. praemorsa* and early blue violet, *V. adunca*). Adults require late-season nectar, and especially seek out native and non-native thistles (*Cirsium).* There have been no hostplant or habitat studies in Olympic Mountain populations.

**Valley Silverspot:** Restricted to native grasslands in western Washington, primarily montane meadows in the northeastern Olympic Mountains, and low-elevation, short-stature grasslands in the south Puget Sound region. In a 2-year study of Valley Silverspot habitat and nectar use on two south Sound prairies, early blue violet was identified as a larval host, and two plants were selected for adult nectar sources (showy fleabane, [*Erigeron speciosus*] and Canada thistle [*C. arvense*]). There have been no hostplant or habitat studies in Olympic Mountain populations.

**Oregon Silverspot:** Uses open, short-stature grasslands in coastal dunes, bluffs, and nearby forest glades. Habitat studies have been conducted for this butterfly on the remaining sites in Oregon; early blue violet is the sole hostplant for this butterfly, and females selected patches with more than 20 plants per square yard for egg-laying sites. Although the Oregon Silverspot has been extirpated from Washington, WDFW has led habitat restoration efforts on coastal sites in Pacific County in preparation for future butterfly reintroductions.

**Meadow Fritillary:** Inhabits meadows, forest openings, and riparian corridors in aspen and pine woodlands between 2000 to 4500 feet in elevation in northeastern Washington. Another violet host butterfly, it is found with the white-flowering Canada violet (*V. canadensis*). Beyond their violet host need, little is known of their habitat requirements.

**Silver-bordered Fritillary:** This butterfly is dependent on fen and *Sphagnum* bog sites located in the xeric steppe and open forests of the Columbia River Basin. Bogs in this region are small, mid-elevation patches dominated by *Sphagnum* moss species and other bog-specific herbaceous plants and shrubs. Their hostplants are unknown violet species, likely marsh violet (*V. palustris*) and bog violet (*V. nephrophylla*). Beyond their fen and bog habitat restriction, little is known of their habitat requirements.

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**Subfamily Heliconiinae: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| Puget Sound Fritillary | | | | | |
| 1 | Invasive and other problematic species | Invasive plants, those currently here, and many yet to come in the future, out-compete native grassland species, and otherwise make habitat unsuitable | Using herbicide, fire, and mechanical methods to restore native prairie | Current insufficient | Both |
| 2 | Invasive and other problematic species | Invasive plants, those currently here, and many yet to come in the future, out-compete native grassland species, and otherwise make habitat unsuitable | Planting/seeding native prairie species | Current insufficient | Both |
| 3 | Resource information collection needs | Knowledge of current distribution is incomplete | Conduct surveys to determine current status and distribution of populations, primarily needed on the Kitsap Peninsula and northeast Olympic Peninsula | Nothing current - new action needed | Both |
| 4 | Invasive and other problematic species | Trees and shrubs encroaching on habitat in forest matrix sites throughout range, due to long-term fire suppression | Remove invading trees and shrubs | Current insufficient | Both |
| Valley Silverspot | | | | | |
| 1 | Invasive and other problematic species | Invasive plants, those currently here, and many yet to come in the future, out-compete native grassland species, and otherwise make habitat unsuitable | Using herbicide, fire, and mechanical methods to restore native prairie | Current insufficient | Both |
| 2 | Invasive and other problematic species | Invasive plants, those currently here, and many yet to come in the future, out-compete native grassland species, and otherwise make habitat unsuitable | Planting/seeding native prairie species | Current insufficient | Both |

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 3 | Resource Information Collection Needs | Incomplete knowledge of distribution in NE Olympic Mountains | Conduct surveys to determine current status and distribution of populations in the WA southern Cascades | Nothing current - new action needed | WDFW |
| Oregon Silverspot | | | | | |
| 1 | Invasive and other problematic species | Invasive plants, those currently here, and many yet to come in the future, out-compete native grassland species, and otherwise make habitat unsuitable | Using herbicide, fire, and mechanical methods to restore native prairie | Current insufficient | Both |
| 2 | Invasive and other problematic species | Invasive plants, those currently here, and many yet to come in the future, out-compete native grassland species, and otherwise make habitat unsuitable | Planting/seeding native prairie species | Current insufficient | Both |
| 3 | Fish and wildlife habitat loss or degradation | No populations currently extant in WA | Reintroduce at restored sites | Nothing current - new action needed | Both |
| Meadow Fritillary | | | | | |
| 1 | Agriculture and aquaculture side effects | Intensive livestock use may cause direct harm to butterfly through trampling, and indirect harm by reducing host and nectar species and compacting soil | Install fencing to carefully manage or prohibit livestock access to occupied riparian areas | Nothing current - new action needed | Both |
| 2 | Invasive and other problematic species | Forest encroachment due to long-term fire suppression has reduced amount and quality of habitat. Hostplant is an herbaceous species and butterfly occupies open habitats | Remove invading trees and shrubs | Nothing current - new action needed | Both |
| 3 | Invasive and other problematic species | Invasive plants, those currently here, and many yet to come in the future, out-compete native grassland species, and otherwise make habitat unsuitable | Using herbicide, fire, and mechanical methods to restore meadows | Nothing current - new action needed | Both |

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| Silver-bordered Fritillary | | | | | |
| 1 | Agriculture and aquaculture side effects | Intensive livestock use may cause direct harm to butterfly through trampling, and indirect harm by reducing host and nectar species and compacting soil | Install fencing to carefully manage or prohibit livestock access to occupied riparian areas | Nothing current - new action needed | Both |
| 2 | Invasive and other problematic species | Forest encroachment due to long-term fire suppression has reduced amount and quality of habitat. Hostplant is an herbaceous species and butterfly occupies open habitats | Remove invading trees and shrubs | Nothing Current - new action needed | Both |
| 3 | Invasive and other problematic species | Invasive plants, those currently here, and many yet to come in the future, out-compete native grassland species, and otherwise make habitat unsuitable | Using herbicide, fire, and mechanical methods to restore meadows | Nothing Current - new action needed | Both |

NOTE: Numbers are for reference only and do not reflect priority.

## Family Hesperiidae: SKIPPER BUTTERFLIES

*See Appendix B for a range and potential habitat distribution map for the Mardon Skipper

**Conservation Status and Concern**

These five butterflies in the Skipper Family were recognized as SGCN throughout their ranges due to the small number of isolated populations, specialized and restricted habitat, and known threats to their habitat.

| **Common Name** (Scientific name) | Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend |
|---|---|---|---|---|---|---|
| **Propertius Duskywing** (*Erynnis propertius*) western Washington populations only | None | None | No | G5 | S3 | Low/declining |
| **Oregon Branded Skipper** (*Hesperia colorado* Salish Sea segregate) | None | None | No | G5T3T4 | S2 | Critical/declining |
| **Mardon Skipper** (*Polites mardon*) | Species of Concern | Candidate | Yes | G2G3T2 T3 | S1 | Low/declining |
| **Sonora Skipper** (*Polites sonora siris*) | None | None | No | G4T3 | S2S3 | Critical/declining |
| **Yuma Skipper** (*Ochlodes yuma*) | None | Candidate | Yes | G5 | S1 | Critical/declining |

| **CLIMATE VULNERABILITY RANKING** | |
|---|---|
| **Common Name** (Scientific name) | Ranking |
| **Propertius Duskywing** (*Erynnis propertius*) western Washington populations only | Moderate |
| **Oregon Branded Skipper** (*Hesperia colorado* Salish Sea segregate) | Moderate |
| **Mardon Skipper** (*Polites mardon*) | Moderate-high |
| **Sonora Skipper** (*Polites sonora siris*) | Low-moderate |
| **Yuma Skipper** (*Ochlodes yuma*) | Moderate |

**Taxonomic note:** Skipper butterflies are members of two subfamilies: Propertius Duskywing is a Pyrginae (dicot or spread-wing skippers); Oregon Branded, Mardon, Sonora, and Yuma Skipper are Hesperiinae (monocot or folded-wing skippers).

### Biology and Life History

Propertius Duskywing
Photo: A. Barna

These skippers complete a single life cycle annually (univoltine). All are sedentary butterflies and do not migrate; instead, the species inhabits sites year-round (as egg, larva, pupa and adult), typically moving within only a few hundred meters of their natal locations. Adults emerge from their chrysalids (pupae) during species-specific time periods (See Table 1). Males begin emergence first, followed by females; late-season individuals are primarily or solely females. Weather influences butterfly emergence and the flight period duration, with wet or cold conditions delaying emergence. Male skippers seek mates by perching on low vegetation and then darting out to inspect passing butterflies. Males that detect females commence courtship behavior; when males detect another male they engage in a territory defense behavior of tight, upward spiraling flight. Females search for egg-laying sites by slowly flying and hovering just above hostplant vegetation and then depositing single eggs. Both males and females feed by using their long proboscis to sip floral nectar. Skipper larvae conceal themselves in silken shelters and primarily feed at night. Hesperiinae larvae create shelters formed by webbing their hostplant grass blades together, and their prepupal larvae construct strong silken shelters in hostplant grasses in which pupation occurs. Propertius Duskywing (Pyrginae Skipper) larvae construct large cocoons in folded oak leaves, which drop to the ground over the winter, where pupation occurs in early-spring. These species overwinter as larvae, except for Oregon Branded Skipper which survives the winter period in the egg stage.

Table 1. Key life history attributes for Washington populations of skipper butterfly SGCN.

| **Species** | **Adult Period** | Hostplants | **Primary Nectar Plants** |
|---|---|---|---|
| Propertius Duskywing | Apr-May | Garry oak (*Quercus garryana*) | Common camas (*Camassia quamash*) |
| Oregon Branded Skipper | Jul-Aug | Unknown grass/sedge | Tansy ragwort (*Tanacetum vulgare*), white-top aster (*Sericocarpus rigidus*) |
| Mardon Skipper | May-Jun | Grasses/sedges (spp. are site specific) | Violets (*Viola*), common vetch (*Vicia sativa*) |
| Sonora Skipper | Jun-Jul | Unknown grass/sedge | Unknown |
| Yuma Skipper | Jun-Jul | Common reed (*Phragmites americanus*) | Unknown |

### Distribution and Abundance

These skippers primarily occur in a few small isolated populations. Though once common, large populations of these butterflies in Washington are extant today only for Mardon Skipper in the southeastern Cascades.

Table 2. Overall range; counties and estimated number of Washington populations for skipper butterfly SGCN.

| Species | Range-Overall | Counties in WA | Est # Pop in WA |
|---|---|---|---|
| Propertius Duskywing (western Washington only) | Aligned with oak host distribution: SW British Columbia; south and north Puget Sound, WA; E slope Cascades, WA; W Oregon; south to NW California | Mason, San Juan, Skamania, Thurston | 6-10 |
| Oregon Branded Skipper | SW British Columbia; south and north Puget Sound, WA | Pierce, San Juan, Thurston | 5 |
| Mardon Skipper | Highly disjunct: South Puget Sound, WA; Southeast Cascades, WA; Southwest Oregon; NW California | Klickitat, Lewis, Pierce, Skamania, Thurston, Yakima | 3 (S Puget Sound) 30-40 (SE Cascades) |
| Sonora Skipper | SW WA | Grays Harbor, Mason, Thurston | 2-5? |
| Yuma Skipper | Highly disjunct: Columbia Basin, WA; SE Oregon; E Central California; Nevada; S Utah; E Colorado; N Arizona | Asotin, Grant, Klickitat | 3-5? |

**Habitat**

These species use rare and declining habitat types. Oregon Branded, Mardon, and Sonora Skippers inhabit glacial outwash prairies in western Washington that have been reduced to less than 3 percent of historical cover. Research is needed for all species to more accurately quantify specific habitat requirements including vegetation structure, food plant size and density, and key habitat features.

**Propertius Duskywing**: An obligate of Garry oak (*Quercus garryana*), this species Inhabits low-elevation (up to 2000 feet), open-canopied, oak woodlands and savannah. Oak woodlands are rare, patchily distributed, and declining in western Washington. Research is needed to determine the specific Garry oak understory requirements of Propertius Duskywing larvae for overwintering, and by pupae for their development.

**Oregon Branded Skipper:** In the south Puget Sound region, this species selects habitat within glacial outwash prairies dominated by short-stature native grasses and sedges, especially Roemer's fescue (*Festuca roemeri*) and long-stoloned sedge (*Carex inops*), with open structure, and abundant bare ground (or moss/lichen). The sole extant San Juan County population uses open meadows between 1500 to 2200 feet in elevation. Egg-laying has been observed on Roemer's fescue and long-stoloned sedge, however, their use as larval hostplants have not been confirmed with larval feeding.

**Mardon Skipper:** Inhabits glacial outwash prairies in the south Puget Sound region, and montane meadows 1800 to 5500 feet in elevation in the southeastern Cascade Mountain Range. In south Puget Sound grasslands, Mardon Skippers use open, grass dominated habitat with abundant Roemer's Fescue interspersed with early blue violet and select early blue violet and common vetch as nectar sources. Adult Mardon Skippers select for short, open-structured, native fescue grasslands, which provide access to nectar and oviposition plants and a requisite thermal environment. Mardon Skippers on two south Sound prairies oviposited on Roemer's fescue, and females selected for small, mostly green fescue plants, in sparse, short-statured, and open-structured vegetation. In the southeastern Cascade Mountains, Mardon Skippers are found in meadows in an otherwise forested landscape; a variety of grasses and sedges are used for egg-laying (and larval hosts) and females select for large, well developed plants. The historical and ongoing loss of montane meadow habitat is well-documented.

**Sonora Skipper:** Sonora Skipper inhabits glacial outwash prairies, forest glades, and road edges in southwest Washington lowlands. The hostplants for this species have not been identified, and habitat selection and suitability have not been studied.

**Yuma Skipper:** The native common reed is the known hostplant for this skipper which is limited to a few marshes in the xeric Columbia Basin steppe. To date, this butterfly has not been found in stands of the invasive, non-native common reed, although further surveys are needed to address this potential. Beyond their need for the native species of common reed, little is known of their habitat requirements.

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**Family Hesperiidae: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| Propertius Duskywing | | | | | |
| 1 | Fish and wildlife habitat loss or degradation | Oak woodland requisite habitat still being developed | Review proposed projects and protect oak woodland and savanna habitat | Current insufficient | Both |
| 2 | Invasive and other problematic species | Oak woodland and savanna being invaded by non-native shrubs and grasses | Using herbicide, fire, and mechanical methods to restore native oak woodland and savanna | Current insufficient | Both |
| 3 | Invasive and other problematic species | Oak woodland and savanna being invaded by native trees, especially Douglas-fir | Remove invading trees | Current insufficient | Both |
| 4 | Resource Information Collection Needs | Knowledge of current distribution is incomplete | Revisit historic locales and search for new populations | Current insufficient | Both |
| Oregon Branded Skipper | | | | | |
| 1 | Invasive and other problematic species | Invasive plants, those currently here, and many yet to come in the future, out-compete native grassland species, and otherwise make habitat unsuitable | Using herbicide, fire, and mechanical methods to restore native prairie | Current insufficient | Both |
| 2 | Invasive and other problematic species | Invasive plants, those currently here, and many yet to come in the future, out-compete native grassland species, and otherwise make habitat unsuitable | Planting/seeding native prairie species | Current insufficient | Both |
| 3 | Resource information collection needs | Effectiveness of management is minimized by the little known of the habitat requirements for this butterfly | Conduct research to characterize the habitat selected by females for oviposition (multi-year). | Nothing current - new action needed | Both |
| 4 | Fish and wildlife habitat loss or degradation | Only a few, small and disjunct populations remain in the south Sound region | Reintroduce at restored prairie sites | Nothing current - new action needed | WDFW |

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| Mardon Skipper | | | | | |
| 1 | Invasive and other problematic species | Invasive plants, those currently here, and many yet to come in the future, out-compete native grassland species, and otherwise make habitat unsuitable | Using herbicide, fire, and mechanical methods to restore native prairie | Current insufficient | WDFW |
| 2 | Invasive and other problematic species | Invasive plants, those currently here, and many yet to come in the future, out-compete native grassland species, and otherwise make habitat unsuitable | Planting/seeding native prairie species | Current insufficient | WDFW |
| 3 | Resource information collection needs | Knowledge of current distribution and site status in southern Cascades is incomplete | Conduct surveys to determine current status and distribution of populations in the WA southern Cascades | Current insufficient | Both |
| 4 | Invasive and other problematic species | Forest encroachment due to long-term fire suppression has reduced amount and quality of habitat. Hostplant is a grass, and species utilizes open meadows. | Remove invading trees and shrubs | Current insufficient | External |
| 5 | Fish and wildlife habitat loss or degradation | Only a few, small and disjunct populations remain in the south Sound region. | Reintroduce at restored prairie sites | Nothing current - new action needed | WDFW |
| 6 | Resource information collection needs | High likelihood south Sound and Cascades populations are distinct subspecies. | Genetic study to evaluate difference between south Sound and Cascades populations | Nothing current - new action needed | Both |
| 7 | Climate change and severe weather | Species vulnerable in south Sound to cool, wet spring weather; in Cascades to warm winters with low snowpack | Evaluate landscape and develop plan to increase habitat area and habitat heterogeneity in currently occupied sites and within occupied landscapes | Current insufficient | Both |

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| Sonora Skipper | | | | | |
| 1 | Invasive and other problematic species | Invasive plants, those currently here, and many yet to come in the future, out-compete native grassland species, and otherwise make habitat unsuitable | Using herbicide, fire, and mechanical methods to restore native prairie | Current insufficient | Both |
| Yuma Skipper | | | | | |
| 1 | Management Decision Needs | State Parks and other land managers not aware that native Phragmites exists and is the host for this butterfly - so they often attempt to treat native Phragmites as a weed | Develop management plans specific to occupied sites | Current insufficient | Both |
| 2 | Resource information collection needs | Lack of data on current status and distribution | Determine distribution, population status | Nothing current - new action needed | WDFW |

NOTE: Numbers are for reference only and do not reflect priority.

# BUMBLE BEES

## Genus *Bombus*: BUMBLE BEES

**Conservation Status and Concern**

Bumble bees have recently become the focus of conservation concern and efforts due to their precipitous population declines and prodigious capabilities as pollinators. In a recent status assessment, IUCN (International Union of Conservation of Nature) identified three Washington species as facing high or extremely high risk of extinction: Western Bumble Bee and Morrison's Bumble Bee were ranked Vulnerable, and Suckley Cuckoo Bumble Bee was ranked Critically Endangered.

| **Common Name** (Scientific name) | Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend |
|---|---|---|---|---|---|---|
| **Western Bumble Bee** (*Bombus occidentalis*) | None | None | No | G2G3 | S2S3 | Low/declining |
| **Morrison's Bumble Bee** (*Bombus morrisoni*) | None | None | No | G4G5 | SNR | Critical/unknown |
| **Suckley Cuckoo Bumble Bee** (*Bombus suckleyi*) | None | None | No | GH | SNR | Critical/declining |

| CLIMATE VULNERABILITY RANKING | |
|---|---|
| **Common Name** (Scientific name) | Ranking |
| **Western Bumble Bee** (*Bombus occidentalis*) | Moderate-high |
| **Morrison's Bumble Bee** (*Bombus morrisoni*) | Moderate |
| **Suckley Cuckoo Bumble Bee** (*Bombus suckleyi*) | Moderate |

**Biology and Life History**


Morrison's Bumble Bee
Photo: H. V. Davis

These three bumble bee species are from two distinct subgenera: Western and Morrison's Bumble Bees are classified within the *Bombus* subgenus, and Suckley Cuckoo Bumble Bee in the *Psithyrus* subgenus. Bees from these two subgenera have markedly different life histories. *Bombus* subgenus species live in small, highly social and interdependent colonies with structured roles: egg-laying females (queens), foraging and nesting females (workers), and males. Cuckoo bumble bees do not live in a social group, but use the nests and tending workers of social bumble bee species to reproduce. Suckley Cuckoo Bumble Bees use the nests of Western Bumble Bee and likely several other *Bombus* species. Bumble bee colonies are annual. In late-winter or early-spring, queens, which are the sole survivors from the previous year, emerge from their overwintering sites to feed on floral nectar, collect pollen, and search for suitable nest sites, which are often abandoned rodent holes. *Bombus* subgenus queens lay eggs in their individual nests and gather nectar and pollen to feed their first brood of workers. In the nest, eggs develop into larvae and then spin cocoons in which they pupate. Once they emerge from their cocoons, the workers then take over tending and provisioning young, while the queen continues to lay eggs, and typically no longer leaves the nest.  Late in the season, the colony produces males and new queens which mate.  Males, workers, and old queens eventually die; only the newly mated queens are capable of surviving through winter.  Bumble bees are key generalist pollinators of native plants and agricultural crops.  Through their foraging and collection of nectar and pollen they physically transfer the latter between plants, allowing them to reproduce.  Their unique behavior of "buzz pollination", in which they grab onto and strongly shake an entire flower by vibrating their powerful wing muscles, results in large amounts of pollen being released and produces a more complete fruit set than other pollinators, including honey bees.

**Distribution and Abundance**

All three bumble bee species historically occurred in healthy populations across large geographic areas. Recent surveys reveal significant declines in their numbers, distribution, and ranges.  Additional surveys are needed to determine the location and number of extant Washington populations for all three species, especially for Morrison's Bumble Bee and Suckley Cuckoo Bumble Bee.

> **Western Bumble Bee**: Historically common in the western United States and Canada: western South Dakota south to northern New Mexico west to northern California and north to southern Alaska.  Recent surveys have located only a handful of populations in Washington, primarily in remote subalpine and montane sites.  A 28 percent reduction was estimated in detected range-area in a recent study, and Western Bumble Bee was found largely absent from the western portion of its range (including Washington).  Over the past decade, relative abundance of Western Bumble Bee populations is estimated to have declined approximately 50 percent, while Washington has experienced even greater decline.
>
> **Morrison's Bumble Bee**: Historical geographic range primarily within the intermountain western United States: northern Colorado south to northern Mexico west to southern California and north to southern British Columbia, Canada.  Within Washington, Morrison's Bumble Bee occurred historically in the Columbia Basin; however, only a few recent sightings are known from this region.  Many previously known strongholds for this bumble bee have been intensively surveyed in recent years without detection; the decline in rangewide relative abundance is estimated at 82.6 percent.
>
> **Suckley Cuckoo Bumble Bee**: Occurred historically in western Canada and the United States: southwestern Manitoba southwest to western South Dakota south to southern Colorado west to northern California north to the Yukon and Northwest Territories south to central British Columbia; a few populations have also been documented in eastern Canada.  This cuckoo bumble bee historically was found throughout Washington. Recent rangewide surveys detected this species in only six localities, including one near far northeastern Washington.

**Habitat**

Bumble bees depend on habitats with rich floral resources throughout the nesting season, and many species select specific suites of plants for obtaining nectar and pollen.  They also select flowers based on their structure and the bee's tongue length.  For example, the short to medium length-tongued Suckley Cuckoo Bumble Bee uses shallow to medium-depth flowers.  Bumble bees require above and below-ground micro-sites for overwintering and nesting, including logs, stumps, and abandoned rodent and ground-nesting bird nests.  Their habitats must also be protected from insecticides.  Bumble bees are adaptable; they do not require native vegetation.  However, intensive agricultural development has been shown to result in regional bumble bee declines.  Although habitat loss and insecticide use have played a role in bumble bee declines, their rapid and widespread declines even from apparently high quality habitats support the current prevailing hypothesis that pathogens introduced into the wild from commercial bumble bee facilities are the main factor in declines.

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**Genus Bombus: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| Western Bumble Bee | | | | | |
| 1 | Agriculture and aquaculture side effects | Importation of bumble bees for use in pollination of commercial crops introduces pathogens into the wild | Review of federal/state policies that allow translocation and establishment of commercially-reared bumble bees in North America | Current insufficient | Both |
| 2 | Resource information collection needs | Lack of data on current status and distribution | Determine distribution, population status | Current insufficient | Both |
| Morrison's Bumble Bee | | | | | |
| 1 | Agriculture and aquaculture side effects | Importation of bumble bees for use in pollination of commercial crops introduces pathogens into the wild | Review of federal/state policies that allow translocation and establishment of commercially-reared bumble bees in North America | Current insufficient | Both |
| 2 | Resource information collection needs | Lack of data on current status and distribution | Determine distribution, population status | Current insufficient | Both |
| Suckley Cuckoo Bumble Bee | | | | | |
| 1 | Agriculture and aquaculture side effects | Importation of bumble bees for use in pollination of commercial crops introduces pathogens into the wild | Review of federal/state policies that allow translocation and establishment of commercially-reared bumble bees in North America | Current insufficient | Both |
| 2 | Resource information collection needs | Lack of data on current status and distribution | Determine distribution, population status | Current Insufficient | Both |

NOTE: Numbers are for reference only and do not reflect priority.

# MOLLUSKS

## Family Oreohelicidae: MOUNTAINSNAILS

**Conservation Status and Concern**

Many mountainsnail species and subspecies have specialized habitat requirements and very restricted ranges, low ability to disperse, and are vulnerable to disturbances such as logging, fire, unsustainable grazing, or introduced predators. Most mountainsnail species and subspecies (roughly 91 percent) are considered imperiled or critically imperiled by NatureServe.

| **Common Name** (Scientific name) | Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend |
|---|---|---|---|---|---|---|
| **Chelan Mountainsnail** (*Oreohelix sp. 1)* | In review | None | No | G2 | S2 | Critical/declining |
| **Hoder's Mountainsnail** (*Oreohelix n. sp.*) | None | None | No | GNR | SNR | Critical/declining |
| **Mad River Mountainsnail** (*Oreohelix n. sp.*) | None | None | No | GNR | SNR | Critical/declining |
| **Ranne's Mountainsnail** (*Oreohelix n. sp.*) | None | None | No | GNR | SNR | Critical/declining |
| **Limestone Point Mountainsnail** (*Oreohelix sp. 18* or *O. idahoensis baileyi)* | None | None | No | G1 | SH | Critical/declining |

| **CLIMATE VULNERABILITY RANKING** | |
|---|---|
| **Common Name** (Scientific name) | Ranking |
| **Chelan Mountainsnail** (*Oreohelix sp. 1)* | Low-moderate |
| **Hoder's Mountainsnail** (*Oreohelix n. sp.*) | Low-moderate |
| **Mad River Mountainsnail** (*Oreohelix n. sp.*) | Low-moderate |
| **Ranne's Mountainsnail** (*Oreohelix n. sp.*) | Low |
| **Limestone Point Mountainsnail** (*Oreohelix sp. 18* or *O. idahoensis baileyi)* | Low-moderate |

**Taxonomic note:** Many of the Oreohelicidae that are considered distinct species are not yet formally described, and it is likely that additional rare species of *Oreohelix* will be discovered with further investigation.

**Biology and Life History**

Mountainsnails are terrestrial gastropods of western North America. Mountainsnails eat leaf litter, detritus, and microorganisms on the surface of logs, rocks, or soil. They are hermaphroditic, having both male and female organs. They are live-bearers; the eggs hatch before leaving the uterus of the parent, and they raise their young within their shells until they reach a certain size. It is not known how long they live, or how often they reproduce.

Limestone Point Mountainsnail
Photo: from Jensen et al. 2012

**Distribution and Abundance**

**Chelan Mountainsnail a.k.a. Tiny Canyon Mountainsnail (*Oreohelix sp. 1*)**: A local endemic of the eastern foothills of the Cascades in central Washington. Populations of the Chelan Mountainsnail are few, small, and scattered. Its known range covers about 270 square miles in eastern Chelan County. Within this area this snail has been found at less than 10 sites from about one-fourth acre to 10 acres in size. Most of the sites are scattered, ranging from less than one acre to a few acres in size, and only one individual was observed (seven sites destroyed in the 1994 Tyee Fire were those of the Entiat Mountainsnail, erroneously identified as this species). Sites scattered within an area roughly bounded by the Columbia River on the southeast, Lake Chelan on the northwest to include the Twentyfive Mile Creek drainage, then southwest to Tyee Mountain, south to Chumstick Mountain, and following the ridge south and southeast to Burch Mountain, then south to the confluence of the Wenatchee and Columbia Rivers. The USFWS is conducting a status review after a finding that it may warrant listing under the ESA.

**Hoder's Mountainsnail:** This species is only known from Dick Mesa, about 3.5 miles northeast of Entiat, Chelan County.

**Mad River Mountainsnail:** This species has only been collected at one site on the Mad River in the Entiat Valley, eastern Chelan County.

**Ranne's Mountainsnail:** This species is only known from one site of less than 10 acres on Dick Mesa, about 3 miles northeast of Entiat, Chelan County.

**Limestone Point Mountainsnail:** Known from Lime Point, Asotin County, WA, and the Seven Devils Mountains and Snake River Canyon below the mouth of the Salmon River, Idaho. At Limestone Point, empty shells are scattered over the northeastern slope; no living specimens have been found in Washington in recent years, but additional season appropriate surveys are needed.

**Habitat**

*Oreohelix* species are often associated with limestone outcrops, or areas with soil or rock with a fair percentage of lime.

**Chelan Mountainsnail**: Generally open Douglas-fir and ponderosa pine; this species has been found in two types of habitats broadly described as: 1) in schist talus, and 2) in litter or under shrubs in and adjacent to open dry forest stands with pinegrass or elk sedge understory. The typical site occurs within concave landforms that accumulate and maintain moisture more efficiently than the surrounding landscape. Elevations range from 1200 to 2600 feet; site aspect is variable.

**Hoder's Mountainsnail**: On or near ridgetop in grassland and timber edge, with buckwheat (*Eriogonum* sp.) and arrowleaf balsamroot (*Balsamorrhiza sagitta*).

**Mad River Mountainsnail:** In talus under black cottonwood (*Populus balsamifera*) or bigleaf maple.

**Ranne's Mountainsnail**: On southeasterly aspect near the ridgetop, in grassland with buckwheat and arrowleaf balsamroot.

**Limestone Point Mountainsnail**: Associated with limestone outcrops and talus at mid-elevations in arid land.

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**Family Oreohelicidae: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| Chelan Mountainsnail | | | | | |
| 1 | Resource information collection needs | Need taxonomic clarification | Taxonomic clarification; delineate occupied habitat | Current insufficient | External |
| 2 | Fish and wildlife habitat loss or degradation | Fires; road building, unsustainable logging | Need to identify core habitat sites and protect alteration | Current insufficient | External |
| 3 | Invasive and other problematic species | Predation by wild turkeys | Increase turkey harvest, if needed | Nothing current - new action needed | WDFW |
| Hoder's Mountainsnail | | | | | |
| 1 | Agriculture and aquaculture side effects | Fires; road building | Develop management recommendations | Current insufficient | External |

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 2 | Invasive and other problematic species | Predation by wild turkeys | Increase turkey harvest, if needed | Current insufficient | WDFW |
| 3 | Resource information collection needs | Taxonomic uncertainty may mean one or more taxa are in greater decline | Need taxonomic clarification | Current insufficient | External |
| Limestone Point Mountainsnail | | | | | |
| 1 | Resource information collection needs | Need information; confirm still extant | Taxonomic and status clarification | Current insufficient | Both |
| Mad River Mountainsnail | | | | | |
| 1 | Agriculture and aquaculture side effects | Fires; road building; need taxonomic clarification | Delineate and protect occupied habitat | Current insufficient | Both |
| 2 | Resource information collection needs | Taxonomic uncertainty may mean one or more taxa are in greater decline | Taxonomic confirmation, description | Nothing current - new action needed | External |
| Ranne’s Mountainsnail | | | | | |
| 1 | Resource Information collection needs | Taxonomic clarification | Formal species description; taxonomic clarification | Nothing current - new action needed | External |
| 2 | Agriculture and aquaculture side effects | Prescribed fires | Special management, or designation | Current insufficient | External |
| 3 | Agriculture and aquaculture side effects | Unsustainable grazing of mountainsnail habitat | Install fencing to carefully manage or prohibit livestock access to occupied riparian areas | Current insufficient | External |
| 4 | Invasive and other problematic species | Predation by wild turkeys | Increase turkey harvest, if needed | Nothing current - new action needed | WDFW |

NOTE: Numbers are for reference only and do not reflect priority.

## Family Polygyridae: FORESTSNAILS, DUSKYSNAILS, OREGONIANS, AND HESPERIANS

**Conservation Status and Concern**

These snails are of conservation concern because they have specialized habitat requirements, such as moist mature forest with a hardwood component, or moist sites in otherwise dry environments. Snails do not readily disperse and populations are isolated. They are vulnerable to disturbances or alteration of these sites, which may occur through logging, development, use of talus for road-building, or large ungulate grazing of springs.

| **Common Name** (Scientific name) | Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend |
|---|---|---|---|---|---|---|
| **Dry land forestsnail** (*Allogona ptychophora solida*) | None | None | No | G5T2 | S1S2 | Low/unknown |
| **Washington Duskysnail** (*Amnicola sp. 2*) | None | None | No | G1 | S1 | Low/declining |
| **Columbia Oregonian** (*Cryptomastix hendersoni*) | In review | Candidate | Yes | G1G2 | S1 | Critical/declining |
| **Puget Oregonian** (*Cryptomastix devia*) | In review | None | No | G3 | S2S3 | Low/declining |
| **Poplar Oregonian** (*Cryptomastix populi*) | None | Candidate | Yes | G2 | S1S2 | Low/declining |
| **Mission Creek Oregonian** (*Cryptomastix magnidentata*) | None | None | No | G1 | SNR | Low/unknown |
| **[unnamed Oregonian]** (*Cryptomastix mullani hemphilli*) | None | None | No | GNR | SNR | Low/unknown |
| **Dalles Hesperian** (*Vespericola depressa*) | None | None | No | G2Q | S1 | Low/unknown |

| CLIMATE VULNERABILITY RANKING | |
|---|---|
| **Common Name** (Scientific name) | Ranking |
| **Dry land forestsnail** (*Allogona ptychophora solida*) | Low-moderate |
| **Washington Duskysnail** (*Amnicola sp. 2*) | Low-moderate |
| **Columbia Oregonian** (*Cryptomastix hendersoni*) | Moderate-high |
| **Puget Oregonian** (*Cryptomastix devia*) | Low-moderate |
| **Poplar Oregonian** (*Cryptomastix populi*) | Low |
| **Mission Creek Oregonian** (*Cryptomastix magnidentata*) | N/A |
| **[unnamed Oregonian]** (*Cryptomastix mullani hemphilli*) | N/A |
| **Dalles Hesperian** (*Vespericola depressa*) | Low-moderate |

**Taxonomic notes**: The Polygyridae is a large and diverse family of roughly 294 described snail species in North America. The *Cryptomastix* species are medium to moderately large Pacific Northwest endemics; there are likely more *Cryptomastix* and other Polygyrids that will be described with genetic analysis, and some will deserve conservation attention. *C. magnidentata* (Pilsbry 1940) [=*Cryptomastix* (*Cryptomastix*) *n. sp. 2* ['Hells Canyon Oregonian' of Frest and Johannes 1995].

**Biology and Life History**

Polygyrids are generally herbivorous and fungivorous snails; Dalles Hesperian feed by scraping algae, yeast, bacteria and diatoms from rock and woody surfaces; they may also consume green plant materials (Duncan 2009). All of the species addressed here are terrestrial, except the Washington Duskysnail (*Amnicola sp. no.2*), which is a freshwater snail. Washington Duskysnail is a detritivore and grazes along the stems and leaves of aquatic plants eating small organisms clinging to this material (Frest and Johannes, 1995). In most terrestrial gastropods, cross-fertilization appears to be the norm, but self-fertilization can occur in at least some species in the absence of potential mates. Pilsbry (1940) states of the family Polygyridae, "Their food is chiefly the mycelia of fungi." While it is suspected that mycophagy is the primary life style of these species, it appears that at least the young may be partially herbivorous on green plants during certain seasons.

Dalles Hesperian
Photo: W. Leonard

Life history of the terrestrial Polygyrids may resemble that described for the Oregon Forestsnail (*Allogona townsendiana*). This species is most active during the wet spring months when mating occurs. Adults lay eggs in new or existing flask-shaped nesting holes, or sometimes in pre-existing depressions in soil, moss, and under coarse woody debris, or at the base of vegetation. Juvenile snails hatch approximately 8 to 9 weeks after oviposition, and disperse from the nest site within hours of hatching.

**Oregon Forestsnails** estivate deep within litter, under logs or the bark of coarse woody debris during dry summer months and become active again with fall rains. Once the first frosts occur, Oregon Forestsnails enter hibernation until the following spring. Adults likely reach reproductive maturity by two years and have a life span of at least 5 to 8 years, though this may be an underestimate. Edworthy *et al.* (2012) reported that adults generally remained in a core area of less than 18 square yards. (The maximum daily dispersal was 15 feet and the maximum displacement over three years was 105 feet.

**Columbia Oregonians** consume herbaceous plants in captivity, and may also consume algae on wet surfaces and decaying remains of herbaceous plants.

**Puget Oregonians** hatch from eggs and live for more than one year. However, specific details on life span and reproduction for this species were not found. Like most terrestrial gastropods, *Cryptomastix* are hermaphroditic, having both male and female organs. Burke (1999) suggested that Puget Oregonian (*C. devia*) might aid in the dispersal of fungal spores, including mycorrhizal fungi that form tree-root associations which promote healthy tree growth.

**Dalles Hesperians** live approximately 3 to 5 years. Individuals may breed during their second season. Egg laying sites are thought to be in very moist or wet locations, such as in wet moss or under rocks or wood. They are present all year, but probably not active under snow in winter. Individuals are entirely terrestrial, but seek refugia sites where the humidity level is relatively high and temperature is constant, such as deep within cracks in mud, in rock talus or under permanently moist vegetation. May travel several hundred feet during a season, only to return to original refugia sites.

**Distribution and Abundance**

**Dry Land Forestsnail:** *Allogona* in the Pacific Northwest include three species; the very common *A. ptychophora* occurs from the Cascade Range in British Columbia into northern Oregon and east to the Continental Divide. A distinct subspecies, *A. ptychophora solida*, is confined to local populations in the Snake River Canyon, Asotin County, Washington, and eastward in Nez Perce and into Lewis Counties, Idaho. Distinct *A.p. solida* are locally common in Idaho, but appear rare west of the Snake River.

**Washington Duskysnail:** This species is currently known from only three lake sites: one in Ferry County, one in Okanogan County, and one in northwestern Montana. The Washington Duskysnail is declining due mainly to habitat degradation and destruction, both in terms of populations and numbers of individuals.

**Columbia Oregonian:** This species is known from 13 locations at the east end of the Columbia Gorge along both sides of the river from The Dalles to Rufus, Wasco and Sherman Counties in Oregon; this includes only four small sites in Klickitat County, Washington. Most locations are isolated from one another by the arid surrounding landscape. Originally also occurred in Skamania County, and in The Dalles, Oregon, but these sites were lost to by development. Specimens that may be this species suggest its range may extend north into Yakima County, and east along the Columbia and Snake Rivers and the Washington-Oregon border, in Umatilla and Wallowa Counties, Oregon, to Adams and Washington Counties, Idaho, but this requires confirmation.

**Puget Oregonian:** This species is found in the western Cascade Range and Puget Trough from southern Vancouver Island, B.C. through western Washington to the Oregon side of the Columbia Gorge. Records exist from Clark, Cowlitz, King, Lewis, Pierce, Skamania, and Thurston Counties, Washington.  Kogut and Duncan (2005) noted 178 locations, but at most sites only one to three snails were found.  Most sites are in Gifford Pinchot National Forest, where it is relatively common only in the Cowlitz and Cispus River drainages; elsewhere it is quite rare and local.  Much of its former range is now urban or has been developed for agriculture; 10 of 42 records from prior to 1994 are from the metropolitan Seattle area.  There is a single record from the eastern Cascades near Cle Elum.  Formerly found in Hood River and Wasco Counties of Oregon, and in British Columbia (primarily Vancouver Island).  In Oregon, this species is in severe decline; currently only a few sites in Multnomah County remain.

**Poplar Oregonian:** This species is found along the Snake River in Whitman and Asotin Counties, Washington, and in Cottonwood Canyon, Nez Perce County, Idaho.

**Mission Creek Oregonian**:  This species is found in the Snake River Canyon, Grand Ronde Canyon, and Joseph Creek Wildlife Area in Asotin County, Joseph Canyon, Wallowa County, Oregon, and in Lewis and Nez Perce Counties, Idaho.

**[unnamed Oregonian] (*C. mullani hemphilli*)**:  A small disjunct population of this taxa occurs in Swakane Canyon in Chelan County.  Also found in northern Idaho and Sanders and Missoula Counties, Montana.

**Dalles Hesperian**:  This species survives at a few scattered, widely separate colonies in the Columbia Gorge: from Rufus, Oregon downstream to Vancouver, Washington.  Historic sites are located in Wasco, Hood River and Sherman Counties in Oregon; and Clark, Skamania and Klickitat Counties in Washington.  No specific information on abundance at these sites is documented.

**Habitat**

**Dry Land Forestsnail**:  The Dry Land Forestsnail is found in talus and rocky riparian areas in the Snake River Canyon.

**Washington Duskysnail:** This is a freshwater species that occurs in kettle lakes among aquatic vegetation beds, but is absent from dense aquatic vegetation areas. The species is found on soft oxygen-rich substrate at a depth of approximately 2 to 6 feet.

**Columbia Oregonian:** This species occurs at seeps and spring-fed streams and in associated talus in the semi-arid eastern portion of the Columbia River Gorge.  Inhabits margins of low to mid-elevation seeps, and spring-fed streams in an otherwise arid landscape.  Typically found among moist talus, leaf litter and shrubs, or under logs and other debris.

**Puget Oregonian:** This species is thought to be a mature forest specialist and inhabits moist old-growth and late successional stage forests and riparian areas at low and middle elevations (below 600 feet). Mature to late successional moist forest and riparian zones, under logs, in leaf litter, around seeps and springs, and often associated with hardwood debris and leaf litter and/or talus.  It is often found under or near bigleaf maple and may be under western swordferns growing under these trees, or on the underside of bigleaf maple logs.  Canopy cover is generally high.  Often found in old-growth western hemlock/swordfern plant associations with bigleaf maple and/or possibly other hardwood components well represented.

**Poplar Oregonian:** This species is found in talus and brushy draws in canyons in moderately xeric, rather open and dry situations, in talus on steep, cool (generally north or east facing) lower slopes in major river basins.  Surrounding vegetation is sage scrub.  Talus vegetation includes *Celtus*, *Artemesia*, *Prunus*, *Balsamorrhiza*, grasses, small limestone moss (*Seligeria* sp.) and bryophytes.

**Mission Creek Oregonian:** This species has been found in rocky, brushy draws and riparian areas.

**[unnamed Oregonian] (*C. mullani hemphilli*):** There is no habitat data available for this species.

**Dalles Hesperian**: This species is generally found in wet or very moist sites. In dry areas, it is associated with a permanent water source such as a spring or seep.

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**Family Polygyridae: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| Columbia Oregonian | | | | | |
| 1 | Fish and wildlife habitat loss or degradation | Loss of perennial flow due to diversions | Taxonomic clarification for additional taxa; delineate occupied sites | Unknown | Both |
| 2 | Fish and wildlife habitat loss or degradation | Habitat loss to development | Delineate and protect sites | Unknown | Both |
| Dalles Hesperian | | | | | |
| 1 | Fish and wildlife habitat loss or degradation | Road building, disturbance of talus; habitat alteration that creates xeric conditions; need distribution data | Delineate and protect sites | Current insufficient | WDFW |
| 2 | Agriculture and aquaculture side effects | Unsustainable grazing of habitat | Install fencing to carefully manage or prohibit livestock access to occupied riparian areas | Current insufficient | Both |
| 3 | Resource information collection needs | Need distribution data | Inventory | Current insufficient | WDFW |
| Dry land Forestsnail | | | | | |
| 1 | Fish and wildlife habitat loss or degradation | Road building and maintenance | Delineate and protect sites | Current insufficient | WDFW |
| 2 | Resource information collection needs | Need distribution data | Identify sites | Current insufficient | WDFW |
| Mission Creek Oregonian | | | | | |
| 1 | Fish and wildlife habitat loss or degradation | Limestone quarrying | Develop management recommendations | Nothing current - new action needed | WDFW |
| 2 | Agriculture and aquaculture side effects | Unsustainable logging practices | Develop management recommendations | Nothing current - new action needed | WDFW |
| 3 | Agriculture and aquaculture side effects | Unsustainable grazing of riparian habitat | Install fencing to carefully manage or prohibit livestock access to occupied riparian areas | Nothing current - new action needed | Both |
| Poplar Oregonian | | | | | |
| 1 | Resource information collection needs | Status assessment | Status assessment | Current insufficient | Both |

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 2 | Fish and wildlife habitat loss or degradation | Mining of basalt talus | Management recommendations; tech assistance | Nothing current - new action needed | WDFW |
| 3 | Agriculture and aquaculture side effects | Livestock grazing practices that do not benefit the species | Outreach, coordinate with landowners to incorporate management recommendations to benefit the species | Nothing current - new action needed | Both |
| Puget Oregonian | | | | | |
| 1 | Resource information collection needs | Status assessment | Status assessment | Current insufficient | Both |
| 2 | Fish and wildlife habitat loss or degradation | Habitat loss to urbanization | Management recommendations; tech assistance | Nothing current - new action needed | WDFW |
| 3 | Agriculture and aquaculture side effects | Habitat loss to logging of old-growth; bigleaf maple | Management recommendations; tech assistance | Current insufficient | Both |
| Washington Duskysnail | | | | | |
| 1 | Fish and wildlife habitat loss or degradation | Pollution, siltation | Protect water quality | Current insufficient | External |
| 2 | Resource information collection needs | Taxonomic clarification | Formally describe species | Nothing current - new action needed | External |
| [unnamed Oregonian] (*Cryptomastix mullani hemphilli*) | | | | | |
| 1 | Resource information collection needs | Need taxonomic confirmation | Inventory; taxonomic clarification | Nothing current - new action needed | External |

NOTE: Numbers are for reference only and do not reflect priority.

## Family Vertiginidae

**Conservation Status and Concern**

These three very rare *Vertigo* species are small snails found in small isolated populations, perhaps remnants of a previously much wider range. These small populations, associated with old-growth and/or riparian hardwoods are very vulnerable to logging, road building, fires, or other disturbances.

| **Common Name** (Scientific name) | Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend |
|---|---|---|---|---|---|---|
| **Hoko Vertigo** (*Nearctula new sp*. or *Vertigo new sp*.) | In review | None | No | G1 | S1 | Critical/unknown |
| **Pacific Vertigo** (*Vertigo andrusiana*) | None | None | No | GNR | S1? | Critical/ extirpated? |
| **Idaho Vertigo** (*Vertigo idahoensis*) | None | None | No | G1G2 | SNR | Critical/unknown |
| | Climate vulnerability: Low-moderate | | | | | |

**Taxonomic note:** Burke (2013) considers this group within the family Vertiginidae; earlier authorities placed the subfamily Vertigininae in the family Pupillidae, and in the superfamily Pupilloidea, order Pulmonata, and class Mollusca (Duncan 2005). Frest and Johannes (1996b) placed the Hoko Vertigo into the *Vertigo californica* group. Sterki (1892) gave this group a subgeneric name, *Nearctula*, which was regarded as a synonym of the genus *Vertigo* by Pilsbry (1948). Recently *Nearctula* has been used by some authors as the valid genus for this species group. The Hoko Vertigo has not yet been formally named or described.

**Biology and Life History**

The Vertiginidae are minute (roughly .05 to 0.12 inch) terrestrial snails with ovoid-shaped shells. Land snails, including Vertiginid snails, are hermaphroditic and exchange gametes with conspecific individuals when conditions are favorable. At least some species seem to retain the fertilized eggs and give birth to small numbers of live young. The Hoko Vertigo is thought to be a short-lived species with a potential life span of less than 2 years. The distinctly arboreal lifestyle and mouthparts of this group of snails suggest that they feed on microorganisms growing on the surfaces of smooth-barked trees and shrubs or epiphytic lichens. In Pacific Northwest forests, Vertiginidae snails overwinter on tree limbs, so presumably they are not killed by freezing temperatures.

*Vertigo columbiana*
Photo: W. Leonard

**Distribution and Abundance**

**Hoko Vertigo:** Hoko Vertigo is known only from along the east side of the Hoko River in Clallam County in the northwestern part of the Olympic Peninsula. The tendency of these snails to have a patchy distribution may make it difficult to make estimates of population size and population trends. Surveys of roughly 300 acres in Olympic National Forest did not find any new locations. Random grid surveys across the Northwest Forest Plan area in Oregon and Washington did not locate this species in any of 498 plots searched. However, a specimen that may prove to be this species was collected in the Salem BLM district of Oregon. This species is under review by the USFWS for listing under the ESA.

**Pacific Vertigo:** This species appears to have once been widely distributed in the Pacific Northwest, with a historical range including well-separated areas of the Cascade and Klamath provinces. It is now apparently very rare, with no confirmed sightings in the Oregon/Washington region in recent years. There are historical records from the San Bernardino Mountains of California north through western Oregon and southwest Washington to Vancouver Island, British Columbia. In Washington, records are in the Puget Trough and Olympic Peninsula (Grays Harbor, Thurston, and King Counties). In Oregon, the species occurred west of the Cascade Mountains, with records from Clackamas, Douglas and Klamath Counties. To date, most known records are from before 1950, with the exception of one 1979 record from Thurston County, Washington, and one 1999 record from Fremont-Winema National Forest, Klamath County, Oregon (Jordan 2013).

**Idaho Vertigo:** Burke (2013) collected this species along a creek in Stevens County, Washington. Pilsbry (1948) found it along a creek east and northeast of the old town, Meadows, Adams County, Idaho. The type locality is the only known Idaho site, but this population has not been relocated. Searches during 1988, 1993, and 1994 within the lower Salmon River, Little Salmon River, and Payette River drainages in Idaho have also failed to find this species.

**Habitat**

The typical habitat for Vertigo snails ranges from moist riparian to relatively dry forests dominated by cottonwood, alder, Douglas-fir, spruce, or hemlock, depending on the species.

**Hoko Vertigo:** The Hoko Vertigo seems to be an old-growth riparian associate. The two known locations are at the bases of wooded slopes near streams at low elevations of between roughly 40 and 300 feet; it is unknown if the species occurs at higher elevations. The habitat seems to be characterized by old trees, riparian hardwoods, and mesic conditions. This species is arboreal and has been found on trunks and lower limbs of deciduous trees, mainly alders. They are most easily detected on the undersides of limbs and leaning trunks of young alders that have relatively smooth bark. One of the two known sites is at the base of a steep northwest-facing slope with seeps and consists of second-growth Douglas-fir forest with a sizable component of bigleaf maple. This site is near a stream; understory vegetation includes liverworts, large swordfern, and maidenhair fern. The other site is at the foot of a slope next to the Hoko River and is characterized by the presence of old hardwood trees, mostly alder.

**Pacific Vertigo:** This species occurred in forested sites at lower elevations and may be found on trunks and lower branches of deciduous trees and shrubs, as well as among the litter beneath them. Pilsbry (1948) wrote that “some thousands of specimens were taken…about clumps of bushes in a meadow" in Oswego, Clackamas County, Oregon. A 1979 Thurston County record notes “maple, salal” as the habitat. A 1999 record from Klamath County, Oregon (Fremont-Winema National Forest) lists the habitat as a drainage through a small open meadow with an overstory of ponderosa pine and western juniper.

**Idaho Vertigo:** This species is a riparian associate, but there is little other information. Habitat characteristics are described from only the type locality. At this site, the Idaho Vertigo inhabits a mid-elevation grass and sedge meadow with springs, seeps, bogs, and fens.

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### Family Vertiginidae: Conservation Threats and Actions

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| Hoko Vertigo | | | | | |
| 1 | Agriculture and aquaculture side effects | Activities that result in drying of habitat (such as logging); need formal species description | Protect sites | Current insufficient | Both |
| 2 | Resource information collection needs | Need formal species description | Taxonomy; describe species; protect sites | Current insufficient | External |
| Idaho Vertigo | | | | | |
| 1 | Resource information collection needs | Need distribution data | Inventory; status assessment | Current insufficient | Both |
| Pacific Vertigo | | | | | |
| 1 | Resource information collection needs | Need distribution data; may be extirpated | Inventory/status information | Current insufficient | Both |

NOTE: Numbers are for reference only and do not reflect priority.

## OTHER TERRESTRIAL SNAILS

### Conservation Status and Concern

These terrestrial snails are very rare and have distributions that include small isolated populations, perhaps remnants of previously much wider ranges. These small isolated populations, often associated with old-growth and/or riparian hardwoods and are very vulnerable to logging, road building, fires, or other disturbances.

| **Common Name** (Scientific name) | Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend |
|---|---|---|---|---|---|---|
| **Oregon Megomphix** (*Megomphix hemphilli*) | None | None | No | G3 | S1 | Low/unknown |
| **Dalles Sideband** (*Monadenia fidelis minor*) | In review | Candidate | Yes | G4G5T2 | S1 | Low/unknown |
| **Crowned Tightcoil** (*Pristiloma pilsbryi*) | None | None | No | G1 | S1 | Low/unknown |
| **Nimapuna Tigersnail** (*Anguispira nimapuna new spp.*) | None | None | No | G1 | SNR | Critical/ unknown |

| **CLIMATE VULNERABILITY RANKING** | |
|---|---|
| **Common Name** (Scientific name) | Ranking |
| **Oregon Megomphix** (*Megomphix hemphilli*) | Low-moderate |
| **Dalles Sideband** (*Monadenia fidelis minor*) | Low-moderate |
| **Crowned Tightcoil** (*Pristiloma pilsbryi*) | Low-moderate |
| **Nimapuna Tigersnail** (*Anguispira nimapuna new spp.*) | N/A |

**Taxonomic note:** Oregon Megomphix is in the family Megophicidae; Dalles Sideband is in the Bradybaenidae; Crowned Tightcoil is in the Pristilomatidae; Nimapuna Tigersnail is in the Discidae. '*Anguispira nimapuna* new spp' appears to be an undescribed subspecies (T. Burke, pers. comm.); they are distinctly like *A. nimapuna* from Idaho, but are smaller, with thinner shells and with weaker rib sculpturing.

### Biology and Life History

Land snails are hermaphroditic and exchange gametes with other conspecific individuals when conditions are favorable, typically in the spring, and then both will lay eggs in damp subsurface situations where the eggs will be relatively safe from predators and desiccation. Land snails do not tend their eggs or young. There is no larval stage and newborn snails look like miniature adults (the innermost part of the shell develops within the egg).

Oregon Megomphix
Photo: W. Leonard

Snails need moisture, so where the habitat dries out, they will estivate in the summer, become active with fall rains, and hibernate when the season turns cold. Land snails eat plants (living or dead), fungi, fruit, microorganisms, litter, wood, and dead animals. Of these species, more is known about Oregon Megomphix and the Dalles Sideband. The Oregon Megomphix seems to be more secretive and photophobic than other Northwest land snails, as no live animals and very few of their shells have been found out in the open; all have been found under the cover of leaf mold or within soft soil or in spaces within rock heaps. Loose soil may be necessary for egg-laying by sideband snails, which lay several dozen eggs; they are likely to live more than 6 years, and probably mature in 2 years. During the moist spring and fall seasons, Dalles Sidebands may be found in the open, away from refugia. Daily refugia used during moist seasons can be down wood, rock or accumulations of litter. During the summer, snails are found deep in talus accumulations which are adjacent to springs or streams and which serve as refuge sites from desiccation and protection from predators while the snails are immobile. These deep rock refugia also provide the important, environmentally stable sites needed to survive wildfire events and cold winter conditions. Mollusks which inhabit talus habitats also utilize the surrounding forest areas during moist, cool conditions, ranging out from the refugia provided by the rocks to forage in the adjacent forest floor litter.

**Distribution and Abundance**

**Oregon Megomphix:** This species is known from Olympia southward in foothills of the Cascade and Coast Ranges in conifer/hardwood forests up to 3000 feet in elevation, south through the Willamette Valley, Cascade Range foothills, and Coast Range of Oregon. For Washington there are 12 records from Thurston, Lewis, and Cowlitz Counties based on 45 specimens (many collected 30 to 120 years ago) that provide seven mappable locations, which are all at low elevations (below 500 feet) in the southwestern part of the state. It is more widespread in Oregon, known from the Siuslaw, Umpqua, and Willamette National Forests and is suspected to occur in the Mt. Hood, Rogue River, and Siskiyou National Forests, and the Columbia River Gorge National Scenic Area.

**Dalles Sideband:** This species is known from the Columbia Gorge from Hood River east to the vicinity of The Dalles on both sides of the Columbia River and in upland sites in the lower Deschutes River watershed within Mt. Hood National Forest in Wasco County, Oregon. The species may have occurred historically in the central and part of the eastern Columbia Gorge and south up the Deschutes River Valley as far as 50 miles from the confluence. A total of 98 sites are known, but most sites are in Oregon, and only a few individuals have been found at most sites. Known sites are widely scattered across the species' range and separated by non-habitat. The distribution of stable rock refugia sites across the landscape may determine or help to explain the distribution of the species in areas with short fire-return intervals.

**Crowned Tightcoil:** This species is known from Pacific County, Washington and the Northern Coast Range of Oregon; there are also historical records from Portland. Stone (2009) states it has also been found in Clallam County, Washington, and is suspected to occur in Grays Harbor, Wahkiakum, Cowlitz and Clark Counties, Washington and Multnomah, Clatsop and Columbia Counties, Oregon.

**Nimapuna Tigersnail:** This yet-to-be described subspecies occurs at two locations on ridges on opposite sides of Lake Chelan, Chelan County, Washington (Burke 2013). Outside of Washington, this species is known from less than 10 localities in the Clearwater, Lochsa, and Selway Rivers' drainages in Idaho County, Idaho, and Wallowa County, Oregon (Hendricks et al. 2006, Burke 2013).

## Habitat

**Oregon Megomphix:** Habitat is within moist conifer/hardwood forests up to 3000 feet in elevation in hardwood leaf litter and decaying non-coniferous plant matter under bigleaf maple trees, or beaked hazelnut (*Corylus cornuta*) bushes, and swordferns, often near rotten logs or stumps. A bigleaf maple component in the tree canopy and an abundance of swordfern on forested slopes and terraces seem characteristic. Appears to be primarily fossorial, often found on soil under leaf litter or in rodent burrows. The presence of rotten logs seems to be important to local survival. Unusually large or multiple-stemmed bigleaf maples, or clumps of bigleaf maples, seem to provide the most favorable habitat.

**Dalles Sideband:** The species has been found in moist talus habitat (especially around seeps and springs), and in forested areas in upland sites near, but outside of, riparian corridors. In some forested sites, the species has been found associated with down wood where no rock substrates occur. Down wood may provide temporary refugia used during dispersal in the wet season, while rock substrates provide more stable refugia used for estivation during summer and winter and during fire events.

**Crowned Tightcoil***:* This species has been collected in moist leaf and woody debris litter in low elevation forested areas under the dense thickets of salal (*Gaultheria shallon*) near the coastal beaches, and in riparian areas under red alder and swordfern. Stone (2009) characterizes it as associated with riparian and old-growth habitat, though it has been collected in the headwater riparian areas of managed second-growth western hemlock forests. Typically associated with abundant, persistent moisture.

**Nimapuna Tigersnail:** In Idaho this species has been found between 1500-2550 feet in elevation at sites with an overstory that included western red-cedar and grand fir, with some alder, paper birch, Douglas-fir and/or ponderosa pine; often under wood or on bryophyte mats among dense ferns.

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**OTHER TERRESTRIAL SNAILS**: Conservation Threats and Actions

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| Crowned Tightcoil | | | | | |
| 1 | Fish and wildlife habitat loss or degradation | Habitat loss to development | Technical assistance to regulatory agencies | Current insufficient | WDFW |
| 2 | Agriculture and aquaculture side effects | Logging of mature timber | Develop management recommendations | Current insufficient | WDFW |
| 3 | Resource information collection needs | Need to delineate distribution | Inventory | Current insufficient | Both |
| Dalles Sideband | | | | | |
| 1 | Fish and wildlife habitat loss or degradation | Road building; fires; habitat alteration that creates xeric conditions | Develop management recommendations | Current insufficient | WDFW |
| Nimapuna Tigersnail | | | | | |
| 1 | Resource information collection needs | Lack of data; need distribution data. | Describe and protect sites | Nothing current - new action needed | WDFW |
| 2 | Resource information collection needs | Possible new subspecies; need taxonomic clarification | Clarify taxonomy | Nothing current - new action needed | External |
| Oregon Megomphix | | | | | |
| 1 | Overharvesting of biological resources | Cutting of bigleaf maples for burls; loss of rotten logs | Increased protection of bigleaf maples by enforcement, outreach, etc. | Current insufficient | External |
| 2 | Resource information collection needs | Clarify distribution, status | Status assessment | Nothing current - new action needed | Both |

NOTE: Numbers are for reference only and do not reflect priority.

## Families: Lymnaeidae and Hydrobiidae

### Conservation Status and Concern

These species require clear, cold, well-oxygenated waters, and are threatened by pollution and siltation. North America once had approximately 700 species of native freshwater snails from 16 families. Currently, 67 species (10 percent) are considered likely extinct, 278 (40 percent) endangered, 102 (15 percent), threatened, 73 (10 percent) vulnerable, and 26 (4 percent) have uncertain taxonomic status.

| **Common Name** (Scientific name) | Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend |
|---|---|---|---|---|---|---|
| **Shortface Lanx *or* Giant Columbia River Limpet** (*Fisherola nuttalli*) | None | Candidate | Yes | G2 | S2 | Uncommon/ declining |
| **Masked Duskysnail** (*Lyogyrus sp. 2*) | None | None | No | G1G2 | S1 | Critical/declining |
| **Olympia Pebblesnail** (*Fluminicola virens*) | None | None | No | G2 | S2 | Low/unknown |
| **Salmon River Pebblesnail** (*Fluminicola gustafsoni*) | None | None | No | GNR | SNR | Low/unknown |
| **Ashy Pebblesnail** (*Fluminicola fuscus*) | None | Candidate | Yes | G2 | S2 | Uncommon/ declining |

| **CLIMATE VULNERABILITY RANKING** | |
|---|---|
| **Common Name** (Scientific name) | Ranking |
| **Shortface Lanx** *or* Giant Columbia River Limpet (*Fisherola nuttalli*) | Moderate |
| **Masked Duskysnail** (*Lyogyrus sp. 2*) | Low-moderate |
| **Olympia Pebblesnail** (*Fluminicola virens*) | Low-moderate |
| **Salmon River Pebblesnail** (*Fluminicola gustafsoni*) | N/A |
| **Ashy Pebblesnail** (*Fluminicola fuscus*) | Moderate |

**Taxonomic notes:** The Shortface Lanx (*Fisherola nuttalli*) is in the family Lymnaeidae (it is not a limpet); Masked Duskysnail (*Lyogyrus sp. 2*) is an undescribed species in the family Hydrobiidae. The genus *Fluminicola* was formerly considered to be in the family Hydrobiidae, but more recent classification system based on genetics treats Lithoglyphidae at the family level, instead of as a subfamily (Lithoglyphinae) in the Hydrobiidae family (Jordan 2013). Hershler and Liu (2012) indicate that the genus *Fluminicola* includes two separate lineages and is in need of revision. The Salmon River Pebblesnail (*F. gustafsoni*) is a recently described species, closely related to *F. virens*.


Ashy Pebblesnail
Photo: WDFW

### Biology and Life History

For these aquatic snails, limiting factors may include hardness, acidity, dissolved oxygen, salinity, high temperature, and food availability as associated with depth. Snails are uncommon in habitats with surface acidity greater than pH 5. Dissolved oxygen limits diversity, so severely polluted waters (oxygen consumed by algae blooms) are often devoid of freshwater snails excepting pollution-tolerant species. Most species live in the shallows, (depths less than 10 feet) where food abundance is greatest. As a result, drastic water fluctuations (draw-downs) may cause declines in snail populations.

**Shortface Lanx:** This is a small pulmonate (lunged) snail; it feeds by scraping algae and diatoms from rock surfaces in streams. May occasionally feed on other plant surfaces. *Fisherola* are hermaphrodites but do not appear to be self-fertilized, thus mating occurs between two individuals. Eggs are laid from spring to autumn in gelatinous capsules attached to plants, stones, or other objects. They lack a free-swimming larval stage, and hatchlings are morphologically similar to adults, except that they lack a functional reproductive system. Young snails appear to grow rapidly and require only a few months to reach full size. Individual *F. nuttalli* probably live for only one year, as this species breeds once and dies afterwards (semelparous breeding). Individuals are present year-round in the streams they inhabit, but are inactive during the winter.

**Masked Duskysnail*:*** This species, like all Hydrobiid snails, has gills that make them dependent upon dissolved oxygen in the water. This species feeds on the algal and microbial film on aquatic plants, and likely on detritus. Individuals overwinter as adults and do not disperse widely, so populations remain very localized in their distribution. Information is sparse, but reproductive biology is probably similar to other Hydrobiid species. Hydrobiids typically are dioecious (i.e., have separate sexes) and semelparous (i.e., breed only once in their life time and then die), and individuals have a life span of one year, with 90 percent or more of the population turning over annually. Surviving individuals are generally those that do not breed during their first year. Eggs are laid in the spring and hatch in approximately 2 to 4 weeks. Sexual maturity is reached by late summer after a few months of growth.

**Pebblesnails:** Pebblesnails feed by scraping bacteria, diatoms and other perilithic organisms from rock surfaces, and may occasionally feed on aquatic plant surfaces. This species is present all year, but not active in winter. Having no lungs or gills, snails in this genus respire through the mantle cavity, and have low tolerance for hypoxia and anoxia. The *Fluminicola* genus exhibits separate sexes with both male and female individuals. Reproduction is by copulation and cross-fertilization, and these species are believed to be semelparous (reproducing only once in a lifetime). Eggs are laid from spring to autumn in gelatinous capsules attached to plants, stones, or other objects. The individual life span of these species is thought to be approximately 1 to 2 years, and population turnover is probably greater than 90 percent. Often, species in this genus appear to be community dominants, comprising most of the invertebrate biomass.

**Distribution and Abundance**

**Shortface Lanx**: This species was historically present throughout much of the Columbia River drainage in Washington, Montana, Oregon, Idaho, and British Columbia, but most populations were extirpated due to habitat loss resulting from dams, impoundments, water removal, and pollution. This species is now presumed extirpated in Montana and possibly in British Columbia. Currently in Washington, large populations of *F. nuttalli* persist in the Okanogan River and the Hanford Reach of the Columbia River; small populations are found in the Methow and Grand Ronde rivers. The species also occurs in the lower Deschutes River in Oregon, and the Snake River in Oregon and Idaho. In Idaho, it occurs in the Middle and Upper Snake River reaches from Elmore County, upstream to at least Bingham County. Populations also occur in the Salmon River and Hells Canyon of the Snake River including parts of Nez Perce and Idaho Counties. Additional small populations are found in Oregon in the Grande Ronde, John Day, and Imnaha Rivers, and the lower Columbia River near Bonneville Dam.

**Masked Duskysnail:** The Masked Duskysnail is currently known from three or four sites in two kettle lakes: Curlew Lake in Ferry County, Washington, and Fish Lake, Chelan County, Washington.

**Olympia Pebblesnail:** The Olympia Pebblesnail is known only from Oregon and Washington. In Washington, it is known from about 12 locations, including Cowlitz, Grays Harbor, Pacific, San Juan, Skamania and Thurston Counties in Washington. In Oregon, it is limited in distribution to the lower Columbia River below Portland, the upper Deschutes River, the Umpqua River, the Willamette River from Corvallis to its mouth, and large tributary streams of the Willamette River including the Tualatin and Clackamas Rivers.

**Salmon River Pebblesnail:** This species is known only from the Salmon, Clearwater and lower Snake Rivers. In Washington it is only recorded from Asotin County.

**Ashy Pebblesnail:** This species has been extirpated from much of its historic range. It was historically widespread, with populations scattered throughout Washington in the lower Snake River, lower to middle Columbia River, and large tributaries of these rivers including the Methow, Willamette, Wenatchee, Deschutes, Okanogan, Grande Ronde, and Spokane Rivers (Asotin, Benton, Cowlitz, Chelan, Clark, Franklin, Klickitat, Okanogan, Skamania, Spokane, and Walla Walla Counties). Targeted surveys were conducted at over 500 sites in more than 30 streams in the Columbia Basin (Oregon, Washington, Idaho); this species was absent from nearly all sites (including some historic sites), and detected at just five streams. In Washington, it has been detected relatively recently (1990 or later) in the Okanogan, Grande Ronde and Methow Rivers; Hanford Reach of the Columbia River; and a limited portion of the Snake River.

**Habitat**

**Shortface Lanx**: Shortface lanx are found in unpolluted, cold, well-oxygenated perennial streams and rivers, generally 100 to 325 feet wide, with a cobble-boulder substrate. Within such streams it is found primarily on diatom-covered rocks at the edges of rapids or immediately downstream from rapids in areas that have suitable substrate. Shortface Lanx have not been found in areas with silt or mud substrates, extreme seasonal variations in water level, an abundance of aquatic plants or algae, bedrock substrate, or where dredging or mining occurs.

**Masked Duskysnail:** This species is a kettle lake inhabitant and riparian associate. It lives in lentic ecosystems on oxygenated mud substrates with aquatic plants.

**Pebblesnails:** This genus is fairly intolerant of impounded waters and soft substrates as well as nutrient-enhanced or lacustrine (lake) habitats. These species are usually found in clear, cold streams with high dissolved oxygen content. They are generally found on hard rocky surfaces where they graze on algae and detritus. They occur under rocks and vegetation in the slow to rapid currents of streams. It is common at the edges of rapids or immediately downstream from whitewater areas, and becomes much less common or absent in major rapids. In the absence of rapids or whitewater areas, this species is restricted to habitat with sufficient flow, oxygenation, and stable substrate.

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**Families: Lymnaeidae and Hydrobiidae**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| Ashy Pebblesnail | | | | | |
| 1 | Fish and wildlife habitat loss or degradation | Water pollution, siltation | Protect water quality | Current Insufficient | Both |
| Masked Duskysnail | | | | | |
| 1 | Fish and wildlife habitat loss or degradation | Pollution | Protect sites | Nothing current - new action needed | Both |
| 2 | Resource information collection needs | Formally describe species | Taxonomy; describe species | Nothing current - new action needed | External |
| Olympia Pebblesnail | | | | | |
| 1 | Fish and wildlife habitat loss or degradation | Pollution, siltation | Improve water quality of occupied streams | Current insufficient | Both |
| Salmon River Pebblesnail | | | | | |
| 1 | Fish and wildlife habitat loss or degradation | Pollution, siltation | Improve water quality of occupied streams | Current insufficient | External |
| Shortface Lanx | | | | | |
| 1 | Fish and wildlife habitat loss or degradation | Pollution and siltation | Protection of water quality | Current insufficient | WDFW |
| 2 | Agriculture and aquaculture side effects | Pollution and siltation | Develop management recommendations | Current insufficient | WDFW |

NOTE: Numbers are for reference only and do not reflect priority.

## Family Pleuroceridae (Genus *Juga*): FRESHWATER AQUATIC SNAILS

**Conservation Status and Concern**

These species require cold, clear, well-oxygenated water; they are sensitive to pollution, and intolerant of warm waters, low dissolved oxygen, or major seasonal fluctuations. Destruction of springs by grazing, logging, and diversions (e.g. for water supply, fish hatcheries) has already caused extensive extinction of *Juga* species throughout western North America.

| **Common Name** (Scientific name) | Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend |
|---|---|---|---|---|---|---|
| **Barren Juga** (*Juga hemphilli hemphilli*) | None | None | No | G2T1 | S1 | Low/unknown |
| **Dalles Juga** (*Juga hemphilli dallesensis*) | None | None | No | G2T1 | S1 | Low/unknown |
| **Brown Juga** (*Juga sp. 3*) | None | None | No | G1 | S1 | Low/unknown |
| **Three-band Juga** (*Juga sp. 7*) | None | None | No | G1 | S1 | Low/unknown |
| **One-band Juga** (*Juga sp. 8*) | None | None | No | G2G3 | SNR | Low/unknown |
| | Climate vulnerability: Moderate-high | | | | | |

**Taxonomic notes:** The genus *Juga* and *Oreobasis* are synonymous. Three-Band Juga (*Juga* sp. 7) listed as Juga (*Juga* n. sp. 2) and One-band Juga (*Juga sp. 8)* listed as *Juga* n. sp. 1 in Frest and Johannes (1995: 178). The taxonomy of the Pleuroceridae, like most freshwater gastropods, has been based largely on shell morphology, and the tremendous variation makes the current taxonomy problematic and species identification difficult. Current work using reproductive anatomy and DNA to help resolve some of the taxonomic problems will likely result in changes in taxonomy in the future. Lee et al. (2006) analyzed DNA and suggested that *J. hemphilli* is a disjunct lineage from eastern North America, and should be designated *Elimia hemphilli*, but O'Foighil et al. (2009) reported that the Lee et al. (2006) paper was based on mislabeled voucher specimens, and confirmed that *J. hemphilli* belongs in *Juga* based on both DNA and anatomical evidence.

**Biology and Life History**

*Juga* species are freshwater aquatic snails with tall conical shells, native to the streams and springs of the Pacific Northwest and the Great Basin. *Juga* snails are characterized as rasper-grazers, feeding on both algae and detritus on rock surfaces and deciduous leaf litter. They exhibit seasonal migrations both upstream and downstream. The egg masses of *Juga* are most often found in loose (non-cemented) but stable cobble substrate, with free and fairly vigorous flow through at least the upper substrate layers. Egg masses are located under rocks in the spring, and eggs hatch in one month. *Juga* species live from 5 to 7 years, reaching sexual maturity in 3 years, and can continue to grow.

Genus *Juga*
Photo: nwnature.net

**Distribution and Abundance**

Where found, *Juga* can comprise over 90 percent of the invertebrate biomass in some streams. These five species seem to be restricted in distribution in Washington to the Columbia River Gorge, which historically provided abundant springs for habitat. Frest and Johannes (1995) systematically collected throughout much of the Gorge from 1987-1992, so that substantial additions to the range or an increase in the number of sites is highly unlikely.

**Barren Juga**: Barren Juga are known from a few populations on the west end of the Columbia Gorge in Washington and Oregon (mostly urbanized areas in Clark and Skamania Counties, Washington and Multnomah County, Oregon). Dillon (1989) lists occurrences from Oak Creek west of Corvallis, Benton County, Oregon.

**Dalles Juga:** The Dalles Juga has been found in Mill Creek and the central and eastern Columbia River Gorge from Hood River to the Dalles, in Hood River and Wasco Counties, Oregon and Skamania County, Washington. Lee et al. (2006) determined that material collected in 1883 by Whiteaves at the headwaters of the Columbia River in British Columbia and described as *Goniobasis columbiensis* is, in fact, this species.

**Brown Juga**: The Brown Juga is rare, found only in a few of the central and eastern Columbia Gorge tributaries, Skamania and Klickitat Counties, Washington, and in Multnomah and Hood River Counties, Oregon (Frest and Johannes 1995).

**Three-band Juga**: Three-band Juga are known from scattered sites, mostly in the eastern Columbia Gorge: Skamania and Klickitat Counties., WA, and Hood River, Wasco, Sherman, and Gilliam Counties, Oregon.

**One-band Juga**: One-band Jugas are known from a few of the central and eastern Columbia Gorge tributaries in Skamania and Klickitat Counties, Washington. Substantive range extensions are unlikely as most of the Columbia Gorge streams, as well as tributaries of the Klickitat and White Salmon rivers in recent years were surveyed.

**Habitat**

**Barren Juga:** The Barren Juga is found at low elevation large springs and small to medium streams with a level bottom and a stable gravel substrate and fast-flowing, unpolluted, highly oxygenated cold water. These typically lack aquatic macrophytes and have little epiphytic algae.

**Dalles Juga**: This species is found in low elevation large springs and small to medium streams with a stable gravel substrate and fast-flowing, unpolluted, highly oxygenated cold water. Relatively few macrophytes or epiphytic algal taxa are present.

**Brown Juga:** This species is found in low to medium elevation small spring-fed streams and springs, with cold, fast-flowing, well oxygenated water and gravel substrate. It is most frequently found in very small and shallow but perennial spring-fed streams and springs.

**Three-band Juga:** This species occurs in shallow, slow flowing springs and permanent seeps, sometimes associated with talus. Most often, these are covered by dense brush; the substrate ranges from bare rock faces to mud and sand. Rarely, this species occurs in smaller spring-fed streams.

**One-band Juga:** This species occurs in low to mid-elevation spring-fed streams and large springs with, cold, fast flowing, highly oxygenated water and a level bottom; if in streams, only in low-gradient streams, generally spring-fed.

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### Family Pleuroceridae: Conservation Threats and Actions

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| Barren Juga | | | | | |
| 1 | Fish and wildlife habitat loss or degradation | Water diversions; habitat destruction; pollution | Protect water quality | Current insufficient | Both |
| 2 | Resource information collection needs | Taxonomic uncertainty may mean one or more taxa are in greater decline; | Taxonomic clarification | Current insufficient | External |
| Brown Juga | | | | | |
| 1 | Fish and wildlife habitat loss or degradation | Water diversions; habitat loss to development | Protect small spring-fed streams | Current insufficient | WDFW |
| 2 | Resource information collection needs | Taxonomic uncertainty may mean one or more taxa are in greater decline; | Taxonomic clarification | Current insufficient | External |
| Dalles Juga | | | | | |
| 1 | Fish and wildlife habitat loss or degradation | Water diversions; habitat loss to development | Taxonomic clarification | Nothing current - new action needed | Both |
| 2 | Resource information collection needs | Taxonomic uncertainty may mean one or more taxa are in greater decline; | Taxonomic clarification | Current insufficient | External |
| One-band Juga | | | | | |
| 1 | Fish and wildlife habitat loss or degradation | Water diversions; habitat loss to development | Taxonomic clarification | Unknown | Both |

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 2 | Resource information collection needs | Taxonomic uncertainty may mean one or more taxa are in greater decline; | Formal species description, taxonomic clarification | Nothing current - new action needed | External |
| Three-band Juga | | | | | |
| 1 | Resource information collection Needs | Need formal species description and status assessment | Formal species description, and status assessment | Nothing current - new action needed | Both |
| 2 | Fish and wildlife habitat loss or degradation | Water diversions; habitat loss to development | Management recommendations; identification and protection of sites; | Nothing current - new action needed | Both |
| 3 | Agriculture and aquaculture side effects | Intensive livestock use may trample the species or reduce riparian vegetation | Install fencing to carefully manage or prohibit livestock access to occupied riparian areas | Current insufficient | Both |

NOTE: Numbers are for reference only and do not reflect priority.

# SLUGS

## TAILDROPPER SLUGS

**Conservation Status and Concern**

These endemic taildropper slugs are of concern due to their rarity. The Spotted Taildropper is only found in part of one county, and the rarity of both species suggest they have specific habitat needs that make them sensitive to land use activities, such as logging and loss of coarse woody debris.

| **Common Name** (Scientific name) | Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend |
|---|---|---|---|---|---|---|
| **Bluegray Taildropper** (*Prophysaon coeruleum*) | None | Candidate | Yes | G3G4 | S1 | Low/declining |
| **Spotted Taildropper** (*Prophysaon vanattae pardalis*) | None | None | No | GNR | SNR | Critical/ unknown |
| | Climate vulnerability: Low-moderate | | | | | |

**Taxonomic note**: *P.v. pardalis* has not been formally described as a subspecies; some specimens collected in northwestern Oregon assigned to this taxa appear to be a color variation of *P. andersoni*. Molecular analysis compared the genetic similarities of specimens identified as *P. coeruleum* from locations in western Oregon, Washington, California and Idaho. The results indicate that the species is not monophyletic in regards to color (i.e., body color is not related to genetic similarity), and there is a divergence in genetic similarity that occurs in southwestern Oregon populations which has resulted in several "clades" or variants in that region. None of these clades as yet have been officially named or described as subspecies or separate species.

**Biology and Life History**


Bluegray Taildropper
Photo: J.S. Applegarth

Like most terrestrial gastropods, taildroppers are hermaphroditic, having both male and female organs. Although not confirmed specifically for *P. coeruleum*, self-fertilization has been demonstrated in some species of gastropods, but cross-fertilization is the norm. Slugs are generally oviparous (egg-laying). Eggs of *Prophysaon* slugs are laid in clusters in cool damp spots including under logs or pieces of wood on the shaded forest floor. Slugs are preyed upon by a variety of vertebrates and other invertebrates. Tail-dropping is a means to escape some predators. Fungi made up most (90 percent) of the identifiable food ingested by *P. coeruleum*; this included a variety of mycorrhizal fungi and the species may be an agent of spore dispersal for these fungi, which are beneficial symbionts of many plants. Other food items include plant material and lichens; plant material is more commonly consumed in spring than in fall. There is no specific information available about the life history of the Spotted Taildropper.

## Distribution and Abundance

**Bluegray Taildropper:** This species occurs in a few isolated populations and is a rare Pacific Northwest endemic closely associated with coniferous forest stands and conifer debris. In Washington, scattered sites are documented within the Puget Trough; extant populations occur in Lewis and Cowlitz Counties. The entire species range encompasses the Oregon Coast Range, Oregon and Washington Cascades, Puget Trough, Klamath Mountains of southwestern Oregon and northern California, western Idaho, and southern Vancouver Island, British Columbia. Although somewhat widespread and abundant in southwestern Oregon, it is rare and likely declining elsewhere in its range (including the rest of Oregon, and in California, Washington, Idaho, and British Columbia) with populations scattered and disjunct.

**Spotted Taildropper:** A quite rare subspecies from a very limited range in Pacific County, Washington. It is a rare spotted form of the Scarletback Taildropper, a common slug of western Washington and western Oregon forests. May or may not also occur in northwestern Oregon.

## Habitat

**Bluegray Taildropper:** This species inhabits moist, coniferous or mixed-wood forests of varying age classes and is associated with moist forest floor conditions and abundant coarse woody debris, particularly of bigleaf maple. All records from British Columbia are from within the Coastal Douglas-fir biogeoclimatic zone, while in Washington, it is often associated with older forests and required microhabitat features, including abundant coarse woody debris or other cover, a deep forest litter layer and shaded, moist forest floor conditions.

**Spotted Taildropper:** Little habitat information is available for this subspecies; they have been found in snags, stumps, coarse woody debris, and large swordferns.

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**Taildropper Slugs: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| Bluegray Taildropper | | | | | |
| 1 | Agriculture and aquaculture side effects | Logging of mature forest sites, loss of coarse woody debris | Identify and protect sites | Nothing current - new action needed | External |
| Spotted Taildropper | | | | | |
| 1 | Resource information collection needs | Lack of data on current status and distribution | Determine distribution, population status | Current insufficient | Both |

NOTE: Numbers are for reference only and do not reflect priority.

# FRESHWATER BIVALVES

## Families Unionidae and Margaritiferidae: FRESHWATER MUSSELS

**Conservation Status and Concern**

Freshwater mussels have been greatly affected by dams and annual water drawdowns, as well as degraded water quality resulting from development and agriculture. Many historical sites no longer support mussels, and many local populations no longer successfully reproduce.

| **Common Name** (Scientific name) | Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend |
|---|---|---|---|---|---|---|
| **California Floater** (*Anodonta californiensis*) | None | Candidate | Yes | G3Q | S2 | Low/declining |
| **Winged Floater** (*Anodonta nuttaliana*) | None | None | No | G4Q | S1 | Low/declining |
| **Western Ridged Mussel** (*Gonidea angulata*) | None | None | No | G3 | S2S3 | Uncommon/ declining |
| **Western Pearlshell** (*Margaritifera falcata*) | None | None | No | G4G5 | S3S4 | Uncommon/ declining |
| | Climate vulnerability: Moderate | | | | | |

**Taxonomic notes:** Recent genetic research suggests that the California and Winged Floaters belong to a single clade, and that this clade exhibits basin-specific substructuring and may contain at least six distinct groups. However, before new species or genus level designations are made, the taxonomy for the entire Unionidae family needs to be resolved. The Western Ridged Mussel is the only species in the genus Gonidea.

**Biology and Life History**

Western Pearlshell
Photo: WDFW

Freshwater mussels are filter feeders that consume phytoplankton and zooplankton suspended in the water. Freshwater mussels have separate sexes, although hermaphrodites (individuals with male and female traits that are capable of self-fertilization) have been documented for some North American species, including the Western Pearlshell. Freshwater mussels have a complex life cycle. During breeding, males release sperm into the water and females filter it from the water for fertilization to occur. Embryos develop into larvae called glochidia, which are released into the water and must encounter and attach to a fin or gill filaments of host fish. Glochidia form a cyst around themselves and remain on a host for several weeks. They subsequently release from the host fish and sink to the bottom, burrow in the sediment and remain buried until they mature. During their lives, mussels may move less than a few yards from the spot where they first landed after dropping from their host fish. Because freshwater mussels are not able to move far on their own, their association with fish allows them to colonize new areas, or repopulate areas from which they have been extirpated. Freshwater mussels that live in dense beds, including Western Ridged Mussel and Western Pearlshells, provide an important water purification service; they can filter suspended solids, nutrients and contaminants from the water column and collectively improve water quality by reducing turbidity and controlling nutrient levels.

**California Floater/Winged Floater:** Floater species grow quickly, reach sexual maturity in 4 to 5 years, and probably have a maximum life span of about 15 years. Host fish are unknown, but may include Chiselmouth (*Acrocheilus alutaccus*) and Northern Pikeminnow (*Ptychocheilus oregonensis*). Like other freshwater mussels, California and Winged Floaters rely on host fishes to reproduce and disperse.

**Western Ridged Mussel:** The Western Ridged Mussel is a relatively slow growing and long-lived species perhaps living 20 to 30 years, and can be an important indicator of water quality. The fish host species in Washington are unknown, but in northern California, Hardhead (*Mylopharodon conocephalus*), Pit Sculpin (*Cottus pitensis*), and Tule Perch (*Hysterocarpus traski*) are hosts for Western Ridged Mussels.

**Western Pearlshell:** The average life span is approximately 60 to 70 years, although some individuals are thought to have lived more than 100 years. Because this species is sedentary, sensitive to environmental changes, and long-lived, it can be an excellent biological indicator of water quality. Documented host fishes for Western Pearlshells include Cutthroat Trout (*Oncorhyncus clarkii*), Rainbow/Steelhead Trout (*O. mykiss*), Chinook Salmon (*O. tshawytscha*), and Brown Trout (*Salmo trutta*), and a number of other fish are considered potential hosts.

**Distribution and Abundance**

**California Floater/Winged Floater:** Historically widespread west of the Continental Divide from British Columbia to Baja, but extirpated from many areas by dams. It is problematic to determine the distribution of these species because of their morphological similarity and confusion of taxonomy; this range description may prove to apply to several distinct species. Frest and Johannes (1995) reported the range has been reduced and extant populations were found in the following areas: the Middle Snake River in Idaho; the Fall and Pit Rivers in Shasta County, California; the Okanogan River in Chelan County, Washington; and Roosevelt and Curlew Lakes in Ferry County, Washington. Extirpated from much of historic range, including the Willamette and lower Columbia Rivers and the Central Valley in California.

**Western Ridged Mussel:** The Western Ridged Mussel is widely distributed in Washington, Oregon, California, Idaho, Nevada, and southern British Columbia. This species is more common east of the Cascades of Oregon and Washington than on the western side. In Washington, the Western Ridged Mussel was known from the Columbia River (Kittitas County), Toppenish Creek (Yakima County), Yakima River (Benton County), the Snake River (Columbia County), Chehalis River (Grays Harbor, Lewis Counties), Skookumchuck River (Lewis County), Spokane River (Lincoln County), the Columbia, Okanagan, Similkameen, Spokane and Little Spokane Rivers, Osoyoos Lake, Palmer and Hangman Creeks, and Spokane Falls (Okanagan County), and Colville River (Stevens County). Declines or extirpations have been reported in the Little Spokane, Wenatchee, and Yakima Rivers.

**Western Pearlshell:** The range of the Western Pearlshell extends from Alaska and British Columbia south to California and east to Nevada, Wyoming, Utah and Montana; it is apparently most abundant in Oregon, Washington, Idaho and British Columbia. In Washington, Pearlshells have been extirpated from much of the mainstem Columbia and Snake Rivers; substantial declines, die-offs, or lack of recent reproduction have also been reported from the SanPoil River (Ferry County), Kettle River (Stevens County), the Little Spokane River (Spokane County), Snohomish River, Muck Creek (Pierce County), Bear Creek (King County), and Nason Creek (Chelan County). High levels of arsenic and organochlorine pesticides were found in the tissues of other mussel species collected from the mid-Columbia River during that survey. This species has also been extirpated from northern Nevada, from most areas in northern Utah, several rivers in Montana, and numerous other locations. In addition, there are reports of populations of Western Pearlshells that apparently have not reproduced for decades. Populations of such a long-lived species may appear stable, when in fact they are not reproducing; populations showing repeated reproduction, evidenced by multiple age classes, are now rare.

**Habitat**

Freshwater mussels are found in shallow habitats in permanent bodies of water, including creeks, rivers, and ponds generally at low elevations. Mussels tend to concentrate in areas of streams with consistent flows and stable substrate conditions. They are often absent or sparse in high-gradient, rocky rivers, but are frequently encountered in low-gradient creeks and rivers, perhaps because they provide a variety of habitat conditions, reliable flow, good water quality, and diverse fish communities.

**California Floater/Winged Floater:** Floaters occur in natural lakes, reservoirs, and downstream low-gradient reaches of rivers in pool habitats. Because their thin shells are prone to damage, floaters favor habitats of sand and silt substrates in lower gradient streams than those favored by Western Pearlshells and Western Ridged Mussels; sandbars near the mouths of tributary streams or below riffles are important habitats.

**Western Ridged Mussel:** Western Ridged Mussels inhabit the bottom of cold creeks, rivers, and lakes from low to mid-elevations with substrates that vary from gravel to firm mud, and include at least some sand, silt or clay. It is generally associated with constant flow, shallow water (less than 10 feet in depth), and well-oxygenated substrates. This species is often present in seasonally turbid streams, but absent from continuously turbid water (e.g. glacial meltwater streams).

**Western Pearlshell:** This species inhabits cold creeks and rivers with clear, cold water and sea-run salmon or native trout including waterways above 5,000 feet in elevation. Western Pearlshells are typically found at depths of 1.5 to 5 feet, and they tend to congregate in areas with boulders and gravel substrate, with some sand, silt and clay. Western Pearlshells occur in waterways with low velocities and stable substrates and are frequently found in eddies or pools and areas with stones or boulders that likely shelter mussel beds from scour during flood events. This species appears to be intolerant of sedimentation.

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**Families Unionidae and Margaritiferidae: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| California Floater | | | | | |
| 1 | Agriculture and aquaculture side effects | Water level fluctuations; pollution | Protect water quality | Current insufficient | External |
| 2 | Resource information collection needs | Taxonomic uncertainty may mean one or more taxa are in greater decline | Taxonomic clarification | Current insufficient | External |
| Western Pearlshell | | | | | |
| 1 | Fish and wildlife habitat loss or degradation | Pollution, siltation | Protect water quality | Current insufficient | External |
| 2 | Agriculture and aquaculture side effects | Pollution, siltation | Protect water quality | Current insufficient | External |
| 3 | Fish and wildlife habitat loss or degradation | Suction dredging for gold | Delineate and protect sites | Current insufficient | Both |
| Western Ridged Mussel | | | | | |
| 1 | Fish and wildlife habitat loss or degradation | Pollution; need info on life history, ecology | Protect water quality | Current insufficient | External |
| 2 | Resource information collection needs | Need info on life history, ecology | Life history research | Current insufficient | External |
| Winged Floater | | | | | |
| 1 | Agriculture and aquaculture side effects | Water level fluctuations; pollution; need taxonomic clarification | Technical assistance to regulatory agencies | Current insufficient | Both |
| 2 | Resource information collection needs | Need taxonomic clarification | Taxonomic clarification; | Current insufficient | External |

NOTE: Numbers are for reference only and do not reflect priority.

# MARINE BIVALVE

## OLYMPIA OYSTER (*Ostrea lurida*)

**Conservation Status and Concern:**
Washington's only native oyster, it is currently present in diminished abundance (less than 5 percent) due to overharvest and habitat alterations throughout most of the species historical range (circa 1850) in Washington. Evidence of natural recruitment and restoration success observed but lack of suitable habitat limits further increases.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| None | Candidate | Yes | G5 | SNR | Low/stable | High |

**Biology and Life History**


Photo: Wikipedia Commons

Olympia Oysters are hermaphroditic and able to alternate between male and female annually during reproduction cycles. Sexual maturity is observed in oysters greater than 0.6 inch shell length, which is typically reached in 12 months. Fecundity is observed to be very high for young oysters in comparison to older oysters. Fertilized larvae are initially brooded internally by the female and then released as large, free-swimming pediveligers for 7 to 10 days before settlement and attachment to available hard substrates. Populations are tolerant of a wide range of environmental conditions and salinity values but are intolerant of freshwater exposures. Intertidal survival is dependent upon thermal refuges provided by immersion, partial immersion, moist substrates, or by location on or underneath rocks, boulders, oysters or other structure. Extreme freezing weather events may result in significant mortalities in exposed intertidal occurrences. Maximum adult size appears to be 3.5 inches but typically they range from 2 to 2.4 inches, reached in 5 to 6 years. Maximum age is generally 10 years.

**Distribution and Abundance**
Olympia Oysters are native along the Pacific coast of North America, form Gale Passage (British Columbia) to Bahia de San Quintin (Baja California). Primarily found, historically and currently, in the low intertidal zone in Puget Sound with rare subtidal occurrences. In Willapa Bay the species occurred both in the intertidal and subtidal historically but now appear to be limited to subtidal occurrences. Occurrences in Grays Harbor appear to be historically and currently of very limited abundance. Present throughout nearly all of the species historical range in Washington. While currently found in diminished abundance, the species is commonly observed intertidally in portions of Hood Canal, South Puget Sound, and Central Puget Sound plus specific embayments in North Sound, Admiralty Inlet and Straits of Juan de Fuca. Dense occurrences in natural beds are limited and estimated to be less than 5 percent of total historical extents and numbers of beds (circa 1850). The Willapa Bay population exhibits observable larval production but abundance of adults remains unknown. Adults are occasionally observed in Grays Harbor. Natural recruitment success in portions of Puget Sound appears to be on the increase.

**Habitat**

Olympia Oysters occur primarily as an intertidal species in Puget Sound and both intertidal and subtidal in Willapa Bay. They form shallow (less than 2 feet in elevation) loose beds of oysters and shell on unconsolidated mud, sand, gravel substrates. They may also be found attached to rocky structures. The species requires hard substrates (oysters, shell, gravel, rock) for attachment of recruits and formation of natural beds.

**References**

Blake, B. and A. Bradbury. 2012. Plan for Rebuilding Olympia Oyster (*Ostrea lurida)* Populations in Puget Sound with a Historical and Contemporary Overview. Washington Department of Fish and Wildlife, Olympia.

**Olympia Oyster: Conservation Threats and Strategies**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Invasive and other problematic species | Localized occurrences of the non-native predators *Ocinebrellus inornatus* and *Koinostylochus ostreaophagus.* | Re-establish or enhance presence of viable, self-sustaining source populations. | Current sufficient | Both |
| 2 | Overharvesting of biological resources | By-catch mortality from Pacific Oyster commercial harvest and other uses of tidelands | Re-establish or enhance presence of viable, self-sustaining source populations. | Current sufficient | Both |
| 3 | Fish and wildlife habitat loss or degradation | Shoreline and tideland modifications, including nearshore or estuarine restoration projects. | Re-establish or enhance presence of viable, self-sustaining source populations. | Current sufficient | Both |
| 4 | Fish and wildlife habitat loss or degradation | Siltation from upland practices and nutrient inputs | Re-establish or enhance presence of viable, self-sustaining source populations. | Current sufficient | Both |
| 5 | Agriculture and aquaculture side effects | Genetic fitness impacts from unrestricted distribution of generic hatchery-origin native oysters | Re-establishment and enhancement of genetic diversity through restoration historic and new sites. | Current sufficient | Both |

NOTE: Numbers are for reference only and do not reflect priority.

# MARINE GASTROPOD

## PINTO ABALONE (*Haliotis kamtschatkana*)

**Conservation Status and Concern**

The Pinto Abalone has failed to recover from dramatic declines resulting from excessive recreational and illegal harvest, despite fishery closure. There is strong evidence of recruitment failure, perhaps because the densities of remaining populations are below the threshold for successful reproduction.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| Species of Concern | Candidate | Yes | G3G4 | SNR | Uncommon/declining | Moderate-high |

**Biology and Life History**

Photo: Wikimedia Commons

Adult Pinto Abalone feed primarily on drift macroalgae, such as bull kelp (*Nereocystis luetkeana*), and juveniles feed predominantly on microalgae and diatoms. Pinto Abalone are broadcast spawners and the sperm and eggs are only viable for a short period, so successful reproduction requires that adults be aggregated. After eggs are successfully fertilized, embryos rapidly become free-swimming trochophores, which metamorphose into veliger larvae. After approximately 10 to 14 days as plankton, the swimming veligers settle onto suitable substrate. Newly settled juvenile abalone require crevices for added protection from predators and remain cryptic until mature. Upon maturation at approximately 2 inches in shell length, abalone become more exposed and are more easily found in their habitat. Many are semi-exposed or fully exposed on open rocky habitat by the time they reach 3.5 inches in shell length.

**Distribution and Abundance**

Pinto Abalone are distributed from Point Conception, California to southeast Alaska. In Washington, they are generally found on hard, rocky substrates in exposed coastal areas, including Puget Sound, Strait of Juan de Fuca and the San Juan Archipelago. Abundance at index sites in the San Juan Islands declined 92 percent between 1992 and 2013.

**Habitat**

Pinto Abalone are typically found on rocky substrate, in water between 10 and 65 feet deep. Their preferred habitat in the San Juan Archipelago and the Strait of Juan de Fuca is exposed rock, often covered (at least partially) with crustose coralline algae.

**References**

Vadopalas, B. and J. Watson. 2014. Recovery Plan for Pinto Abalone (*Haliotis kamtschatkana*) in Washington state. Puget Sound Restoration Fund. 50 pp.

**Pinto Abalone: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Resource information collection needs | Reproductive failure due to low densities | Research augmentation methods | Current insufficient | WDFW |
| 2 | Overharvesting of biological resources | Reproductive failure due to low densities | Life history research | Current insufficient | WDFW |
| 3 | Overharvesting of biological resources | Small populations vulnerable to illegal harvest | Outreach and enforcement of harvest restrictions | Current insufficient | WDFW |
| 4 | Resource information collection needs | Limited understanding of life history and limiting factors | Life history research | Current insufficient | WDFW |

NOTE: Numbers are for reference only and do not reflect priority.

# EARTHWORM

## GIANT PALOUSE EARTHWORM (*Driloleirus americanus*)

**Conservation Status and Concern**
Data on this species are sparse. It is difficult to detect and few surveys have been performed to determine its distribution and abundance. There has been an obvious reduction of range in the Palouse region of Washington with conversion of prairie to cropland. Introduced worm species appear to exclude native species, including this one.

| Federal Status | State Status | PHS | Global Ranking | State Ranking | Population size/trend | Climate Vulnerability |
|---|---|---|---|---|---|---|
| None | Candidate | Yes | G1 | S2 | Unknown/unknown | Low-moderate |

**Taxonomic note:** A genetics study is currently underway to determine whether the worms found in the East Cascades are the same as those found in the Palouse regions of Washington and Idaho. Preliminary findings indicate that these populations are likely the same species.

**Biology and Life History**
A large, pale or white earthworm, this species has until relatively recently been considered endemic to the Palouse prairies of eastern Washington and Idaho, where it was discovered in 1897. This species is considered to be “anecic”, meaning that it burrows vertically deep into the ground and lives in deep, semi-permanent burrows, coming to the surface in wet conditions. Burrows have been found at a depth of 15 feet.

Giant Palouse Earthworm
Photo: M. Teske

**Distribution and Abundance**
In Washington, the Giant Palouse Earthworm has been found in Chelan, Kittitas and Whitman Counties. It may be more widespread because recent records from the east slope of the Cascades have expanded its known range. Based on knowledge of other species in the Megascolecidae family to which this species belongs, the worm’s range could extend along the Columbia Plateau in a band just below the terminal moraines of the Pleistocene glaciation. Because these worms are very slow colonists, range limits are probably determined by the extent of Pleistocene glaciation and the Missoula Floods, both of which would have eliminated earthworms.

**Habitat**
Originally assumed to require deep, loamy soils characteristic of the Palouse bunchgrass prairies, the species was found in the eastern Cascades occupying gravelly sandy loam and other rocky soils in forested areas. They have been found in open forest, shrub-steppe, and prairie. Of sites surveyed, only one occurrence was in non-native vegetation on land enrolled in the Conservation Reserve Program.

**References**

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J. Maynard-Johnson, University of Idaho, pers.comm.
K. McAllister, WSDOT, pers.comm.

**Giant Palouse Earthworm: Conservation Threats and Actions**

| | STRESSOR | DESCRIPTION | ACTION NEEDED | LEVEL OF INVESTMENT | LEAD |
|---|---|---|---|---|---|
| 1 | Agriculture and aquaculture side effects | In the Palouse region, plowing and soil disturbance due to agricultural activity has converted GPE habitat | Surveys are needed in undisturbed areas to determine site occupancy. | Nothing current - new action needed | Both |
| 2 | Resource information collection needs | Originally found in Palouse prairie and thought to be endemic there, but recent detections in the East Cascades and clues regarding range characteristics indicate the need for greater survey efforts | Past surveys have been conducted in the Palouse region. East Cascades detections were accidental at first. Very limited, spot surveys done since. | Current insufficient | External |
| 3 | Resource information collection needs | Questions remain regarding possible genetic differences between the Palouse and East Cascade populations | Research on genetics being done by J. Maynard-Johnson at University of Idaho. Results not definitive. | Current sufficient | External |
| 4 | Fish and wildlife habitat loss or degration | WSDOT highway and USFS road building and alteration have disrupted earthworm concentrations. This is how they were discovered in the East Cascades. | Review of proposed transportation projects | Current insufficient | Both |
| 5 | Invasive and other problematic species | Invasive, non-native earthworm species, notably the European earthworm (*Lumbricus terrestris*). | Note occurrences and continue surveys | Current insufficient | Both |

NOTE: Numbers are for reference only and do not reflect priority.

# REFERENCES

## SECTION A: Alphabetical list of species

## SECTION B: Explanation of Terms

# Conservation Status Table

Federal Status
Refers to legal designations under the Federal ESA (listed as Endangered or Threatened or recognized as a Candidate species for listing), or designated as a Sensitive species.

State Status
The Washington Fish and Wildlife Commission has classified 46 species as Endangered, Threatened or Sensitive, under WAC 232-12-014 and WAC 232-12-011. Species can also be designated Candidate Species for state listing by WDFW policy.

PHS (Priority Habitats and Species Program)
A species listed under the PHS program is considered to be a priority for conservation and management and requires protective measures for survival due to population status, sensitivity to habitat alteration and/or tribal, recreational or commercial importance. Management recommendations have been developed for PHS species and habitats, and can assist landowners, managers and others in conducting land use activities in a manner that incorporates the needs of fish and wildlife.

**Global (G) and State (S) Rankings:** Refers to NatureServe status rankings provided by the Natural Heritage Program. These conservation status ranks complement legal status designations and are based on a one to five scale, ranging from critically imperiled (1) to demonstrably secure (5). The global (G) and state (S) geographic scales were used for the SGCN species fact sheets. For more on the methodology used for these assessments, please see: Methodology for Assigning Ranks - NatureServe.

**State Rank:** characterizes the relative rarity or endangerment within the state of Washington.
**S1** = Critically imperiled
**S2** = Imperiled
**S3** = Rare or uncommon in the state – vulnerable
**S4** = Widespread, abundant, and apparently secure i
**S5** = Demonstrably widespread, abundant, and secure in the State
**SA** = Accidental in the state.
**SE** = An exotic species that has become established in the state.
**SH** = Historical occurrences only are known, perhaps not verified in the past 20 years, but the taxon is suspected to still exist in the state.
**SNR** = Not yet ranked. Sufficient time and effort have not yet been devoted to ranking of this taxon.
**SP** = Potential for occurrence of the taxon in the state but no occurrences have been documented.
**SR** = Reported in the state but without persuasive documentation which would provide a basis for either accepting or rejecting the report (e.g., misidentified specimen).
**SRF** = Reported falsely in the state but the error persists in the literature.
**SU**= Unrankable. Possibly in peril in the state, but status is uncertain. More information is need.
**SX** = Believed to be extirpated from the state with little likelihood that it will be rediscovered.
**SZ** = Not of conservation concern in the state.

Qualifiers are sometimes used in conjunction with the State Ranks described above:

**B** - Rank of the breeding population in the state.
**N** - Rank of the non-breeding population in the state.

**Global Rank:** characterizes the relative rarity or endangerment of the element world-wide.
**G1** = Critically imperiled globally
**G2** = Imperiled globally
**G3** = Either very rare and local throughout its range or found locally (even abundantly at some of its locations) in a restricted range - vulnerable
**G4** = Widespread, abundant, and apparently secure globally
**G5** = Demonstrably widespread, abundant, and secure globally, though it may be quite rare in parts of its range
**GH** = Historical occurrences only are known, perhaps not verified in the past 20 years, but the taxon is suspected to still exist somewhere in its former range.
**GNR** = Not yet ranked. Sufficient time and effort have not yet been devoted to ranking of this taxon.
**GU** = Unrankable. Possibly in peril range-wide but status uncertain. More information is needed.
**GX** = Believed to be extinct and there is little likelihood that it will be rediscovered.

Qualifiers are used in conjunction with the Global Ranks described above:
**Tn** Where n is a number or letter similar to those for Gn ranks, above, but indicating subspecies or variety rank. For example, G3TH indicates a species that is ranked G3 with this subspecies ranked as historic.

## SECTION C: Full List of References


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J. Maynard-Johnson, University of Idaho, pers.comm.

K. McAllister, WSDOT, pers.comm.

D. Ruiter, University of Texas, pers.comm.

# Appendix B

# Potential Range and Habitat Distribution Maps

## Table of Contents

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**LIST OF FIGURES**

# Appendix B
# Potential Range and Habitat Distribution Maps

## 1. Overview

This appendix describes the methodology for developing potential range and habitat distribution maps, and includes the maps for a subset of the Species of Greatest Conservation Need (SGCN). These maps are referred to as "potential" habitat distribution maps because they depict range as areas with documented occurrences, as well as areas with suspected or possible occupancy based on the availability of suitable habitat and the proximity of that suitable habitat to occupied areas. This information is intended to be used in conservation planning, for example to identify and prioritize areas for population surveys or to determine priority areas for restoration.

### Why only selected SGCN?

Since these maps are based on occurrence data, we could only develop maps for those species for which sufficient data existed in our database. We also prioritized species for map development based in part on WDFW's need for spatial distribution data. For example, we prioritized some species for which the agency plans to prepare status assessments in the near future, as well as those included in the Habitat Conservation Plan for WDFW lands, currently in preparation. As we become more familiar with these map products and their utility for conservation planning, and as new data becomes available, we intend to develop additional maps for other SGCN as appropriate.

## 2. Methodology

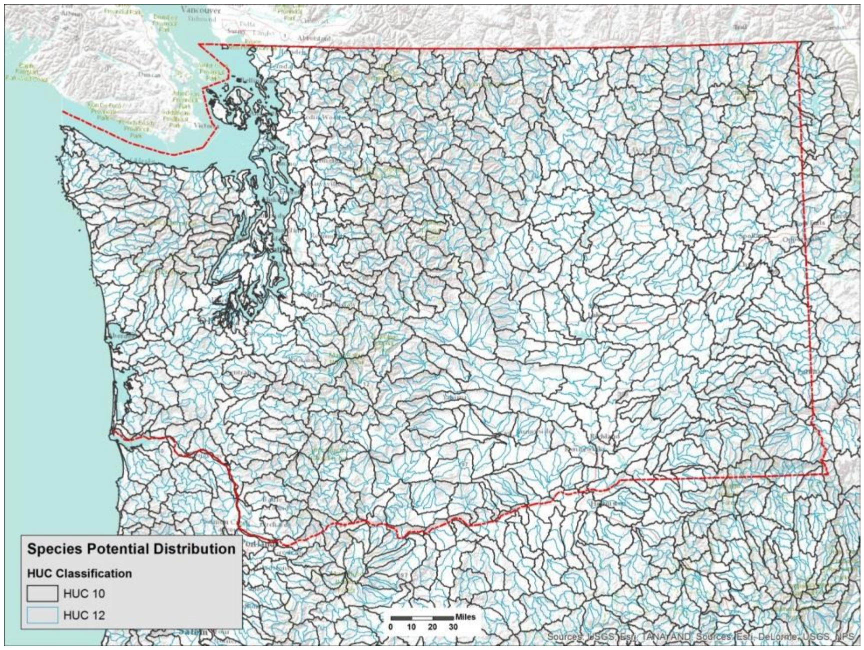
We defined species range as the geographic area in which a species regularly occurs within Washington, including areas used for breeding as well as important foraging, wintering, or migration areas where appropriate. We chose to spatially represent range using watershed boundaries (hydrologic units) at various scales and we used ecological systems[1] as the basis for representing potentially suitable habitat distribution of the species within its range. Each step in the process is described below, using the example of the Washington Ground Squirrel.

### Step 1: Select range units and scale

We used the United States Geologic Survey (USGS) Hydrologic Unit Code (HUC) national watershed classification system to delineate range. The United States is divided and subdivided into successively smaller hydrologic units which are classified into various levels. The hydrologic units are nested within each other, from the largest geographic area to the smallest. Each hydrologic unit is identified by a unique code (HUC), indicating the relative scale. We selected two units to delineate range; HUC 12 (smaller) and HUC 10 (larger - see figure 1 for the distribution and relative size of HUC 10 and HUC 12 watersheds throughout Washington).

[1] Ecological Systems are a component of the National Vegetation Classification Scheme (NVCS) and have been used through the State Wildlife Plan Update to describe habitat needs of SGCN.

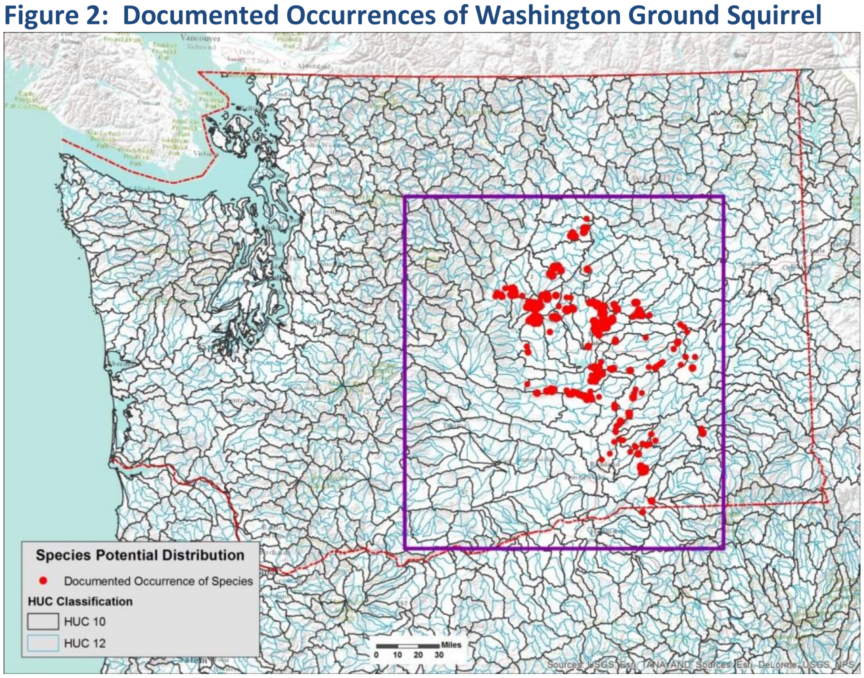
**Figure 1: HUC 10 and HUC 12 Distribution in Washington**




## Step 2: Map species occurrence data within watersheds at smallest scale (HUC 12)

Species occurrence data from the WDFW database was mapped as they occur in HUC 12 watersheds. This data used is considered high accuracy occurrence data from 1978 to 2015 (figure 2).

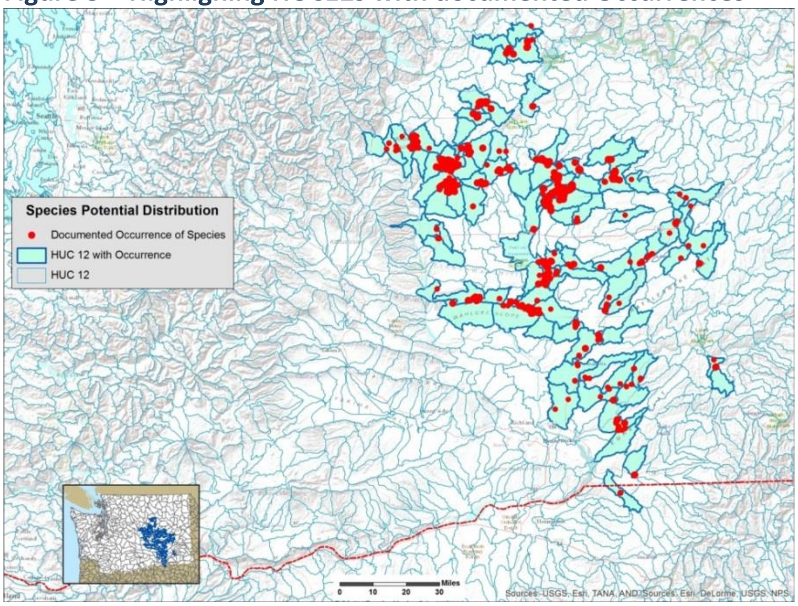
**Figure 2: Documented Occurrences of Washington Ground Squirrel**



### Step 3: Select HUC 12s

Next, HUC 12s, the smaller watershed-based range units, were selected as core range. This preliminary list was then edited by WDFW biologists who used empirical data and literature to determine extant, incidental, accidental, and infrequent occupancy status for HUC 12s. The resulting HUC 12 selected watersheds represent the highest degree of certainty in depicting the current species range (figure 5).

**Figure 3 – Highlighing HUC12s with documented Occurrences**




### Step 4: Identify suitable habitat for habitat distribution

We defined habitat distribution as the spatial arrangement of ecological systems suitable for a species within its predefined range. Species associations were defined on a species-by-species basis for 98 ecological systems in Washington. Biologists used expert knowledge and published habitat associations (Rocchio and Crawford 2008) and preferences to associate ecological systems to species using four categories, closely associated, generally associated, unsuitable, and unknown (figures 3 and 4). It should be noted that associated habitat and habitat distribution refers here to the extent of ecological systems with which a species is associated. Some, if not all species, respond to finer scale habitats such as vernal pools or forest stand age that cannot necessarily be mapped but may drive where a species occurs.

***1. Closely Associated.*** The species demonstrates preference for the ecological system, as indicated by greater occurrence, high densities, greater reproductive output, or other indicators of preference, than in other ecological systems. A species that is closely associated to individual ecological systems often rely on one to a few ecological systems for a significant part, or all, of its life history requirements.

***2. Generally Associated**.* The species occurs in, but does not prefer, the ecological system, as indicated by lesser occurrence, lower densities, or other indicators of a general relationship with the ecological system. A species that is generally associated with individual ecological systems can typically rely on numerous ecological systems to meet its life history requirements.

***Note:*** A species can be closely associated with some ecological systems and generally associated with others, given differences in occurrence, densities, reproductive output, or other indicators of preference.

**3. Unsuitable.** A species demonstrates no use or only occasional use of the ecological system.

***4. Unknown***. The species' use of the ecological system is unknown. There were questions or uncertainty whether or not a species used an ecological system.

**Figure 4 – Associating SGCN with suitable habitats**

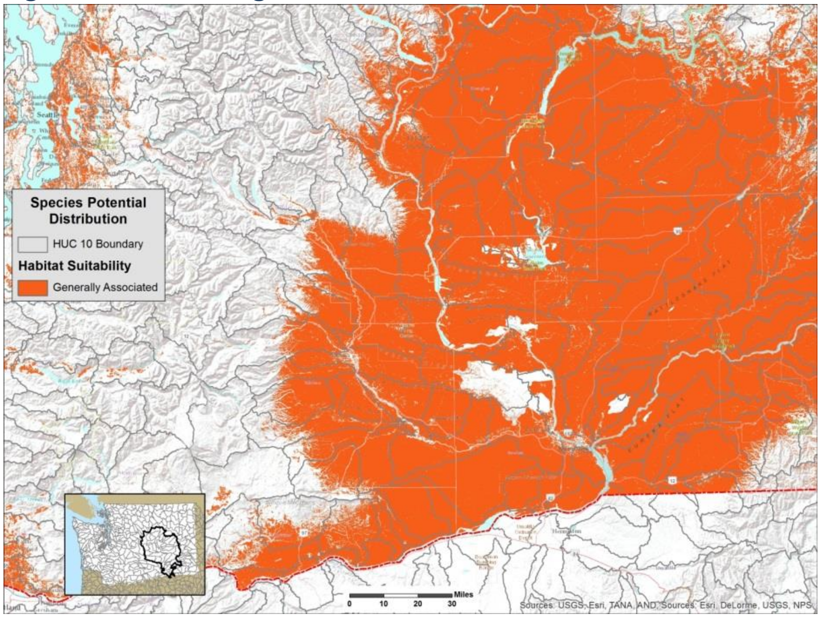
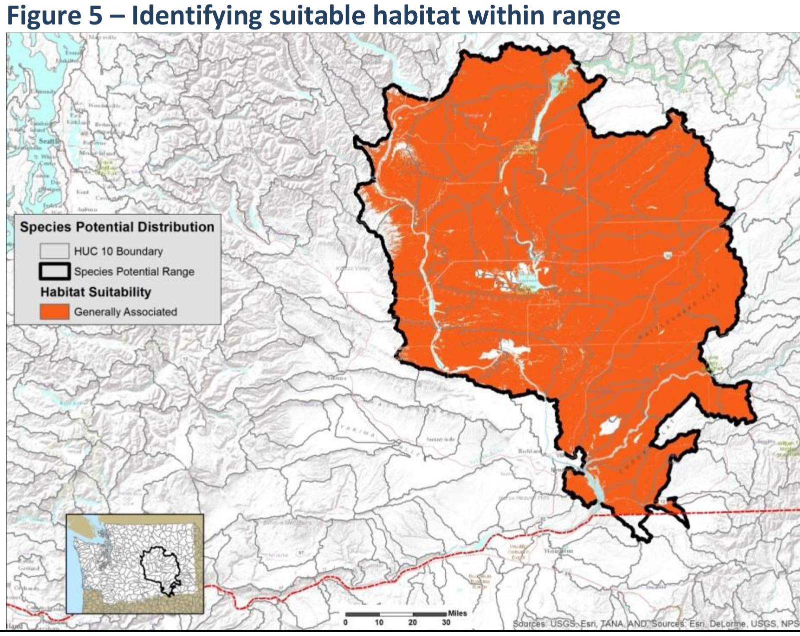



**Figure 5 – Identifying suitable habitat within range**

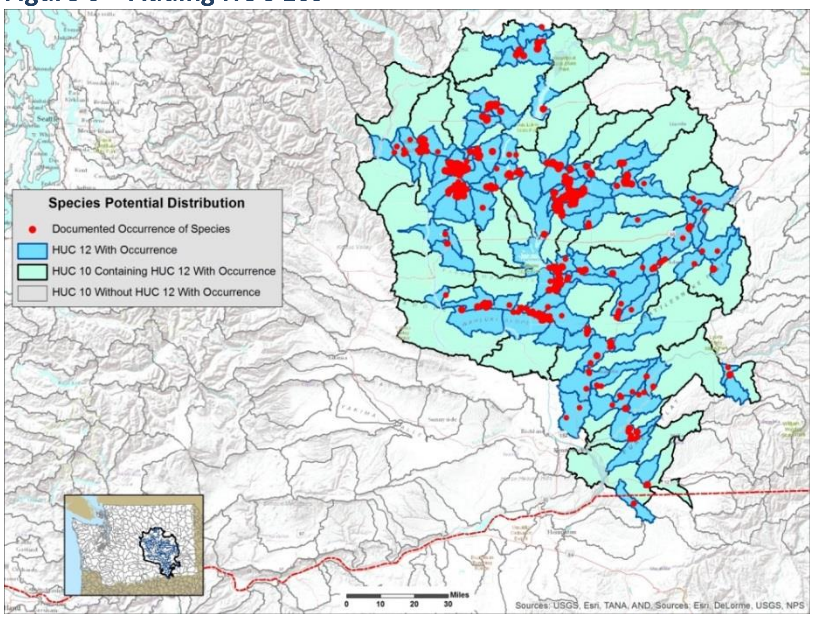



*Note: this particular species happens to have only generally associated habitat - other species with closely associated habitat would have those areas marked in blue.*

### Step 5: Selectively highlight adjacent HUC 10s

Since the HUC system is hierarchical, each HUC 12 is nested within a larger HUC 10. The next step was to highlight the entire HUC 10 watershed as potential range, if suitable habitat exists, given proximity to known occurrences. Decisions to add the HUC 10 to a species' range included consideration of proximity to occupied range units, suitable habitat, and areas known to be subject to conservation action (reintroduction, translocation, and restoration – figure 5). In some cases, HUC 10's were not selected if the extent of the HUC 10 overrepresented where a species might occur. These assessments were made on a species-by-species basis by staff biologists.

**Figure 6 – Adding HUC 10s**




## 3. Considerations for Use

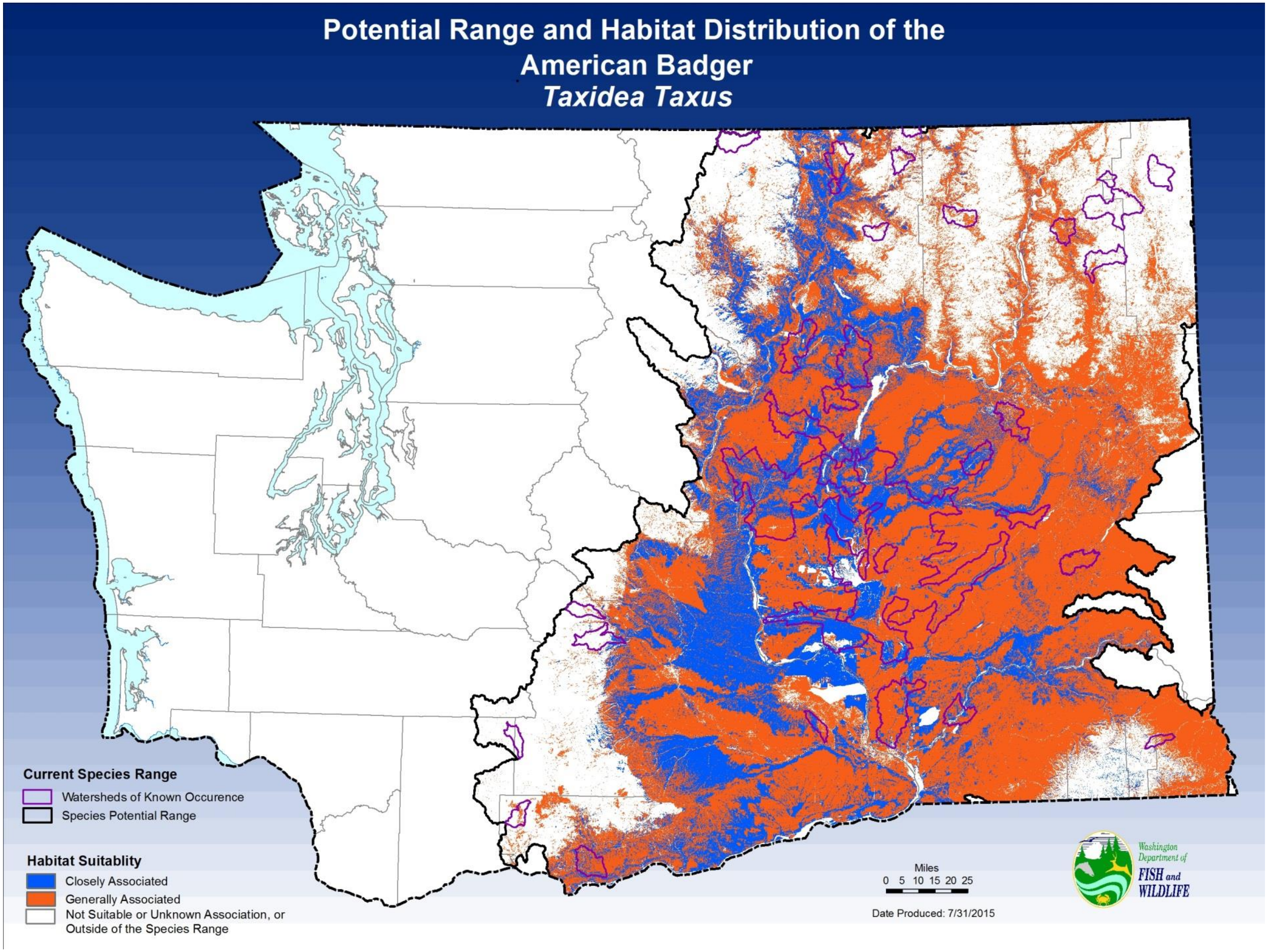
As mentioned in the Overview to this section, these maps are intended to be used to inform conservation planning at fairly broad scales to determine the most effective places to direct conservation investment. They will also serve as a guide for directing survey effort in areas that are thought to contain suitable habitat but for which no observations for a species exist. These activities are expected to lead to a further refinement of species ranges, mapped ecological associations, and associated habitat designations. The maps are not meant to replace existing range maps that may be in use for species recovery planning or in other regulatory processes such as establishing critical area ordinances. They are also not meant to identify specific places for conservation action but rather guide further evaluation within watersheds as to where the most appropriate conservation actions might take place.

### Keeping maps relevant

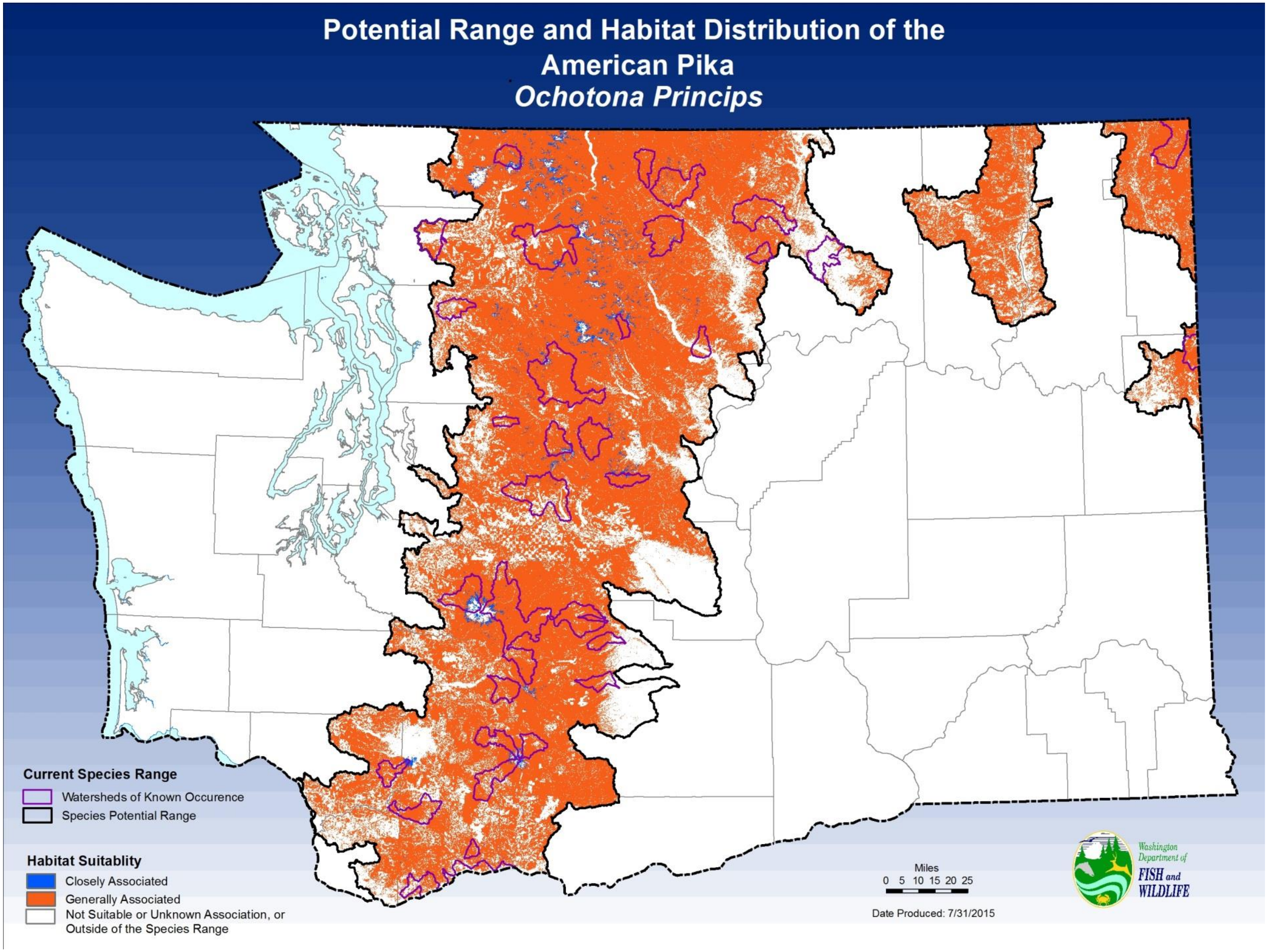
These map products are intended to be dynamic through links to WDFW cooperatively managed and other public domain wildlife occurrence datasets. Thus, new occurrences will be used to improve our range map products and keep them relevant over time. WDFW also has strong data sharing partnerships with U.S. Forest Service, Bureau of Land Management, eBird, and other organizations and intends to incorporate new partner data into our range map update process upon subsequent releases.

# 4. Range and Potential Habitat Distribution Maps for Selected SGCN

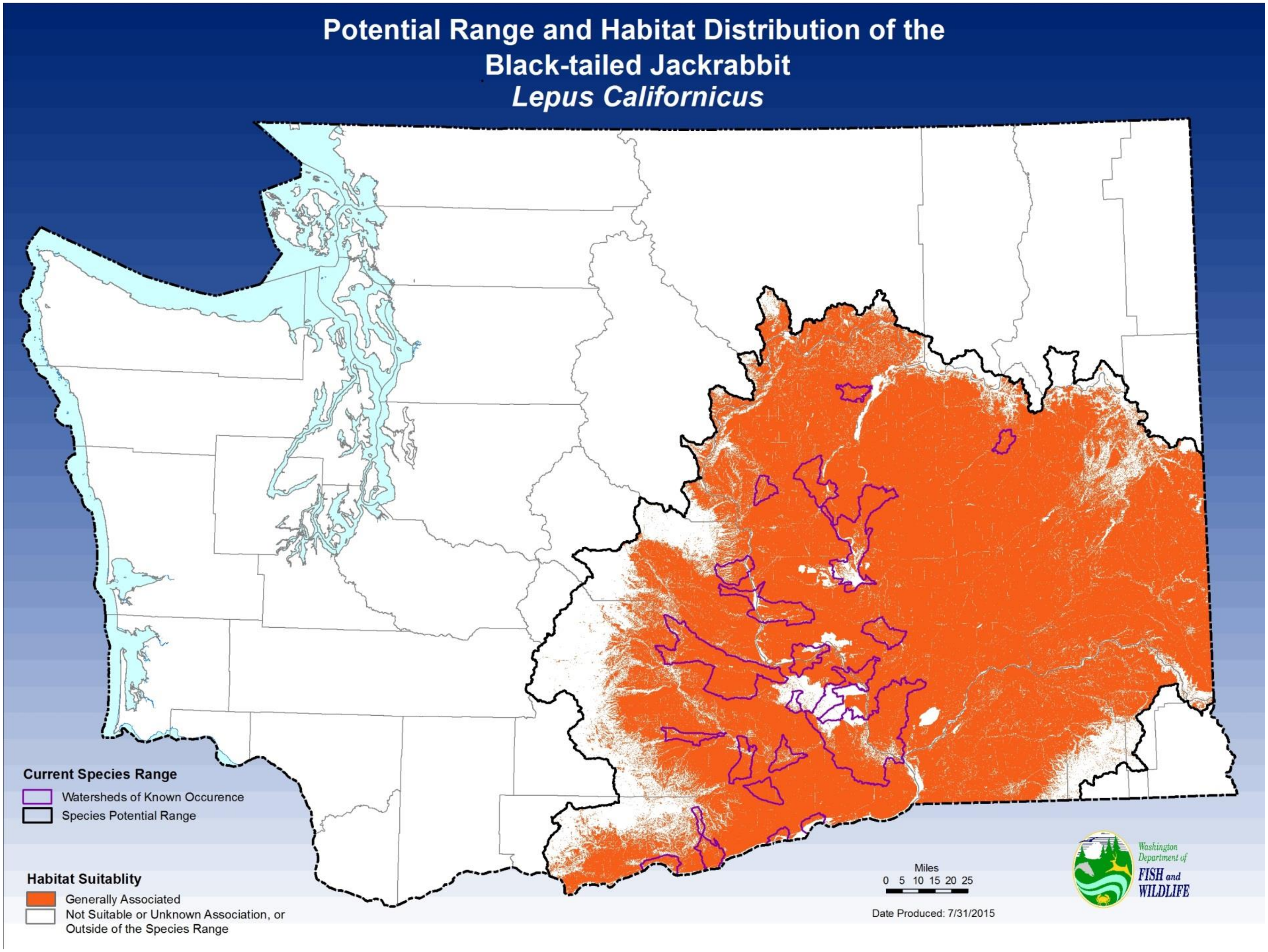
**American Badger**



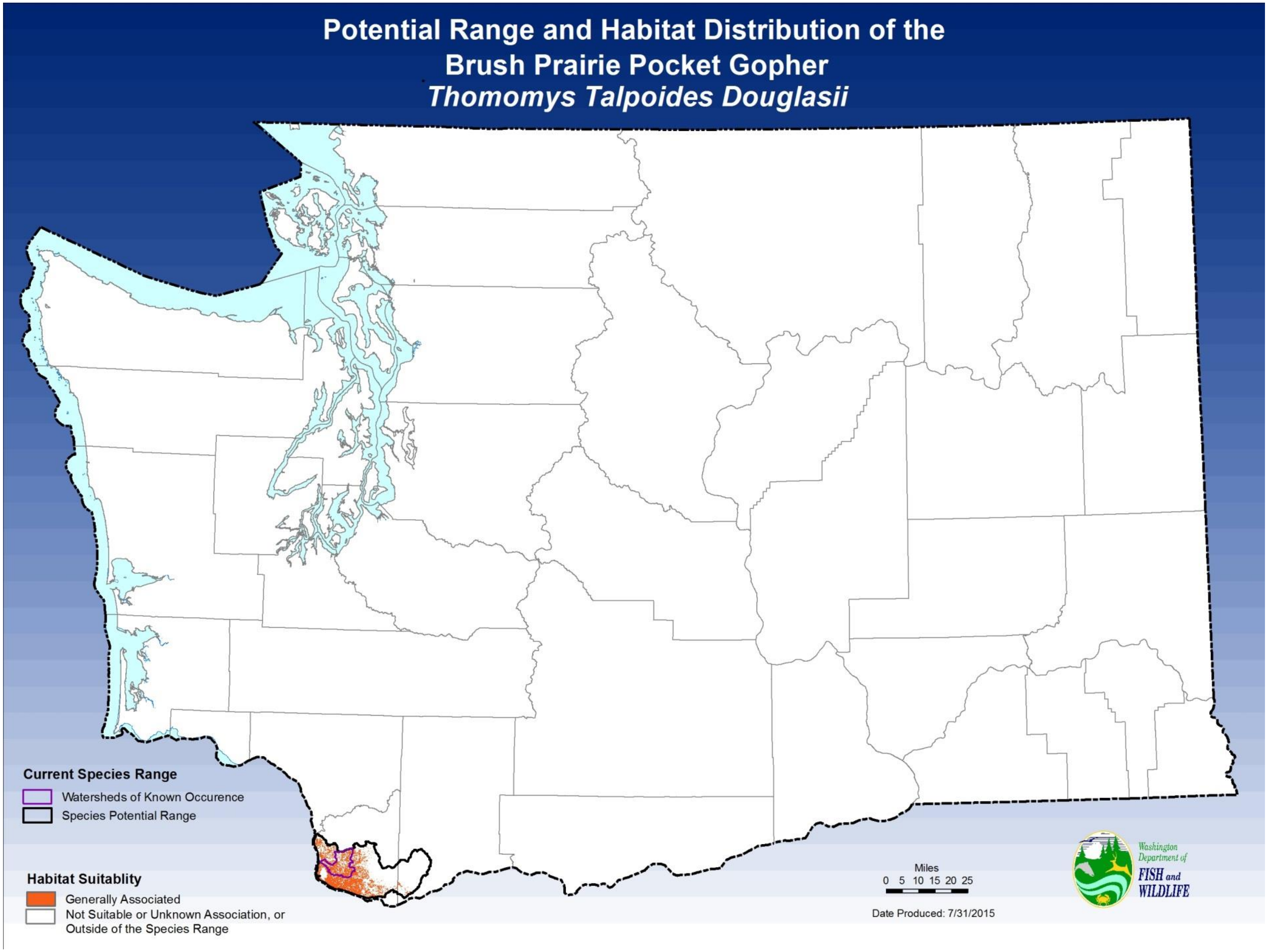
**American Pika**



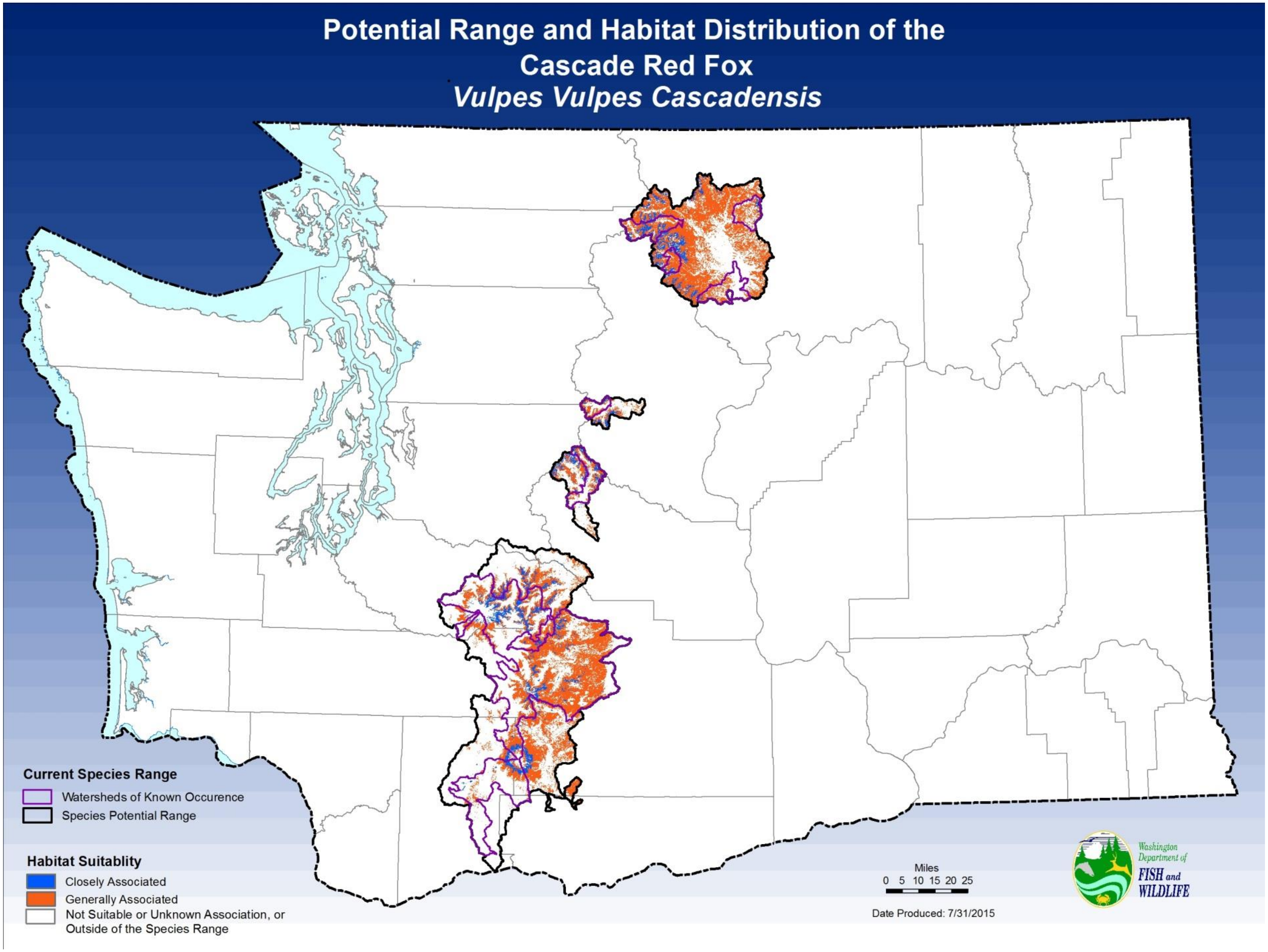
**Black-tailed Jackrabbit**



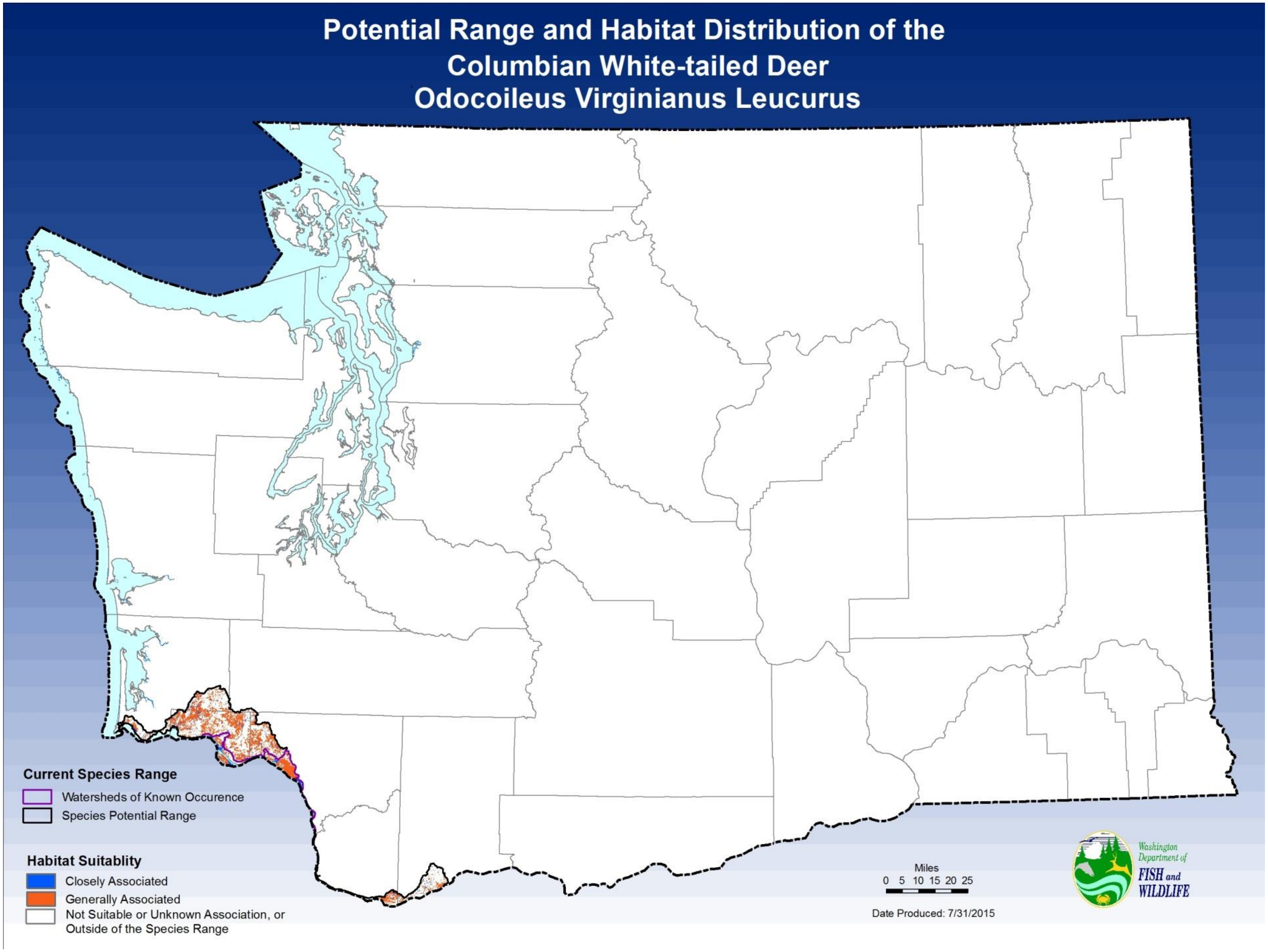
**Brush Prairie Pocket Gopher**



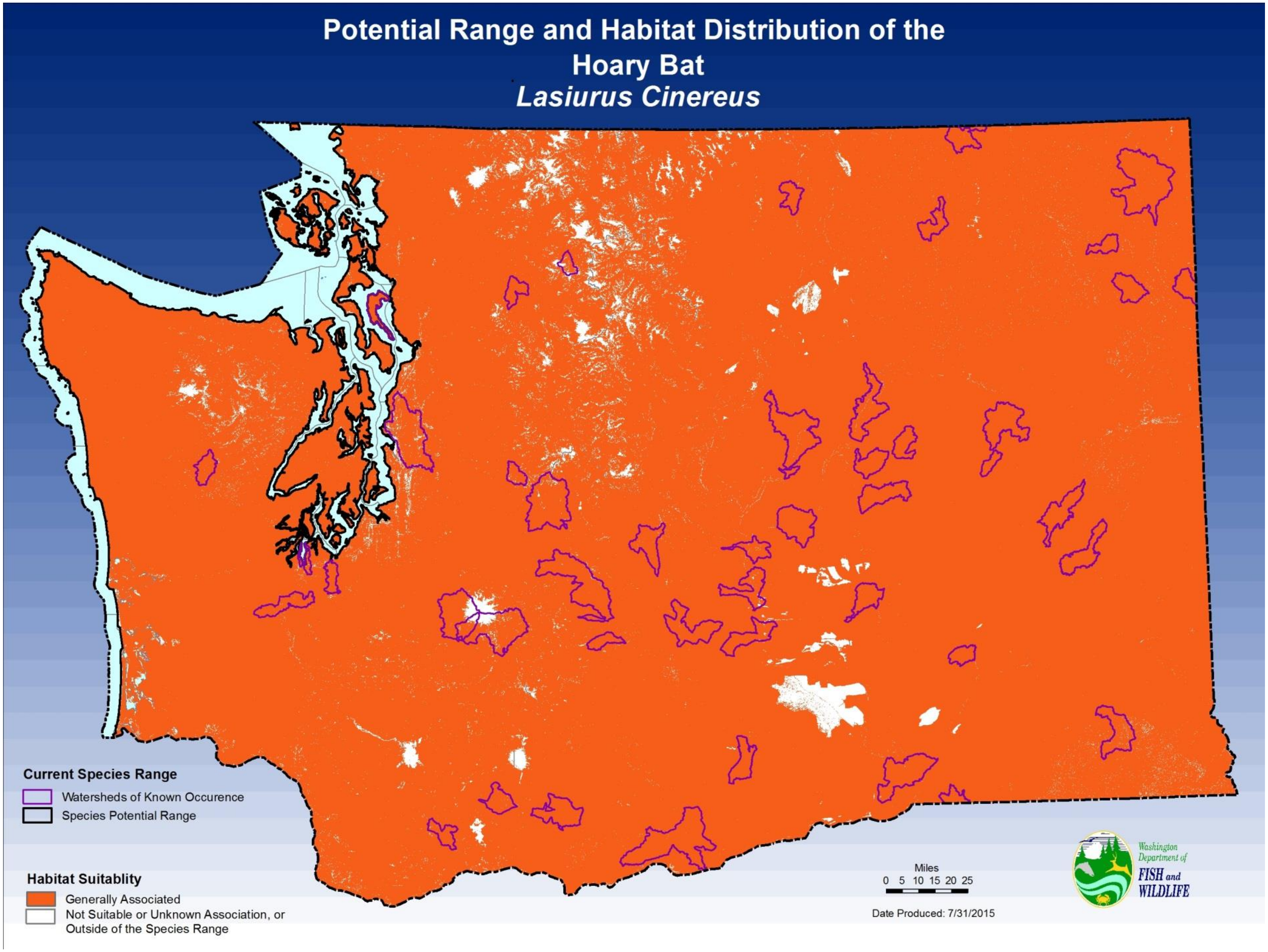
**Cascade Red Fox**



**Columbian White-tailed Deer**

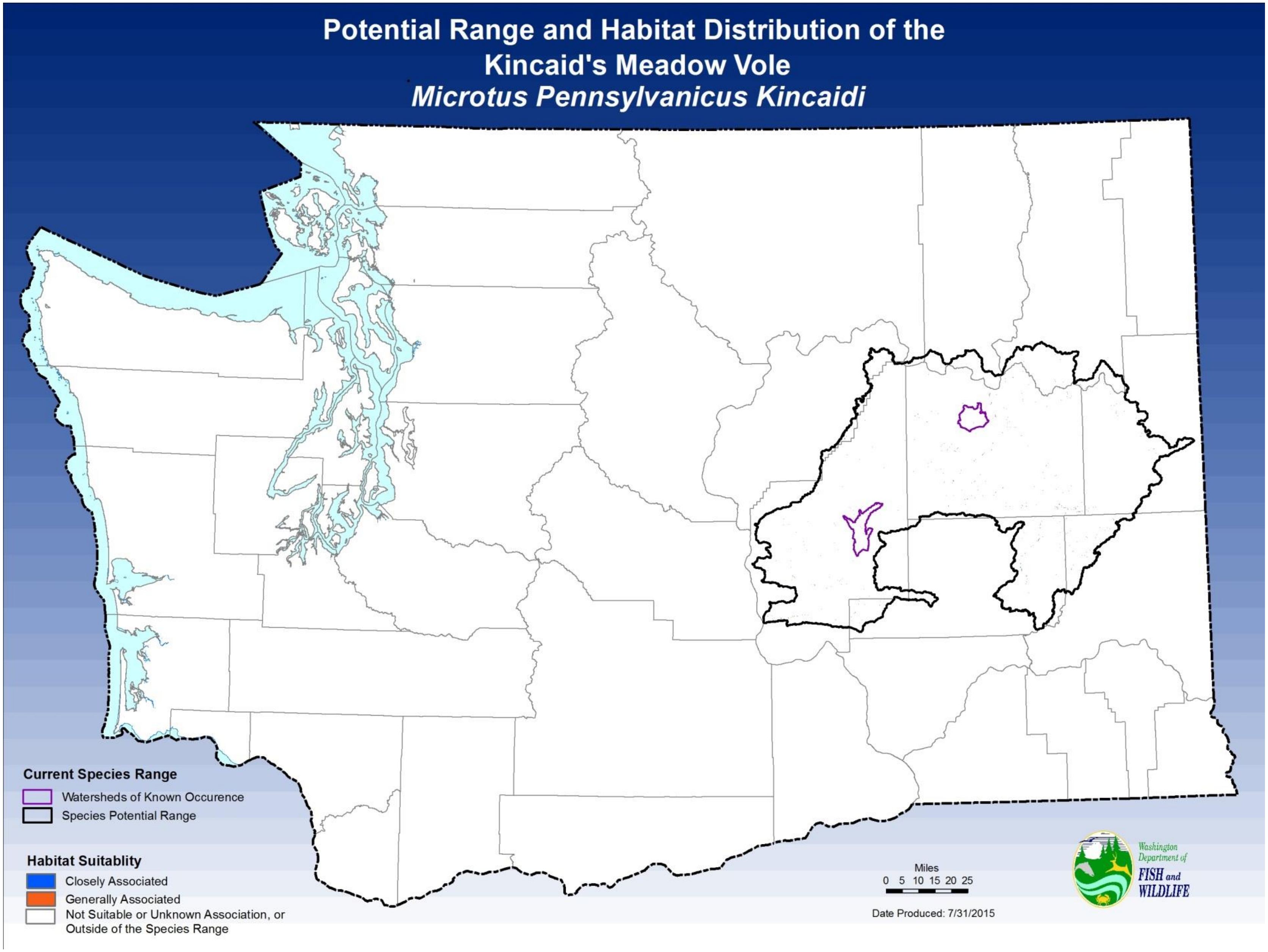


**Hoary Bat**

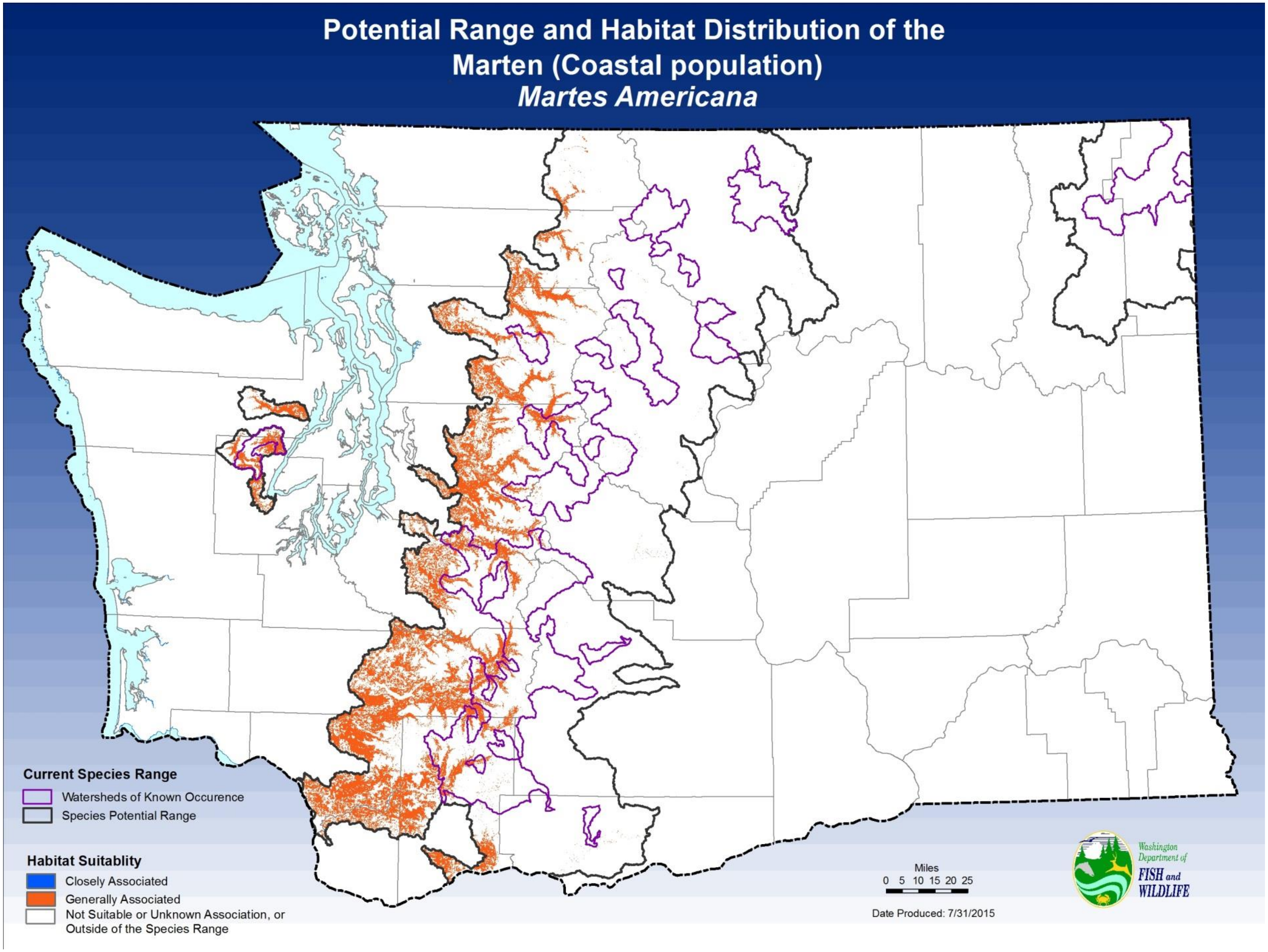


Potential Range and Habitat Distribution of the
Hoary Bat
*Lasiurus Cinereus*
Current Species Range
Watersheds of Known Occurence
Species Potential Range
Habitat Suitablity
Generally Associated
Not Suitable or Unknown Association, or
Outside of the Species Range
Miles
0 5 10 15 20 25
Date Produced: 7/31/2015
Washington Department of
FISH and
WILDLIFE

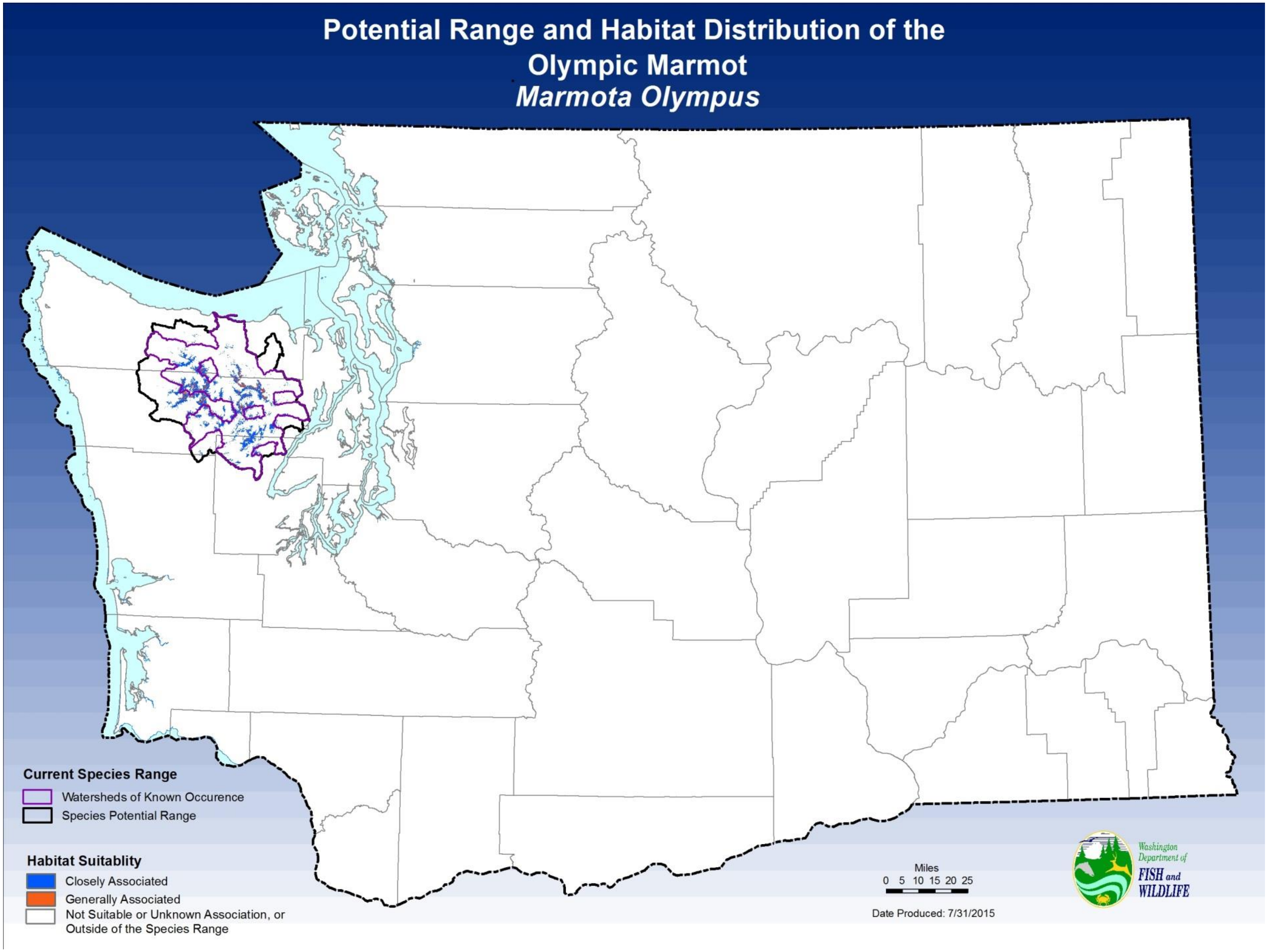
**Kincaid's Meadow Vole**



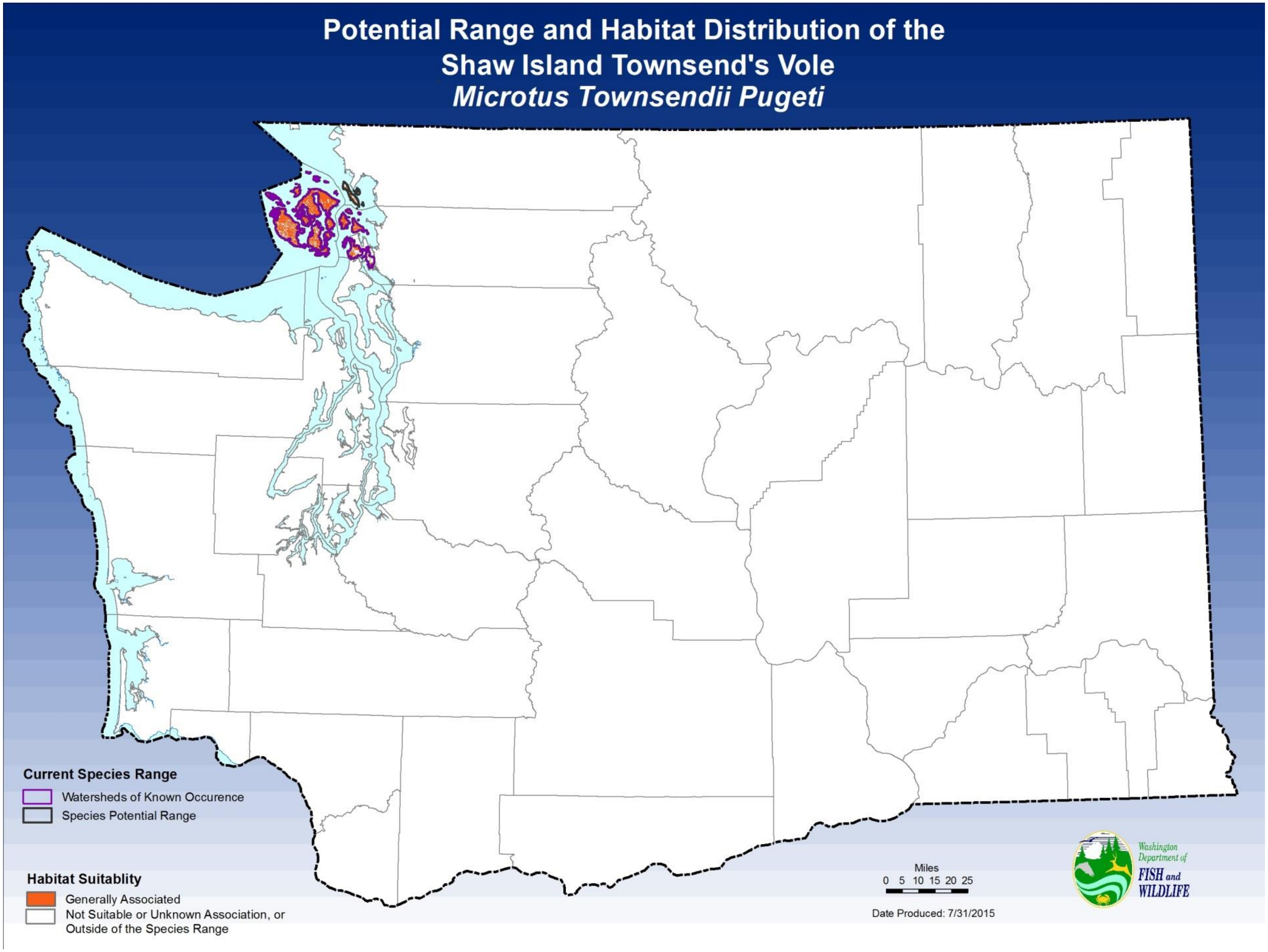
**Marten (Coastal Population)**



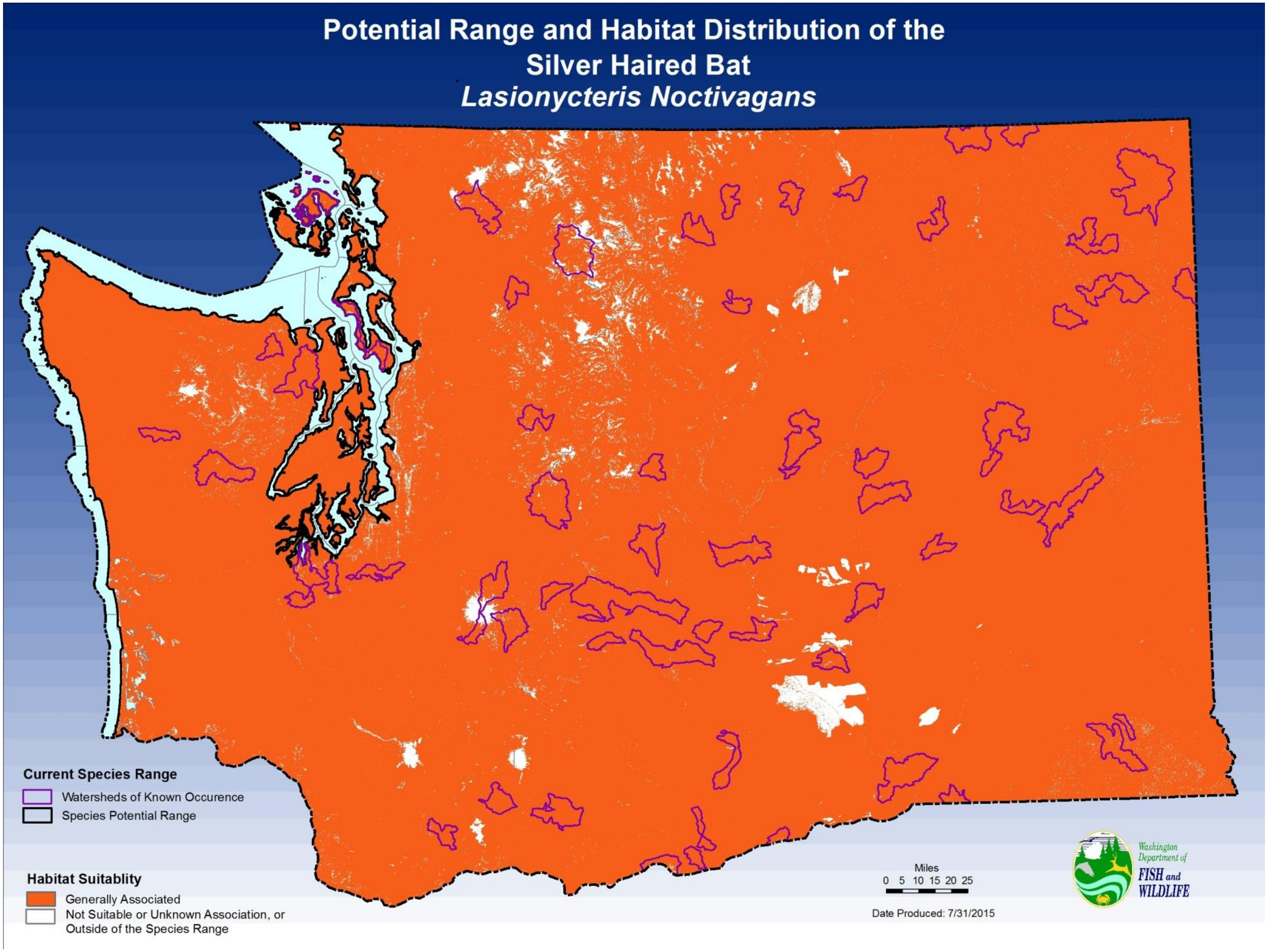
**Olympic Marmot**



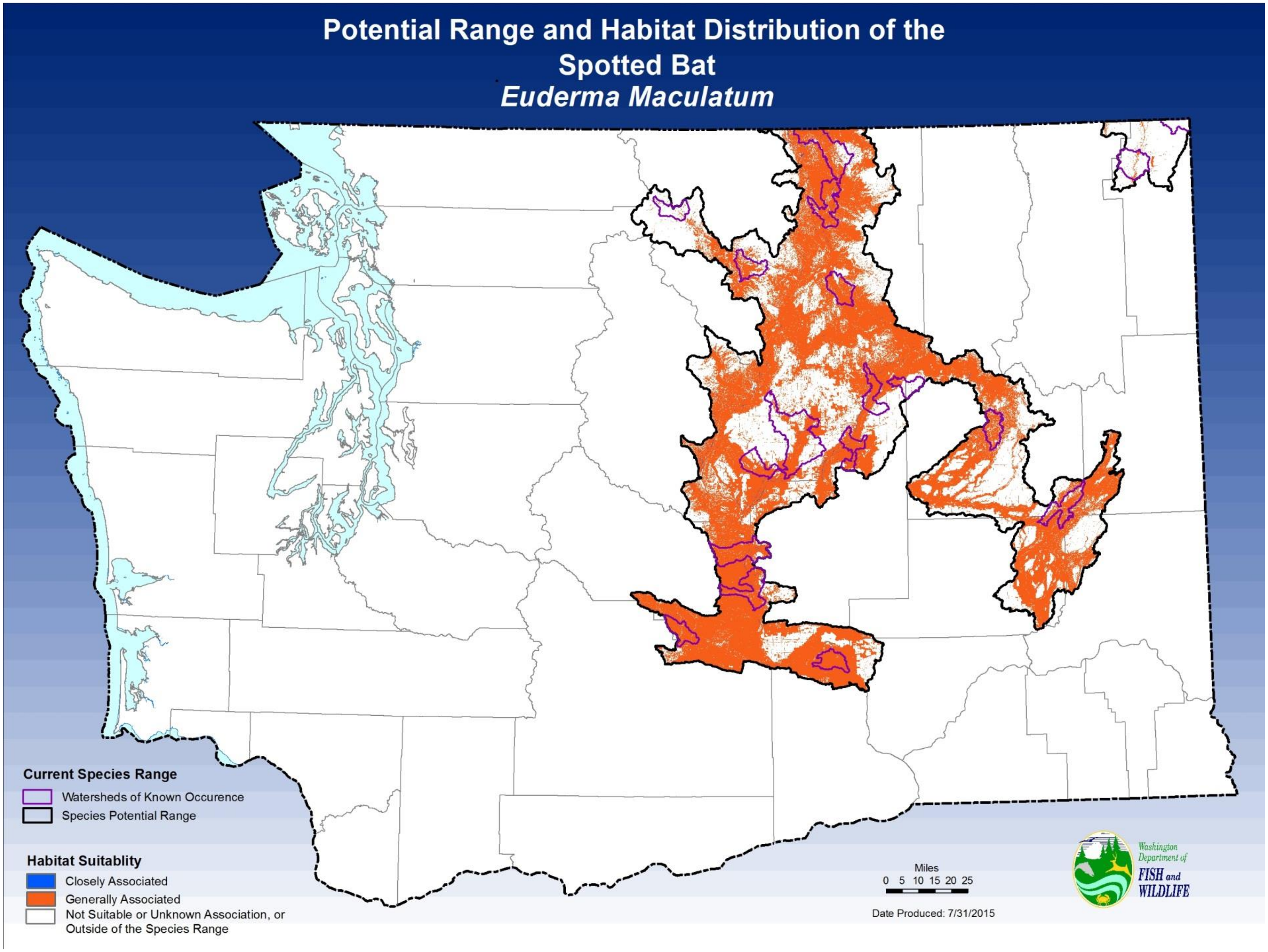
**Shaw Island Townsend's Vole**



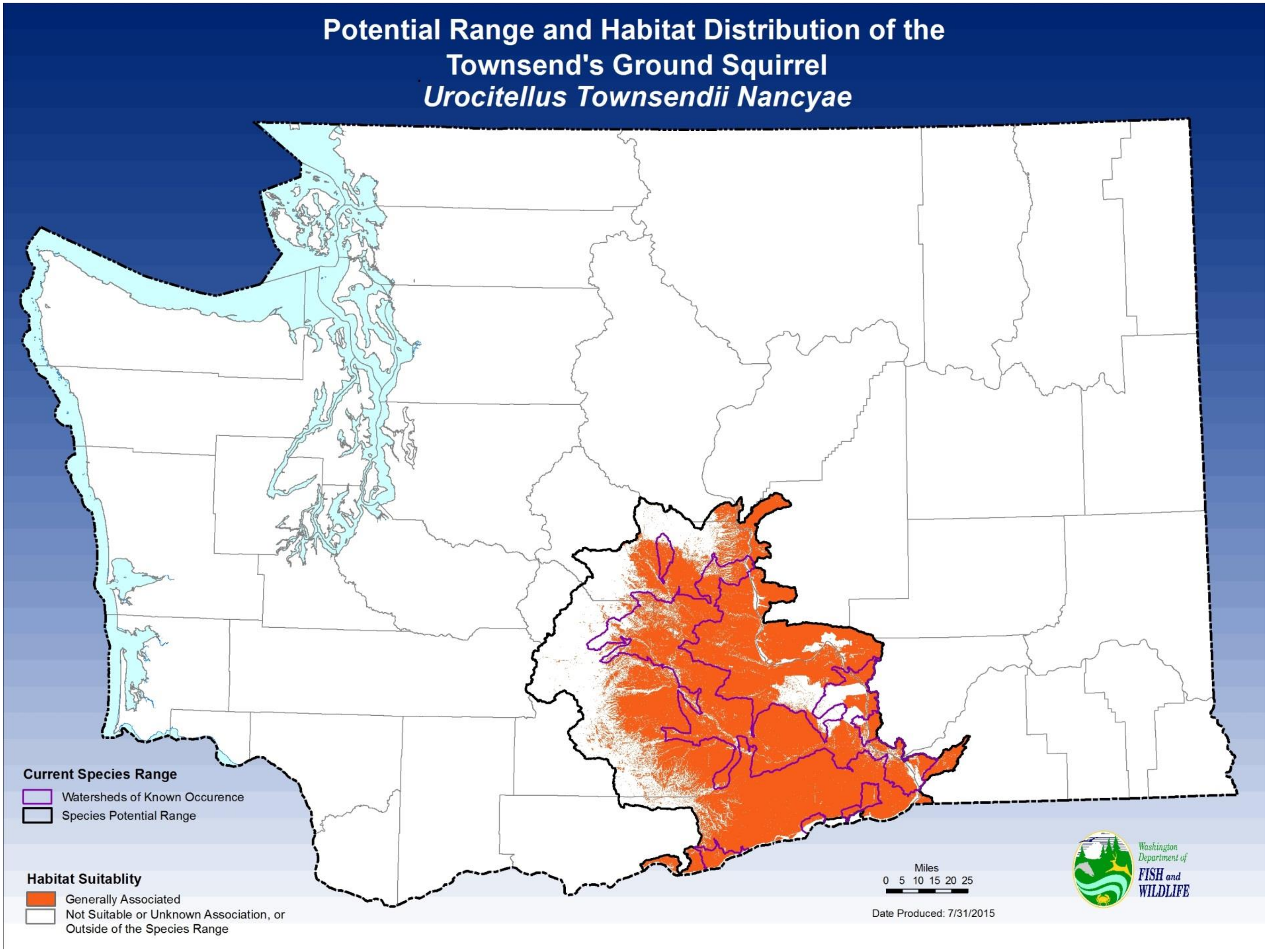
**Silver Haired Bat**



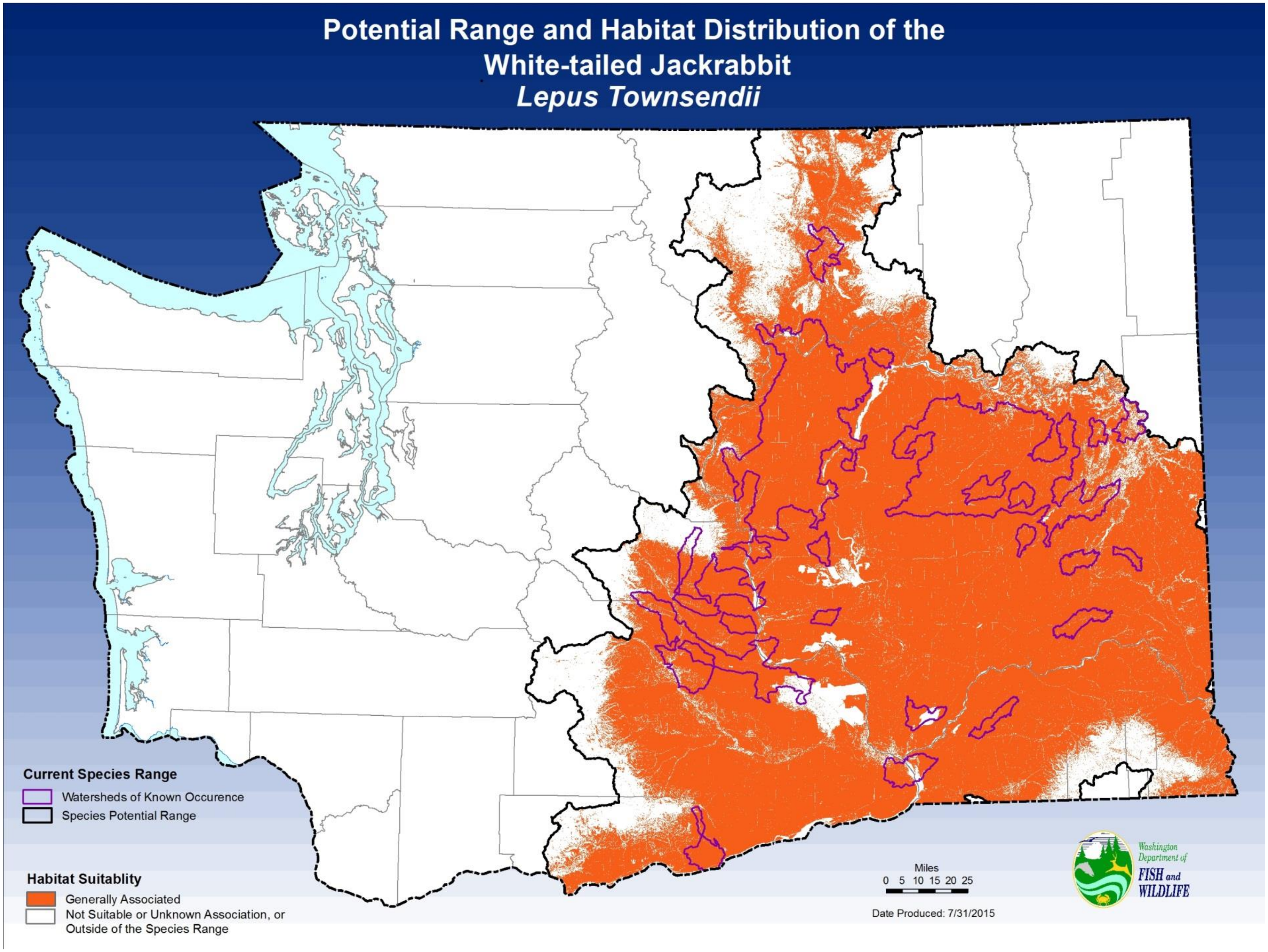
**Spotted Bat**


Potential Range and Habitat Distribution of the
Spotted Bat
*Euderma Maculatum*
Current Species Range
Watersheds of Known Occurence
Species Potential Range
Habitat Suitablity
Closely Associated
Generally Associated
Not Suitable or Unknown Association, or Outside of the Species Range
Miles
0 5 10 15 20 25
Date Produced: 7/31/2015
Washington Department of FISH and WILDLIFE

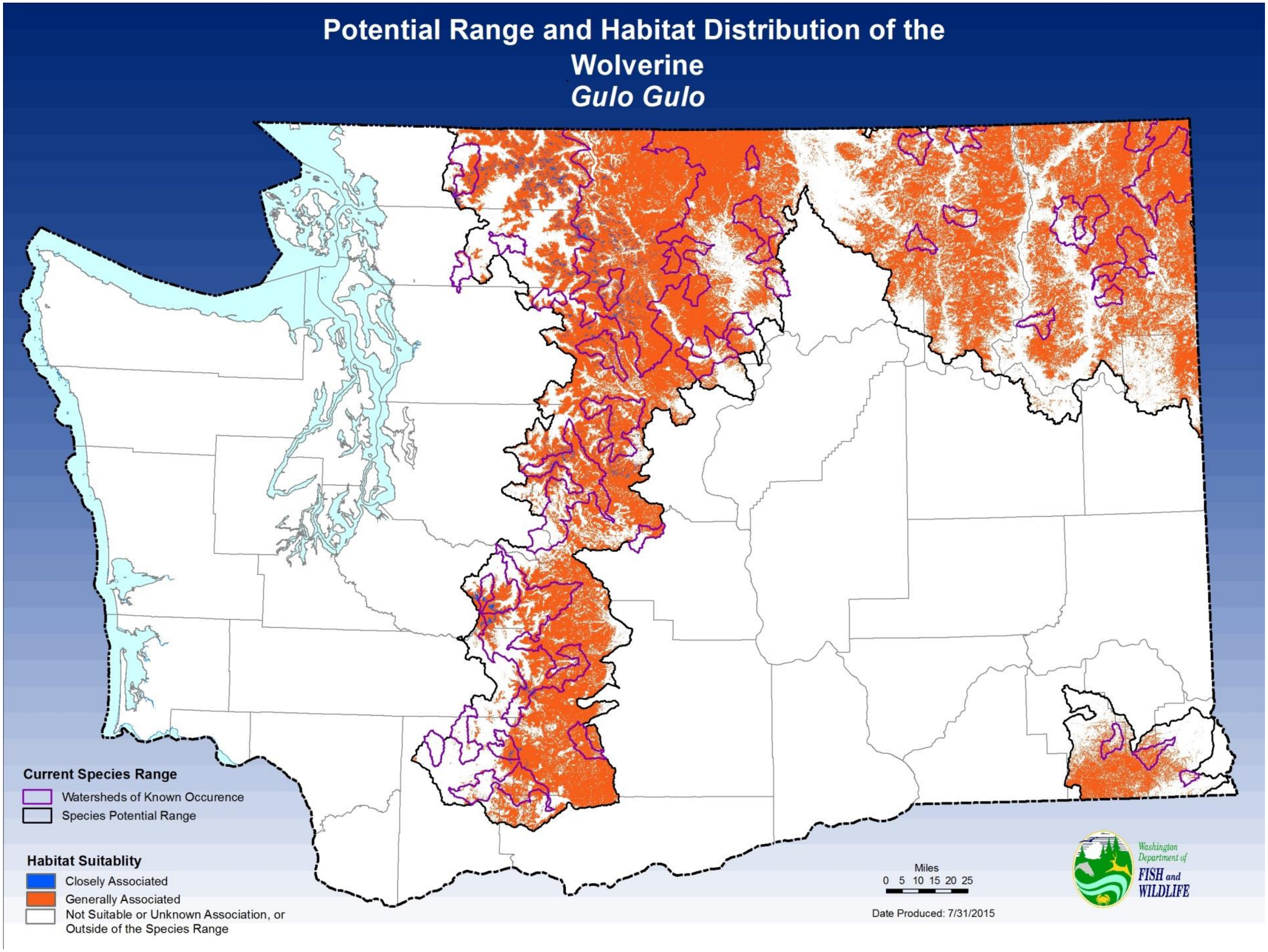
**Townsend's Ground Squirrel**



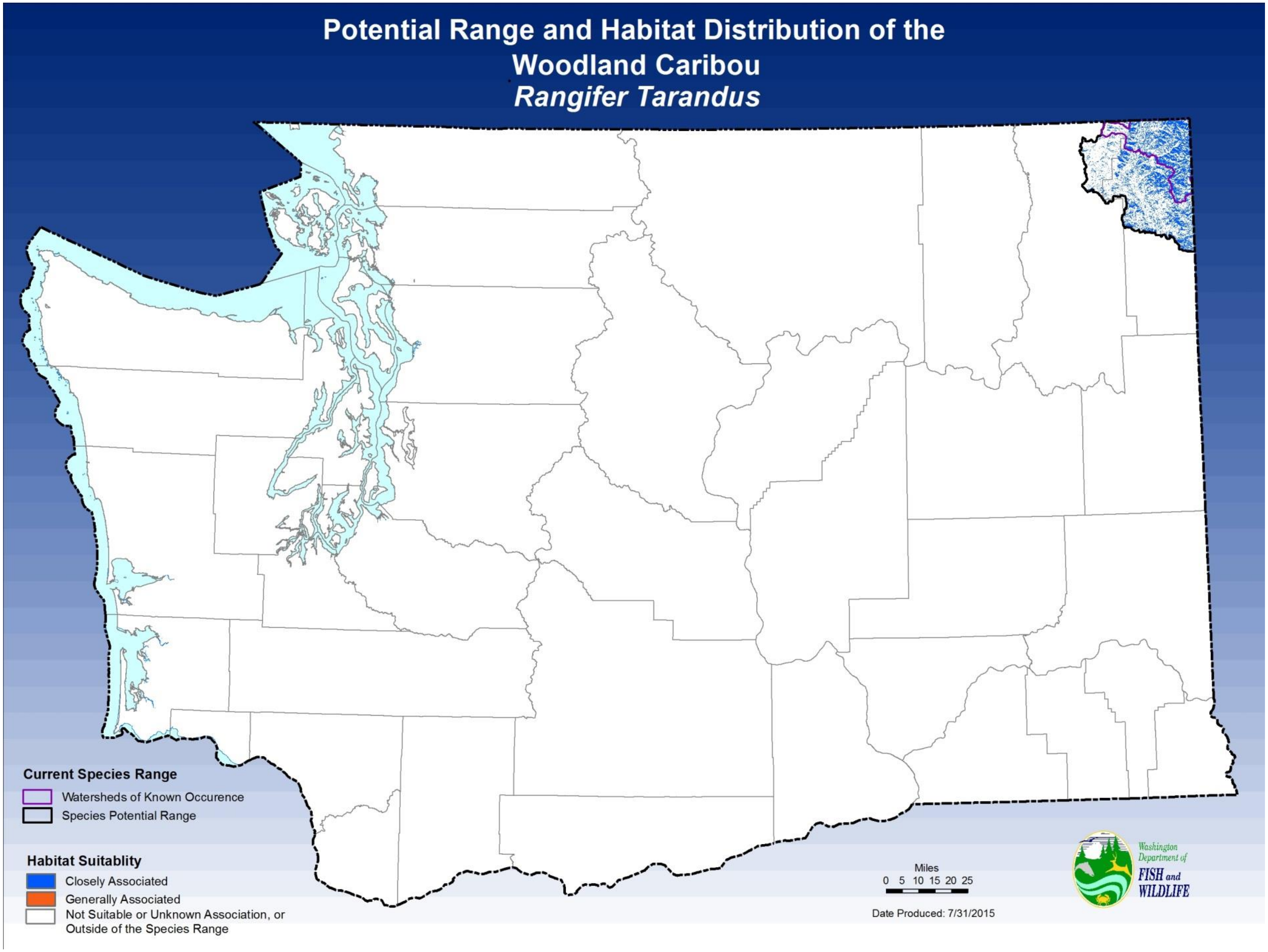
**White-tailed Jackrabbit**



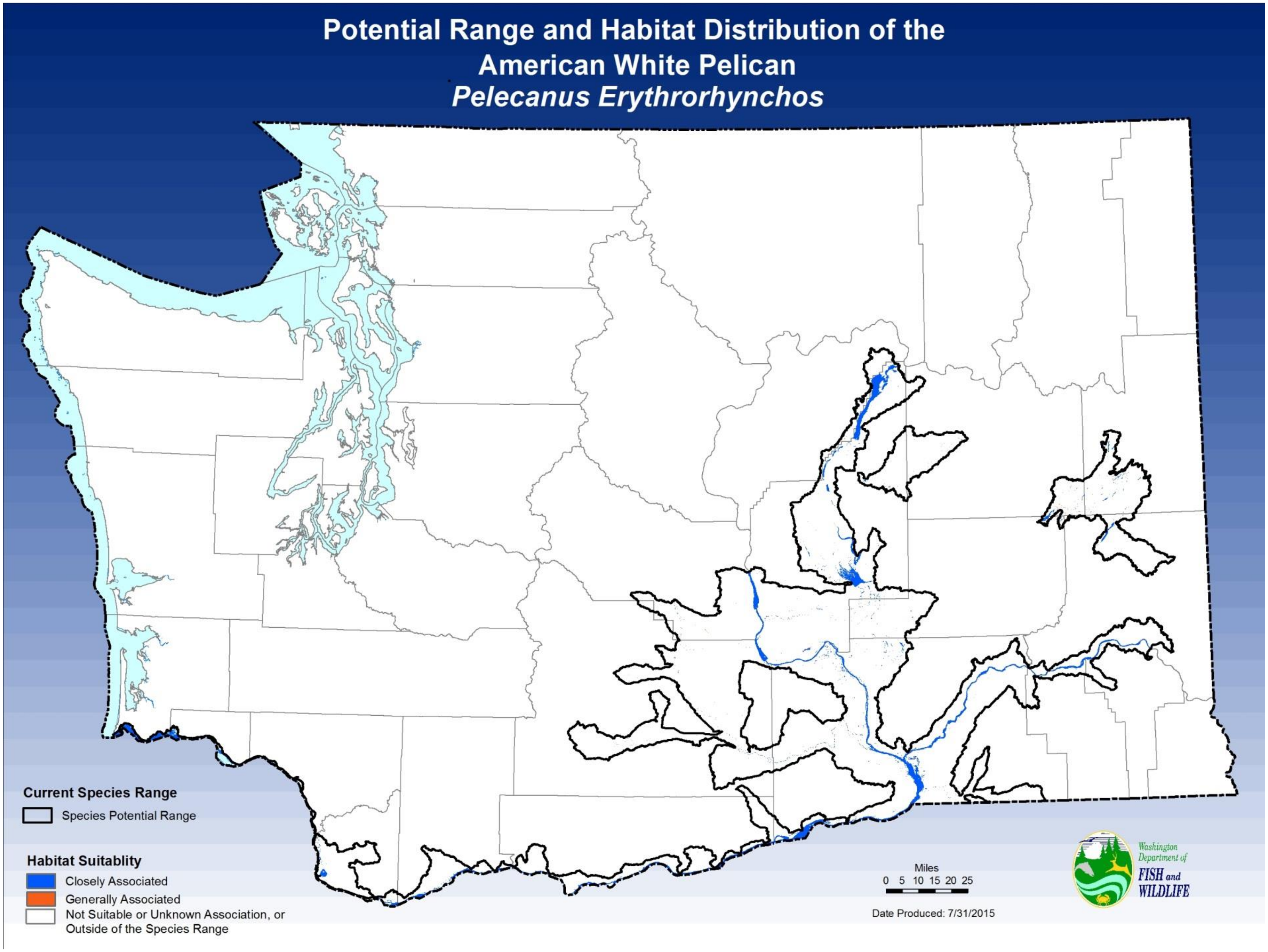
**Wolverine**


Potential Range and Habitat Distribution of the
Wolverine
*Gulo Gulo*
Current Species Range
Watersheds of Known Occurence
Species Potential Range
Habitat Suitablity
Closely Associated
Generally Associated
Not Suitable or Unknown Association, or
Outside of the Species Range
Miles
0 5 10 15 20 25
Date Produced: 7/31/2015
Washington
Department of
FISH and
WILDLIFE

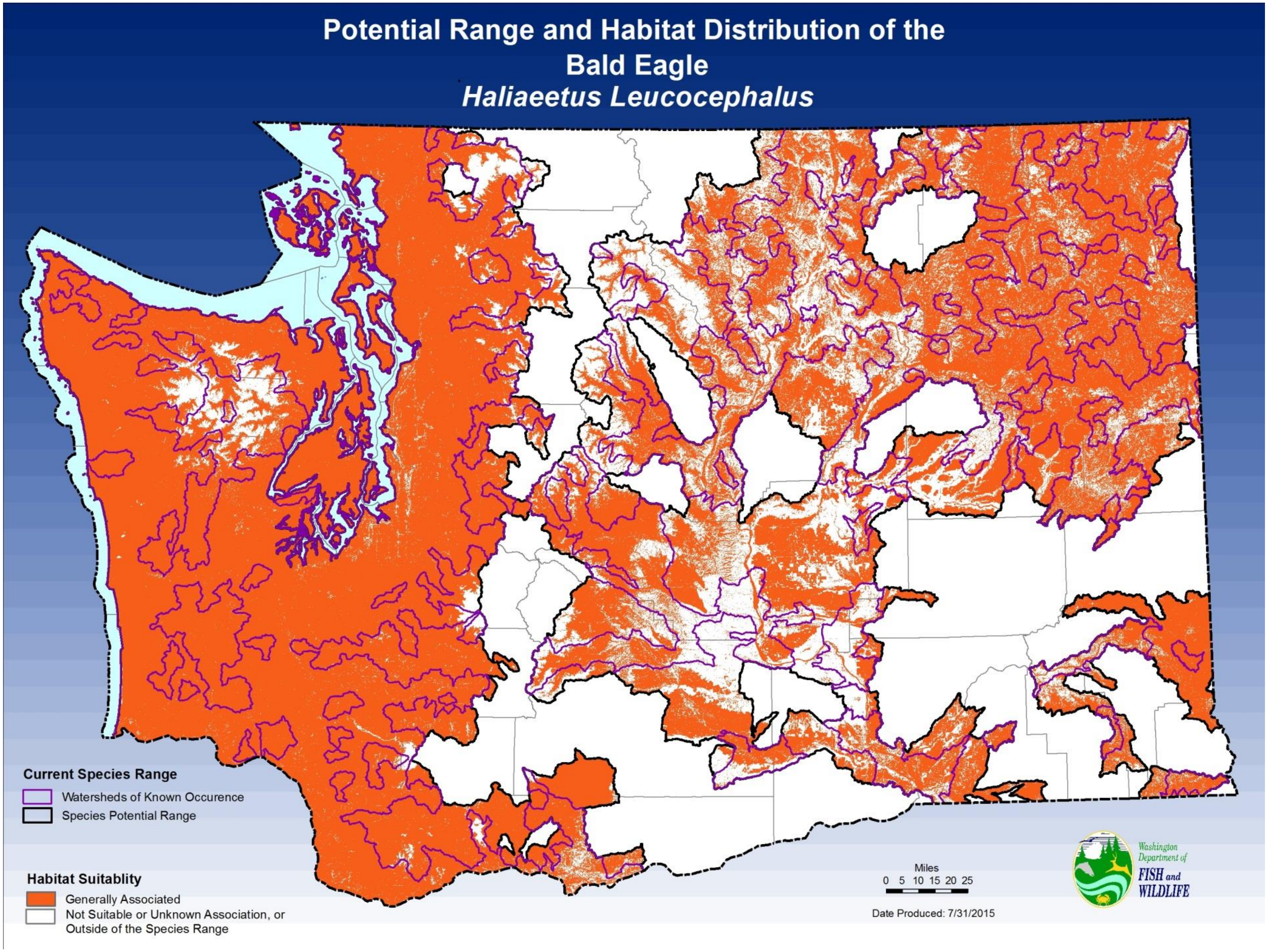
## Woodland Caribou



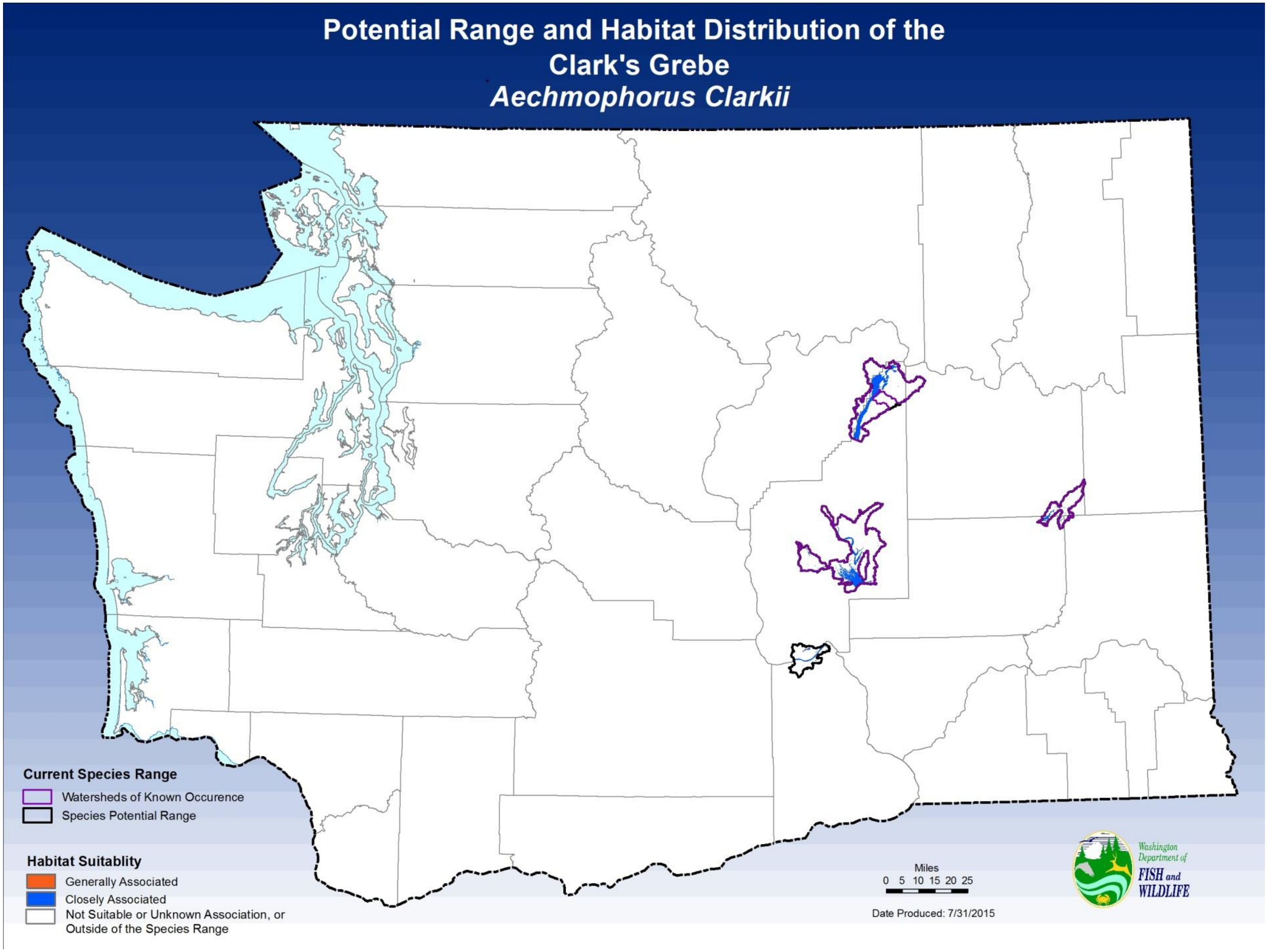
**American White Pelican**



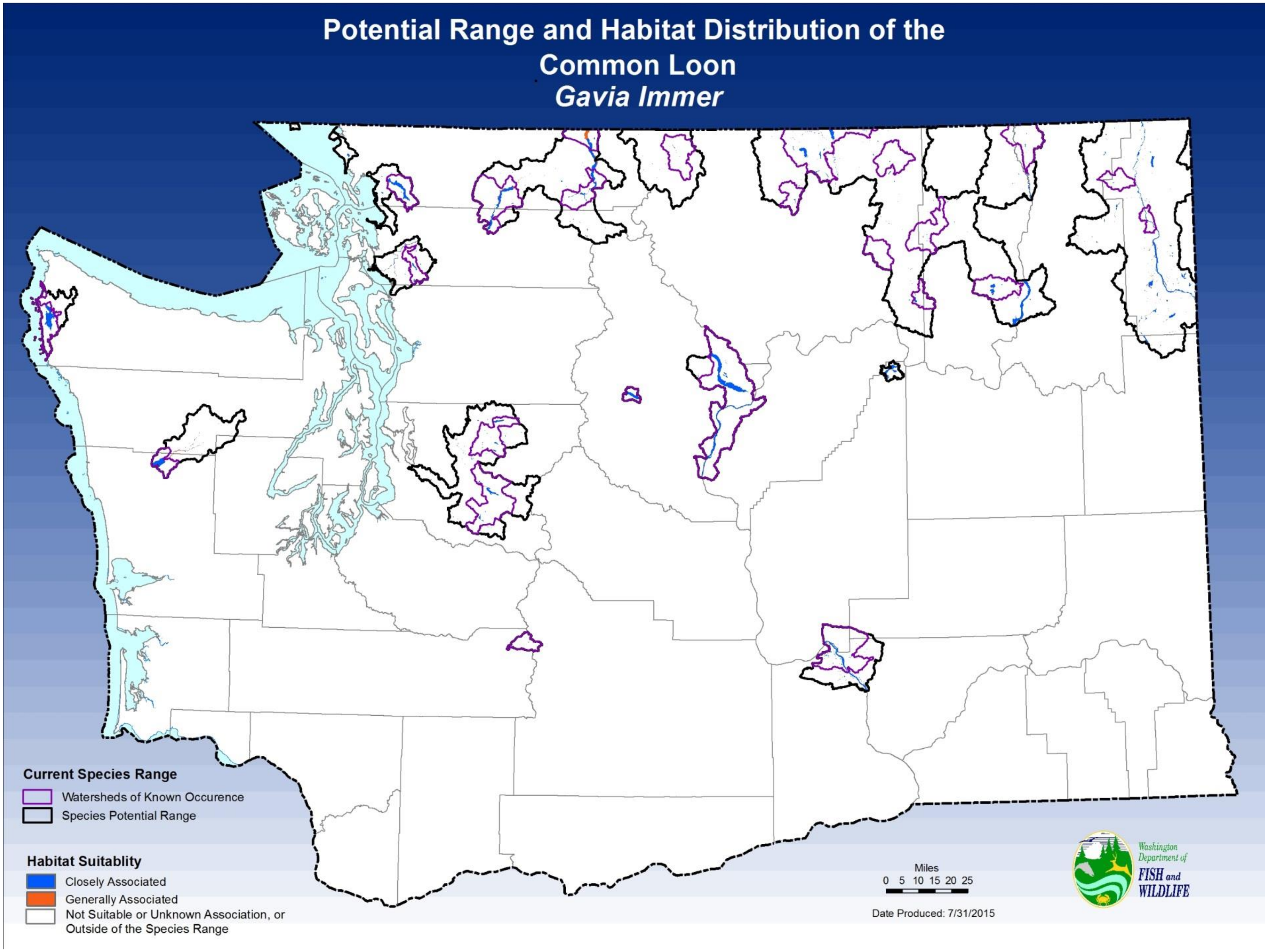
**Bald Eagle**


Potential Range and Habitat Distribution of the
Bald Eagle
Haliaeetus Leucocephalus
Current Species Range
Watersheds of Known Occurence
Species Potential Range
Habitat Suitablity
Generally Associated
Not Suitable or Unknown Association, or
Outside of the Species Range
Miles
0 5 10 15 20 25
Date Produced: 7/31/2015
Washington
Department of
FISH and
WILDLIFE

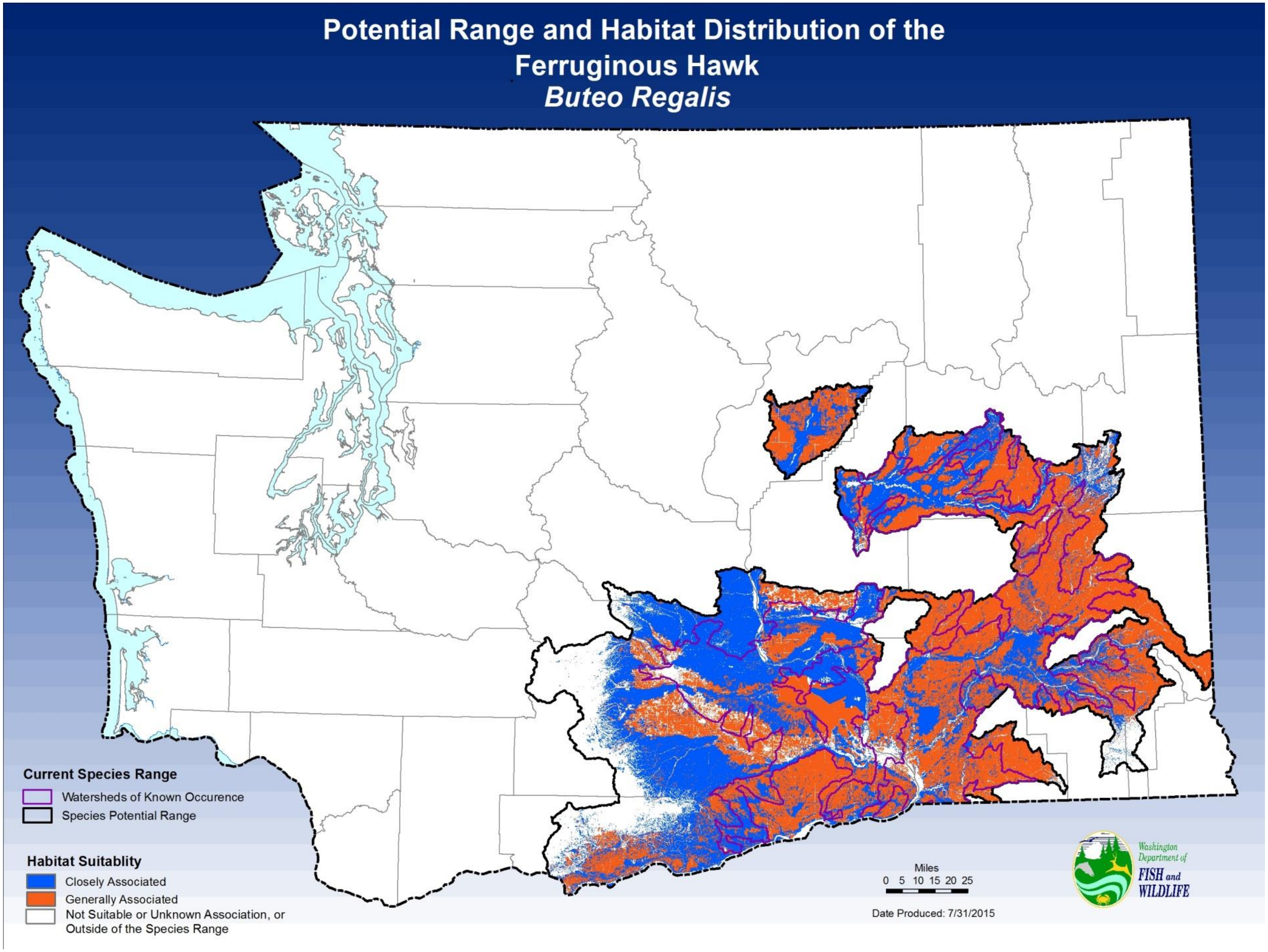
## Clark's Grebe



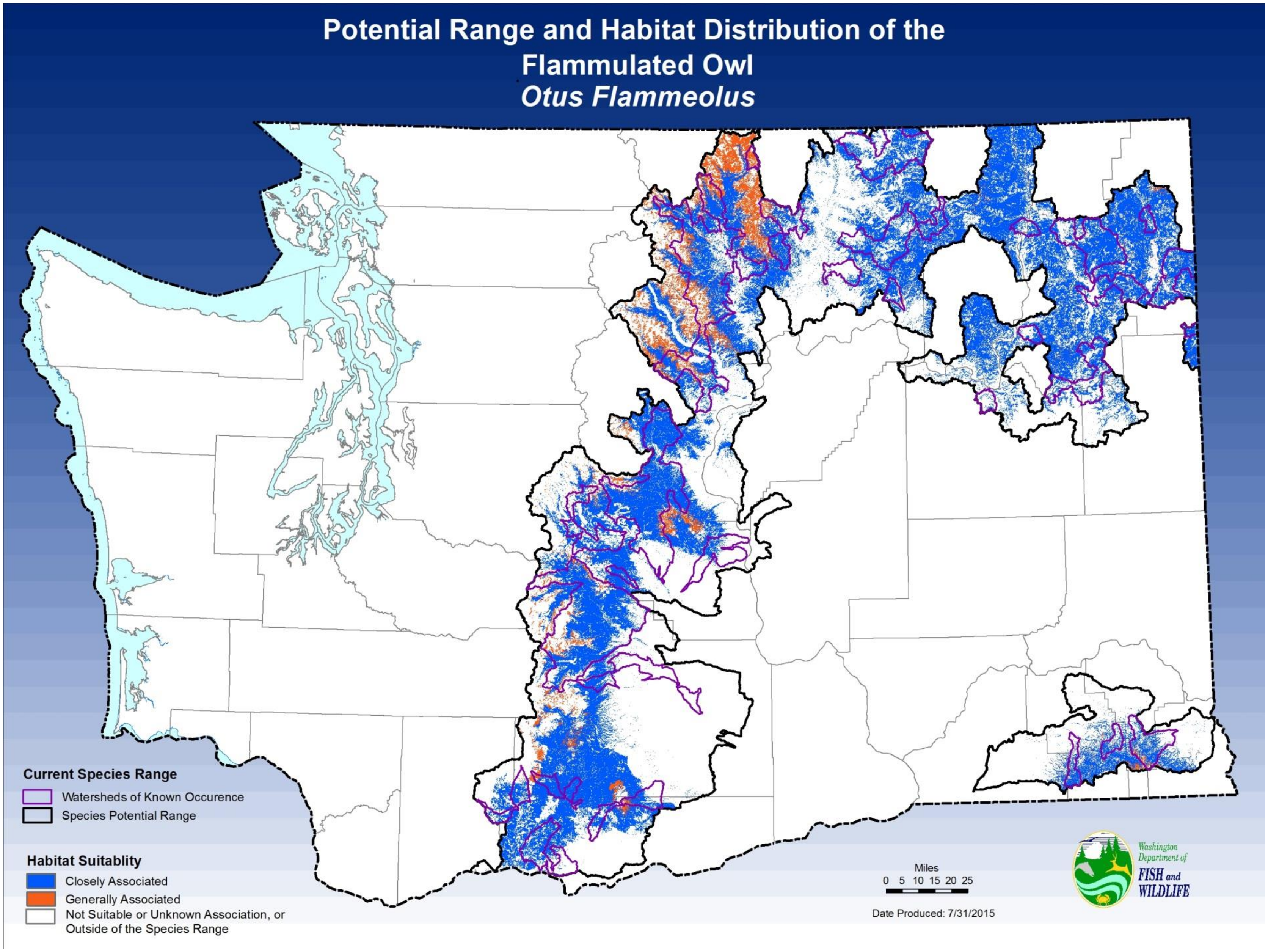
**Common Loon**


Potential Range and Habitat Distribution of the
Common Loon
*Gavia Immer*
Current Species Range
Watersheds of Known Occurence
Species Potential Range
Habitat Suitablity
Closely Associated
Generally Associated
Not Suitable or Unknown Association, or
Outside of the Species Range
Miles
0 5 10 15 20 25
Date Produced: 7/31/2015
Washington Department of FISH and WILDLIFE

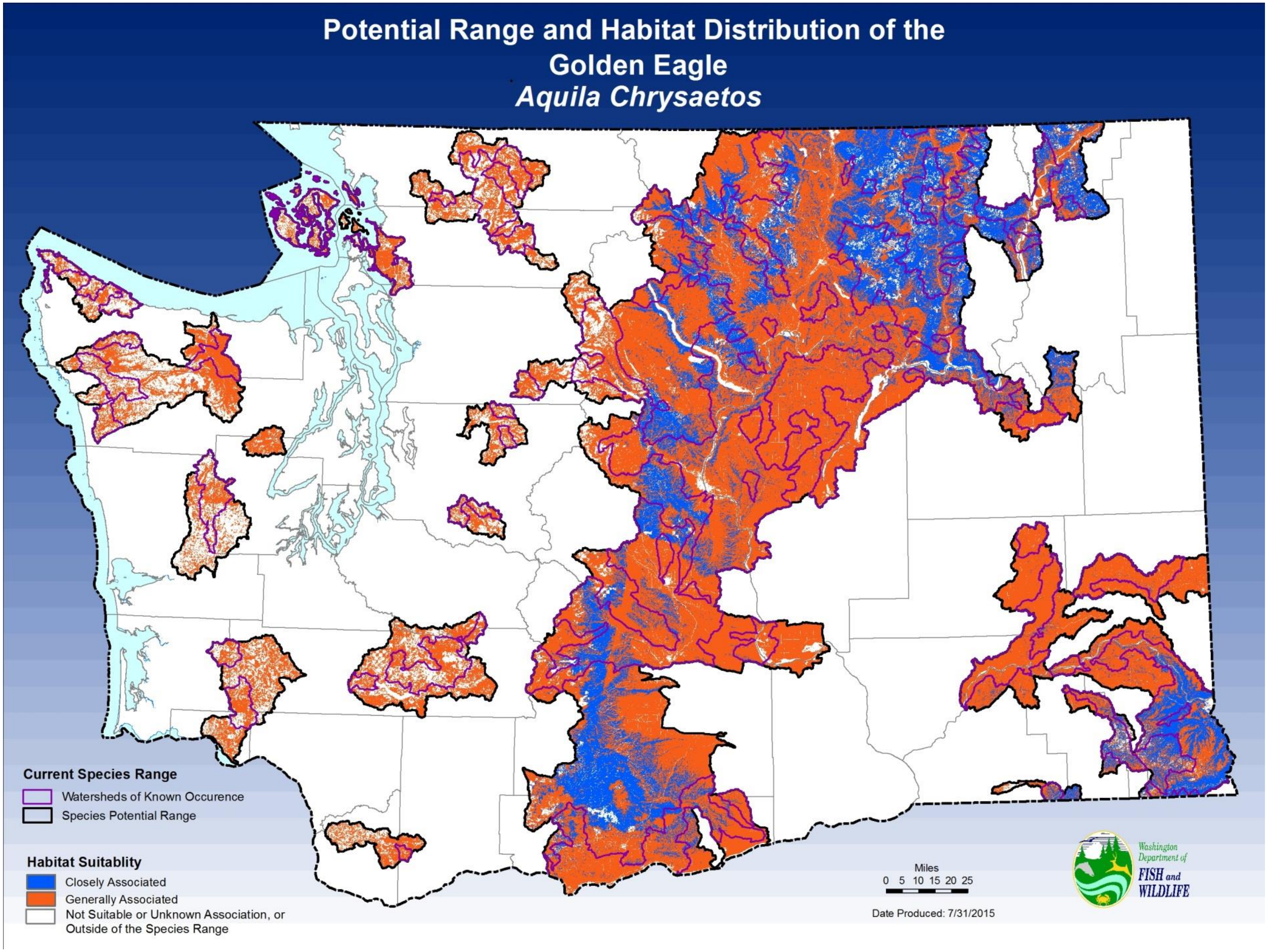
**Ferruginous Hawk**



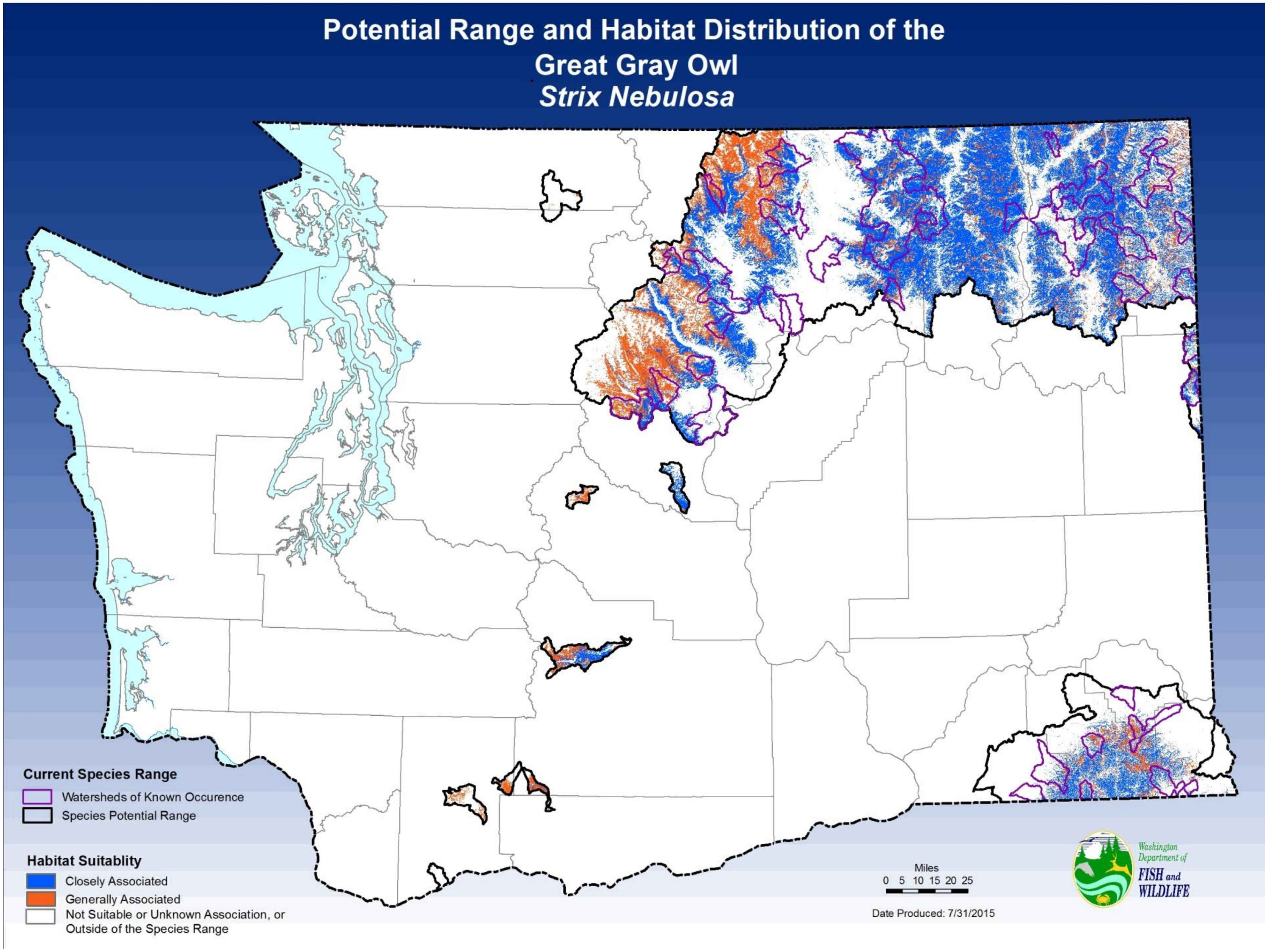
**Flammulated Owl**



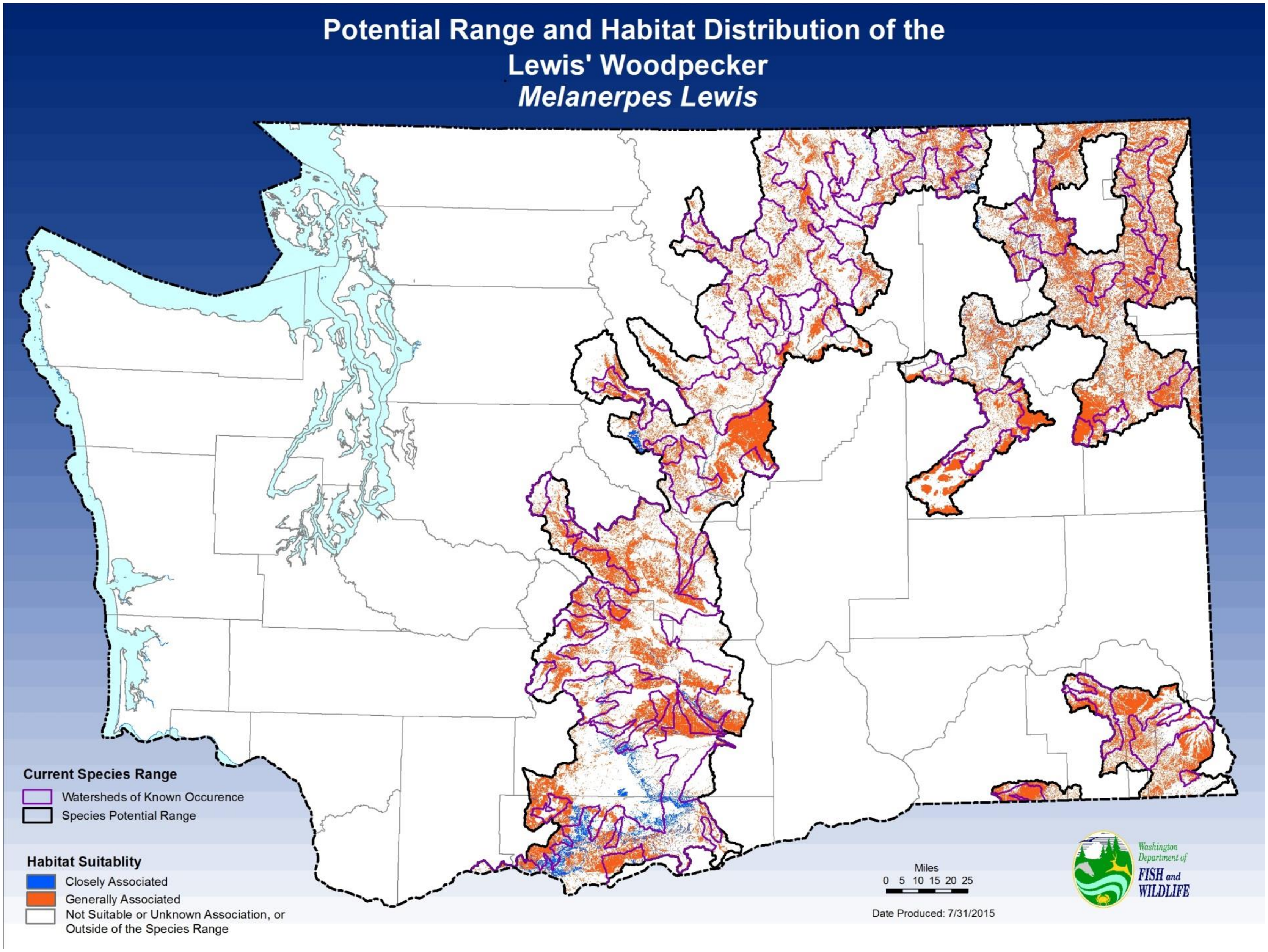
**Golden Eagle**



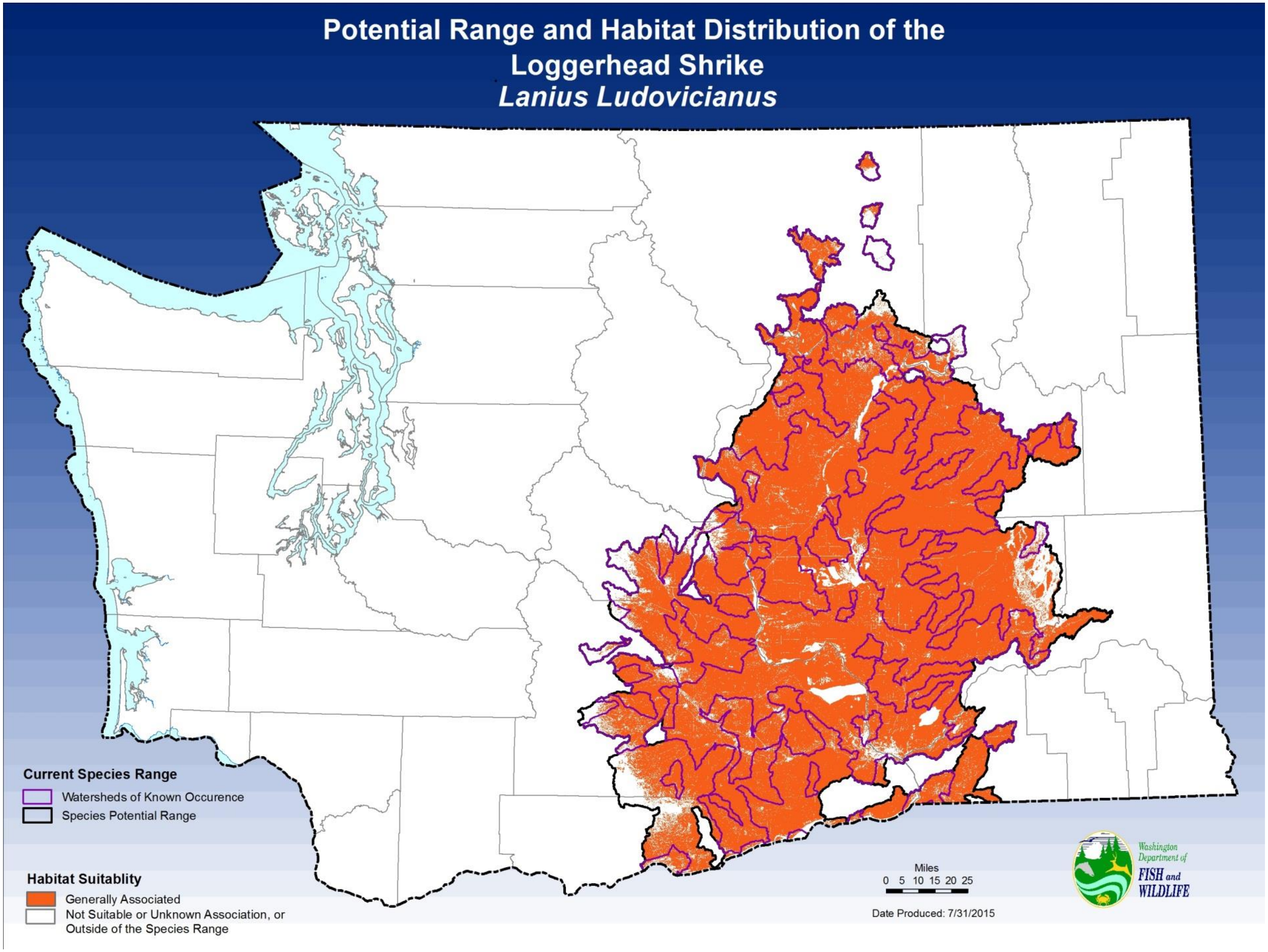
## Great Gray Owl



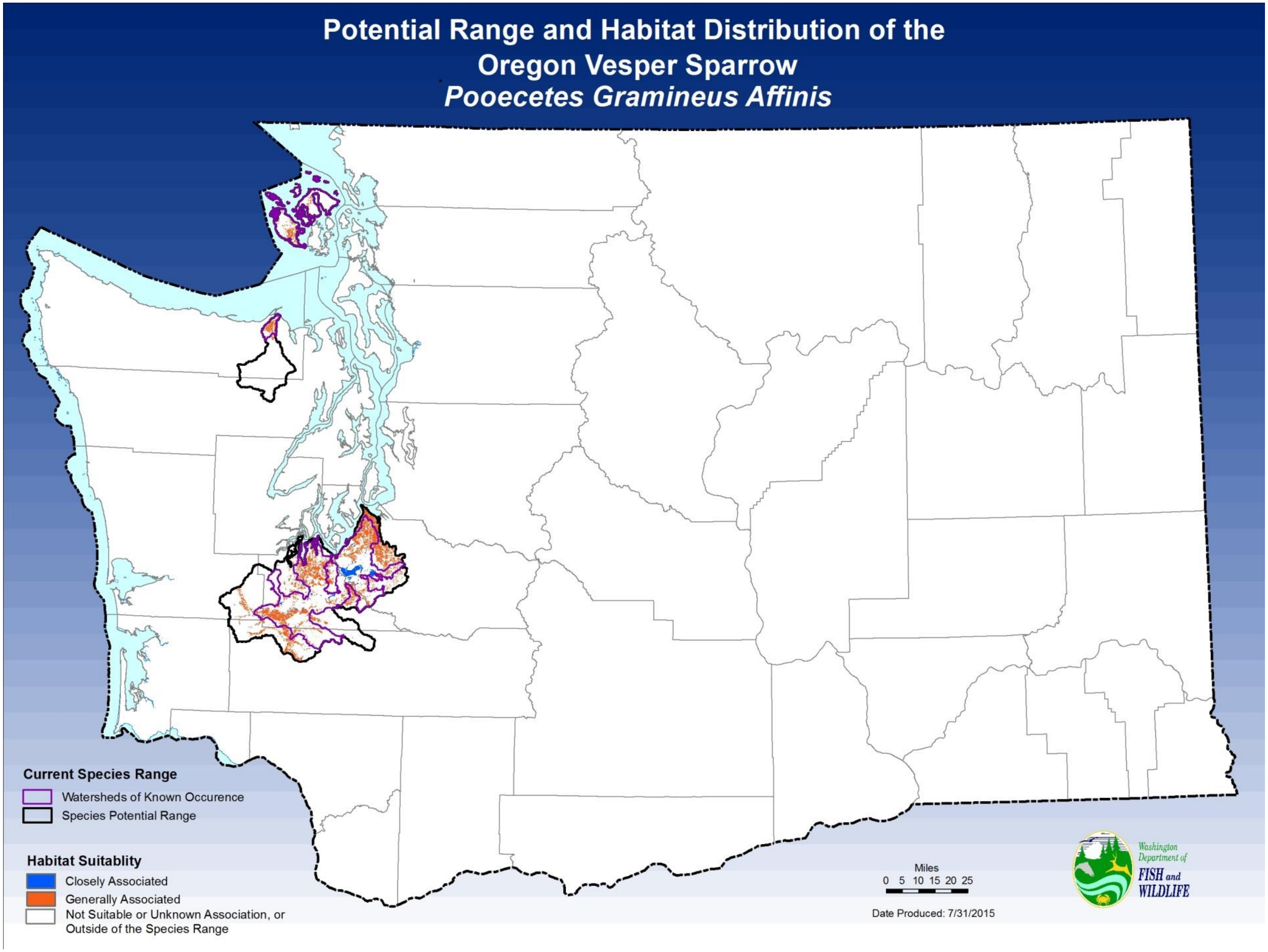
**Lewis' Woodpecker**



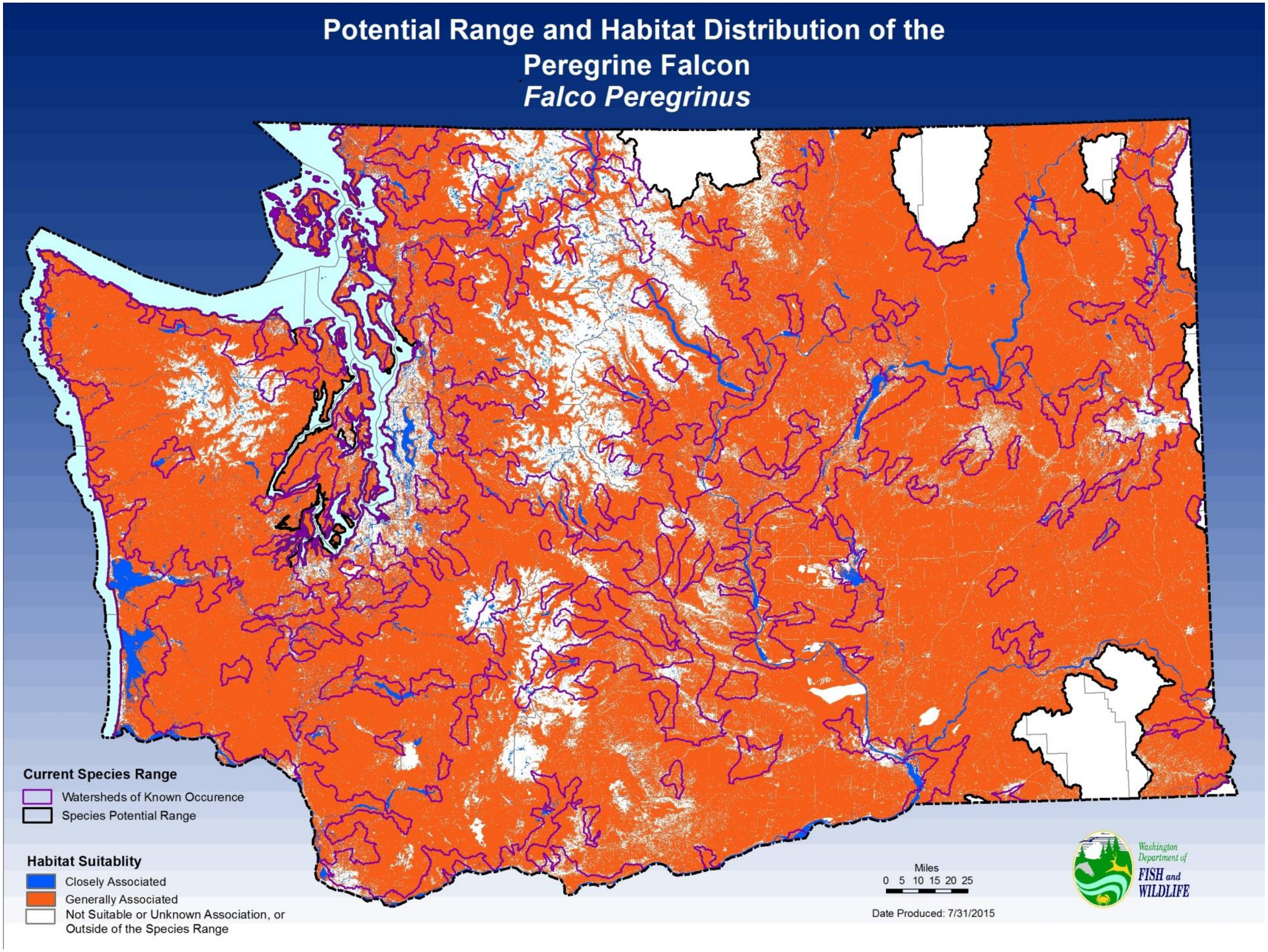
**Loggerhead Shrike**



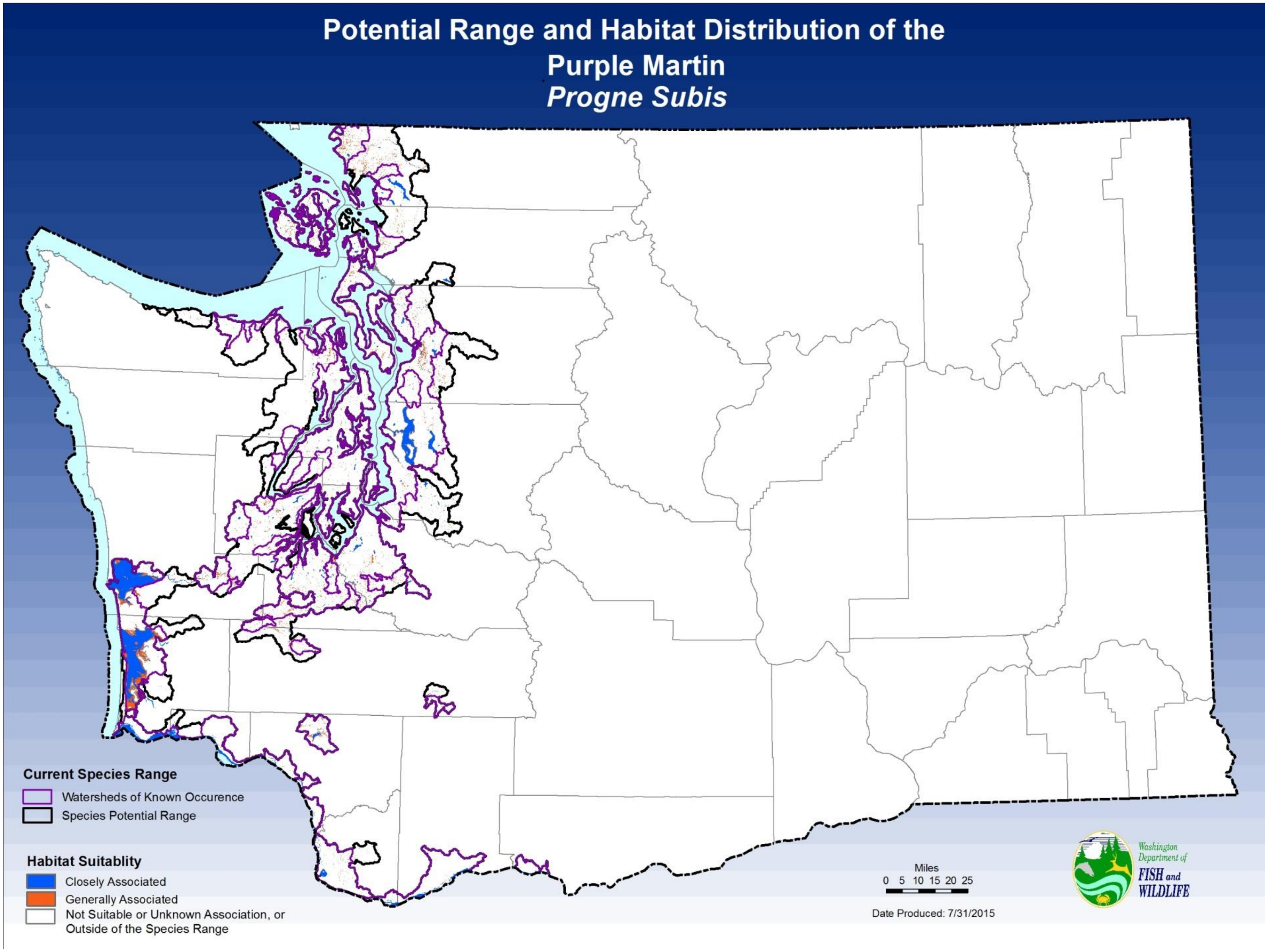
**Oregon Vesper Sparrow**



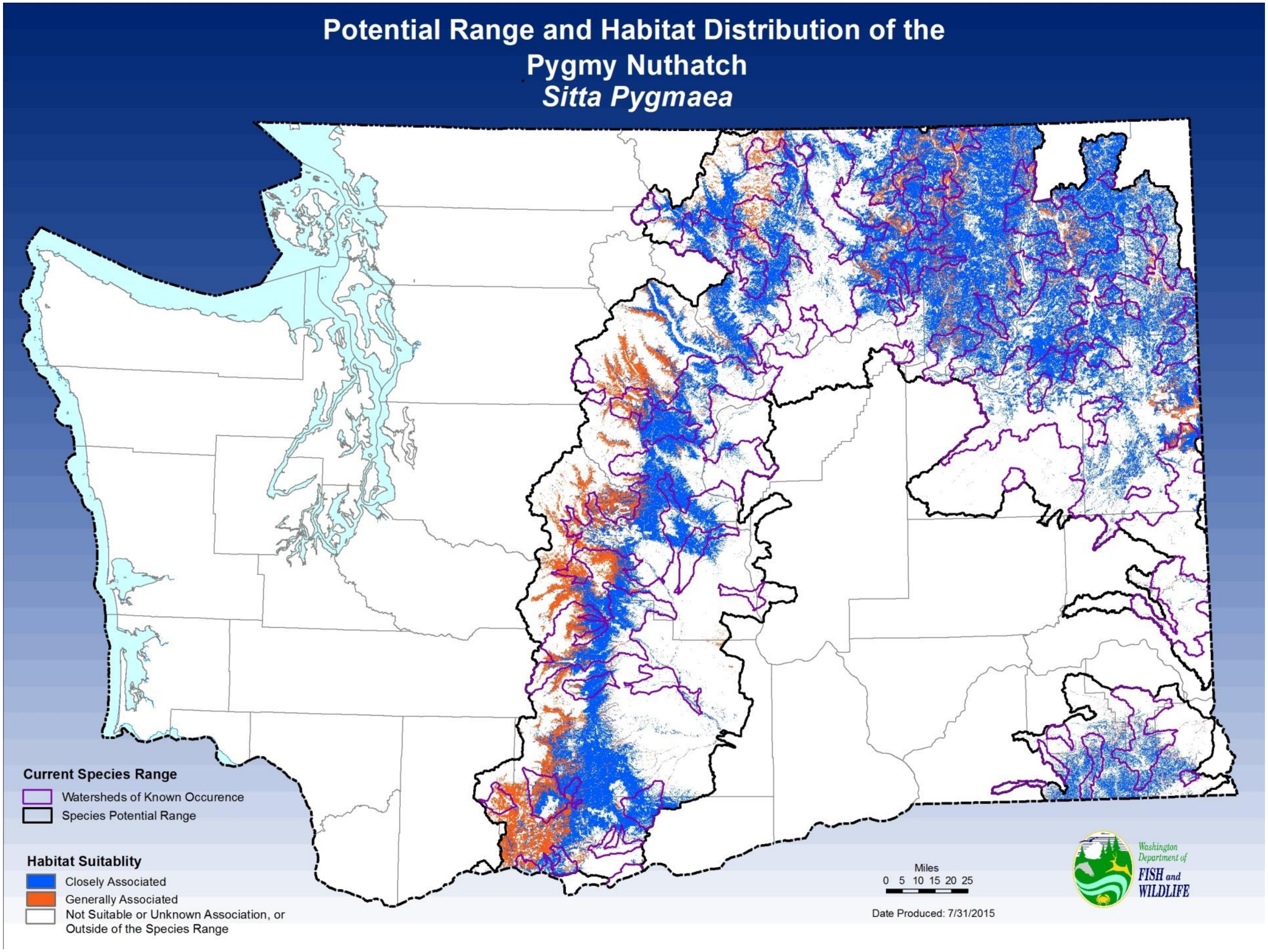
**Peregrine Falcon**



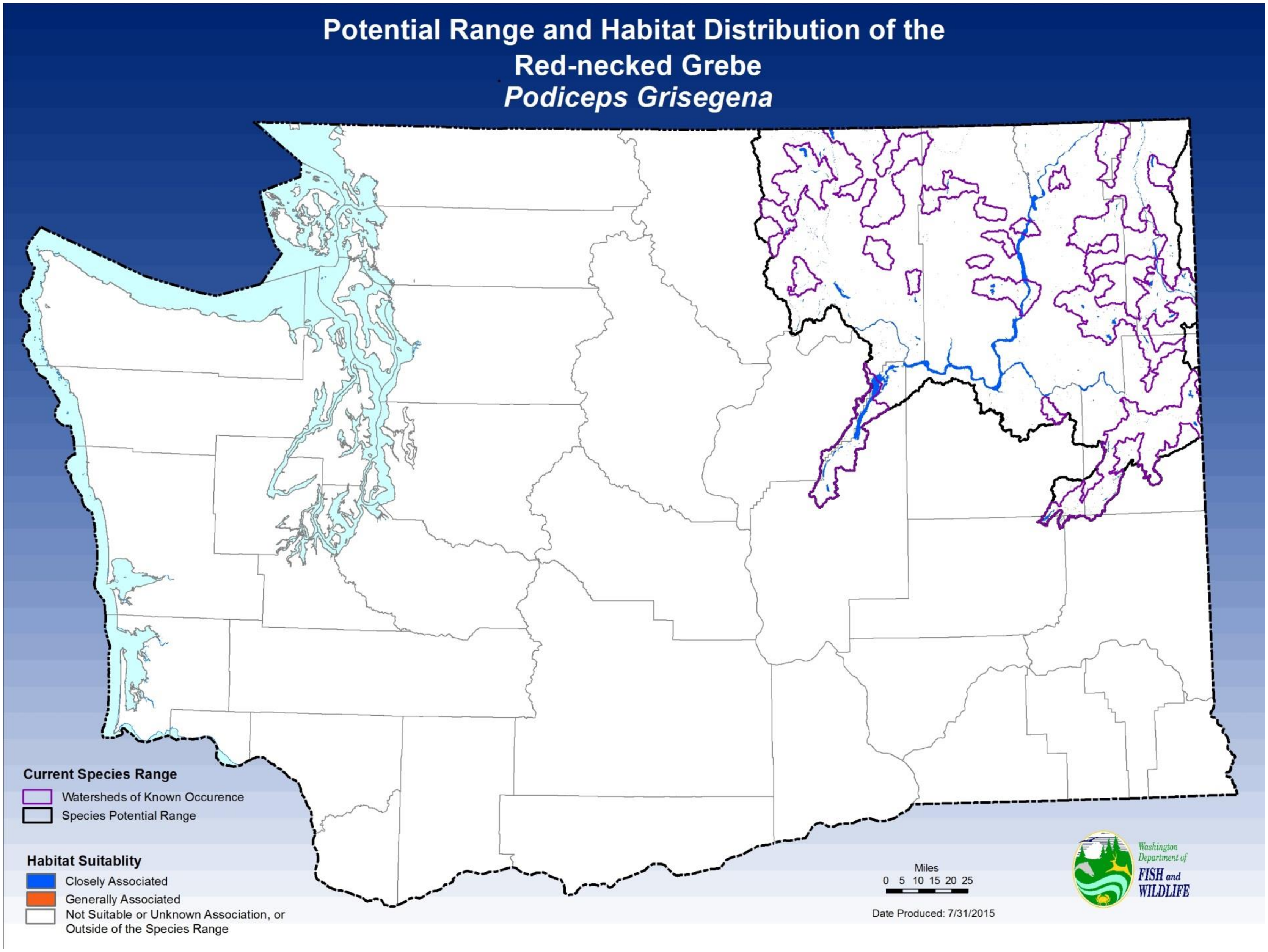
**Purple Martin**



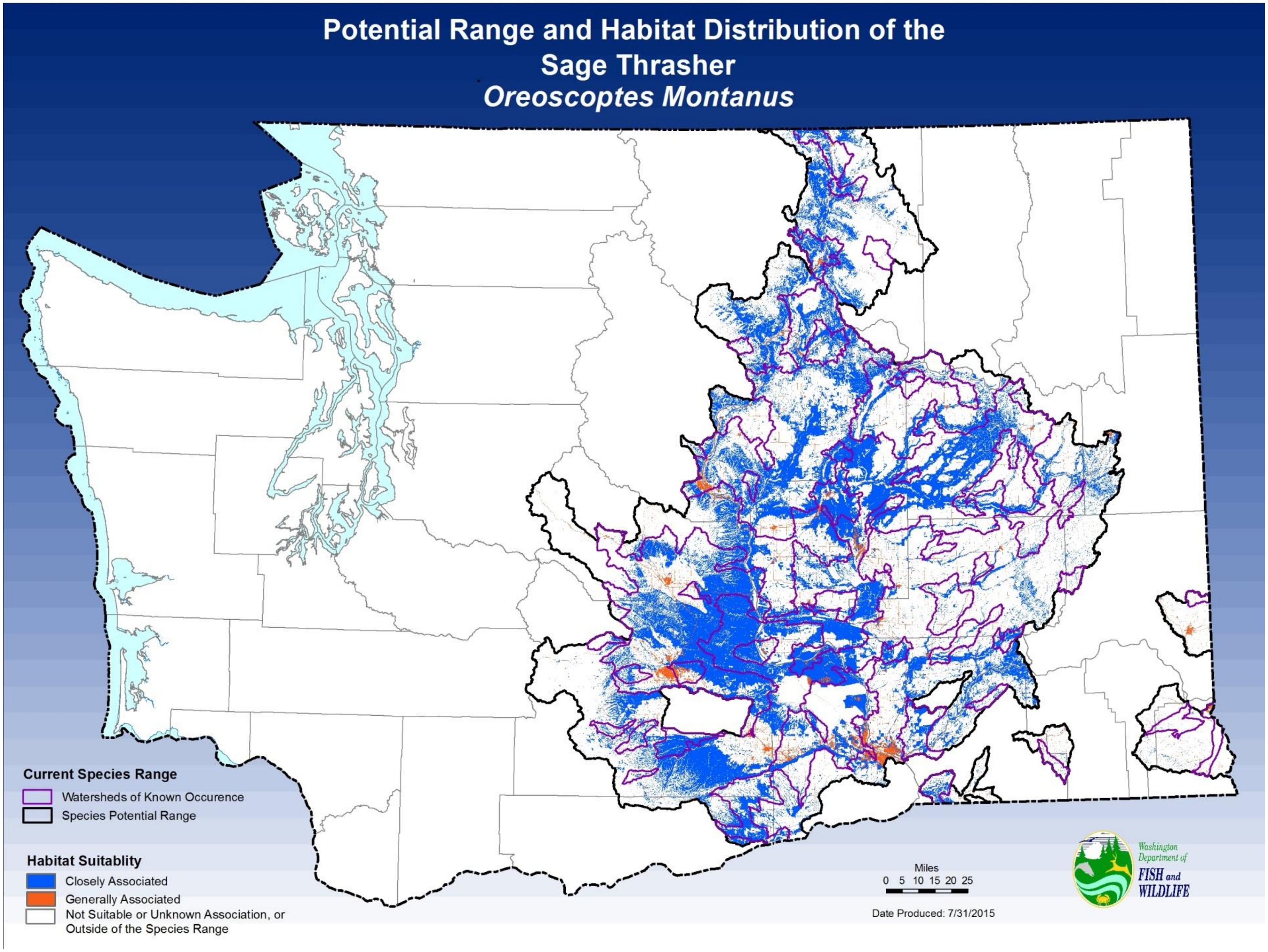
**Pygmy Nuthatch**



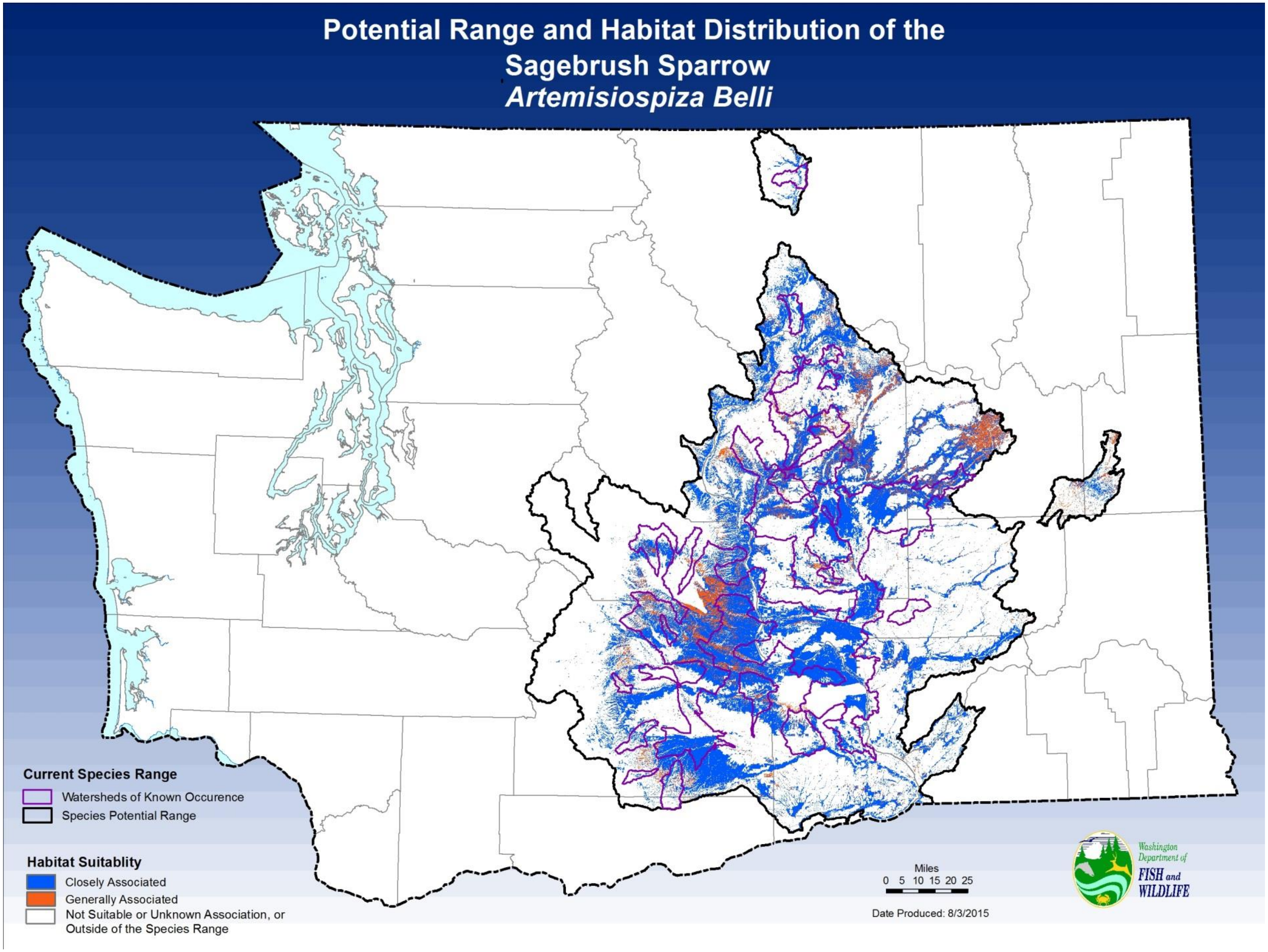
**Red-necked Grebe**



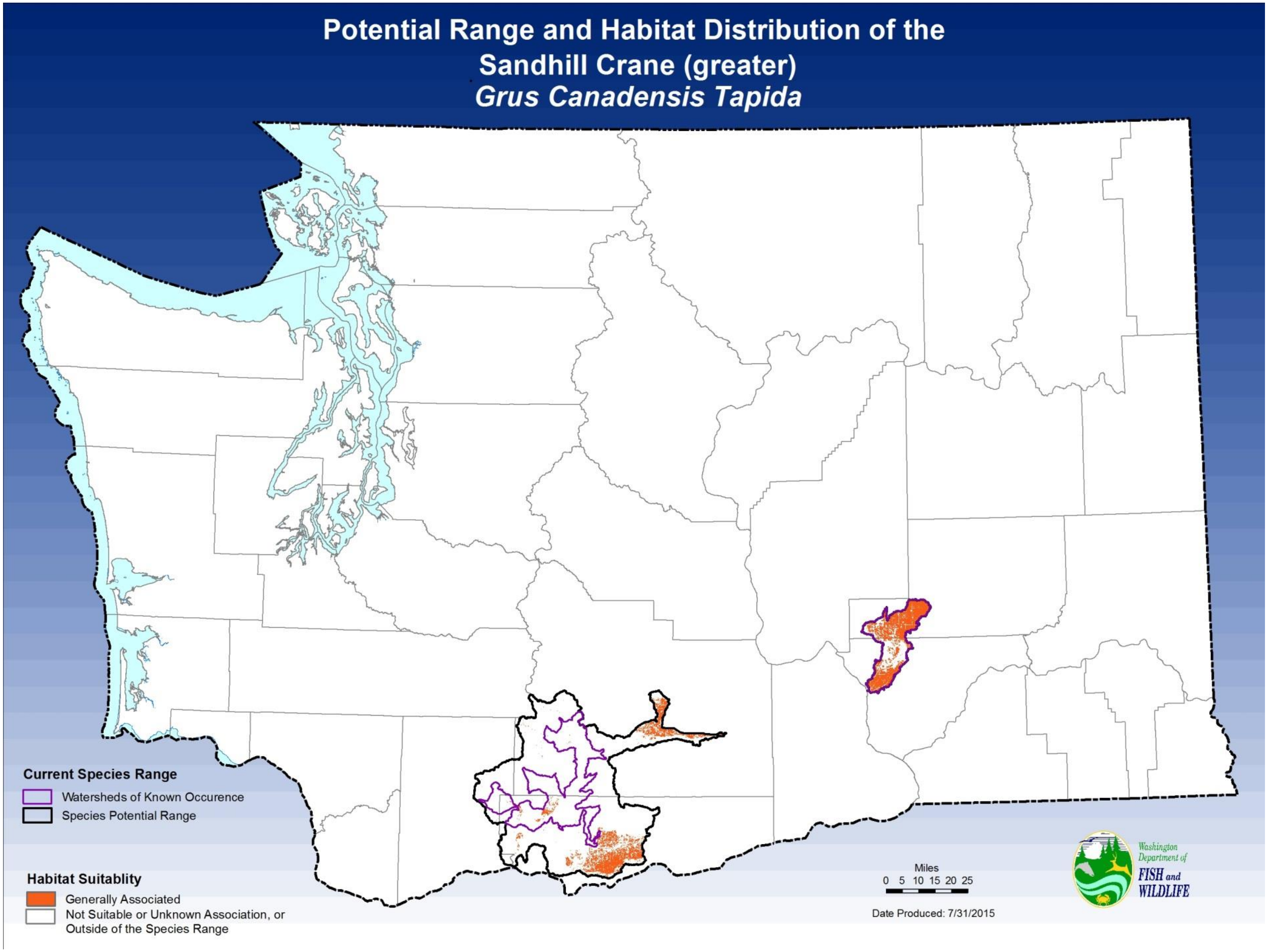
## Sage Thrasher



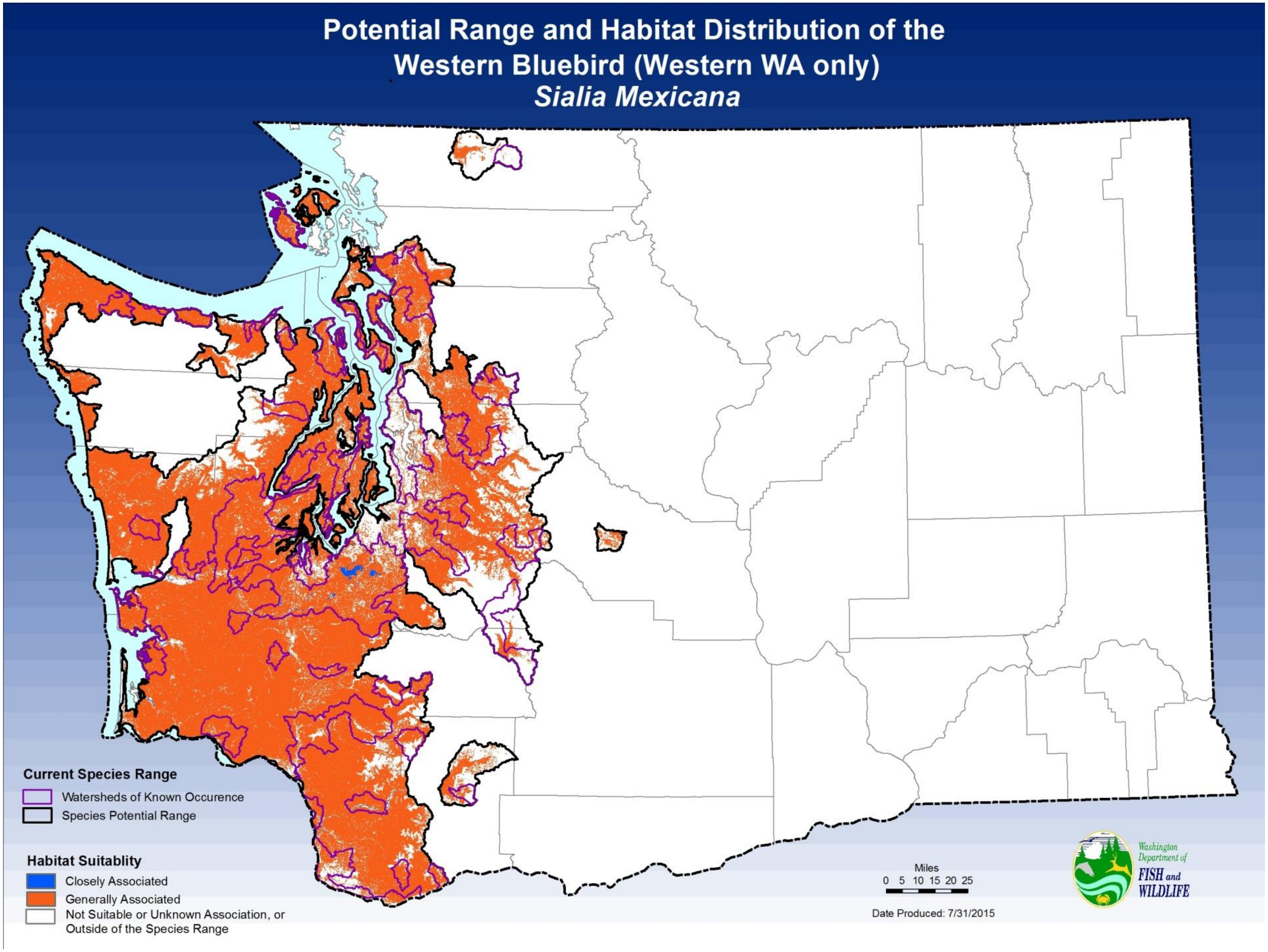
**Sagebrush Sparrow**



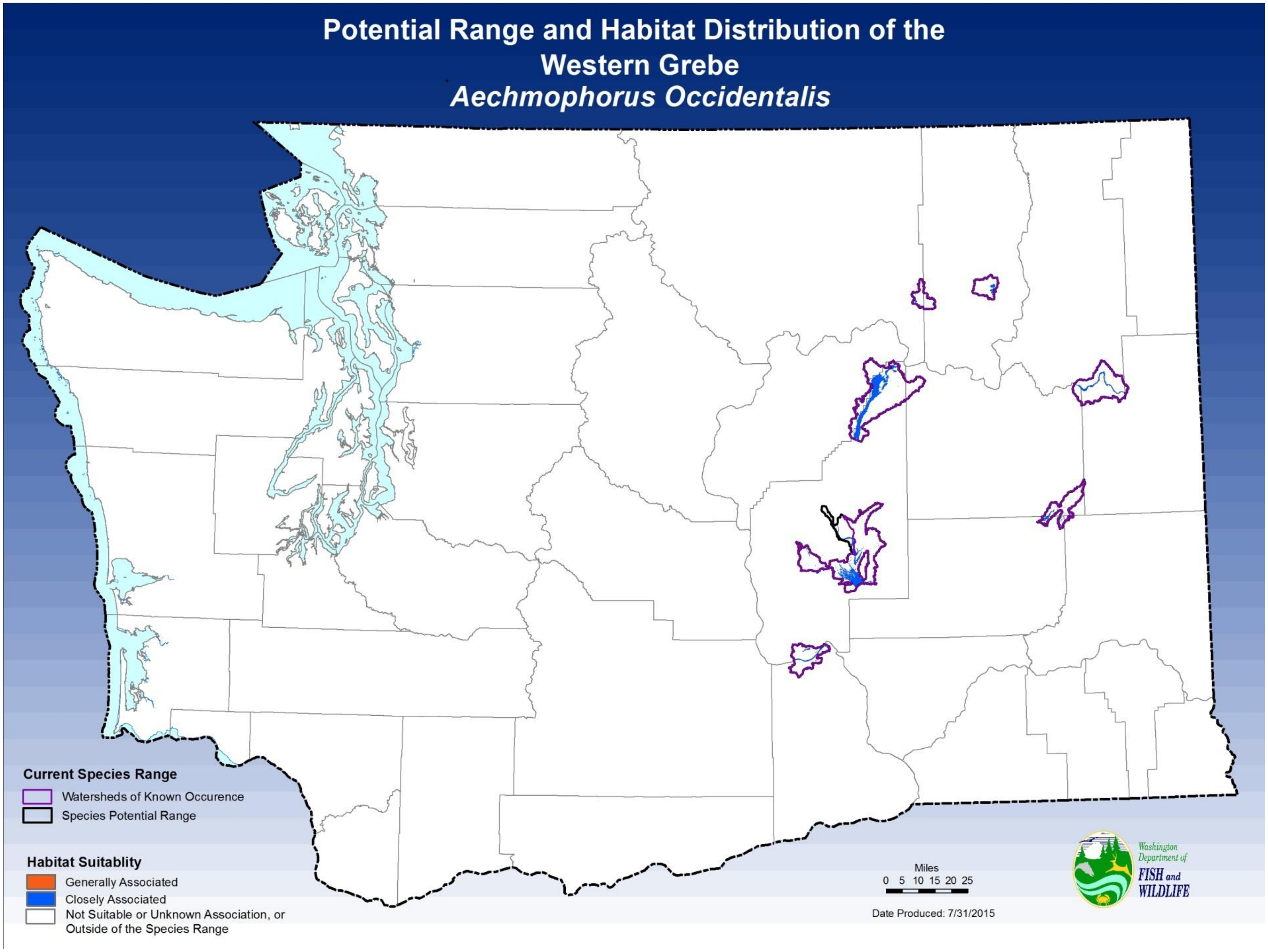
**Sandhill Crane (greater)**



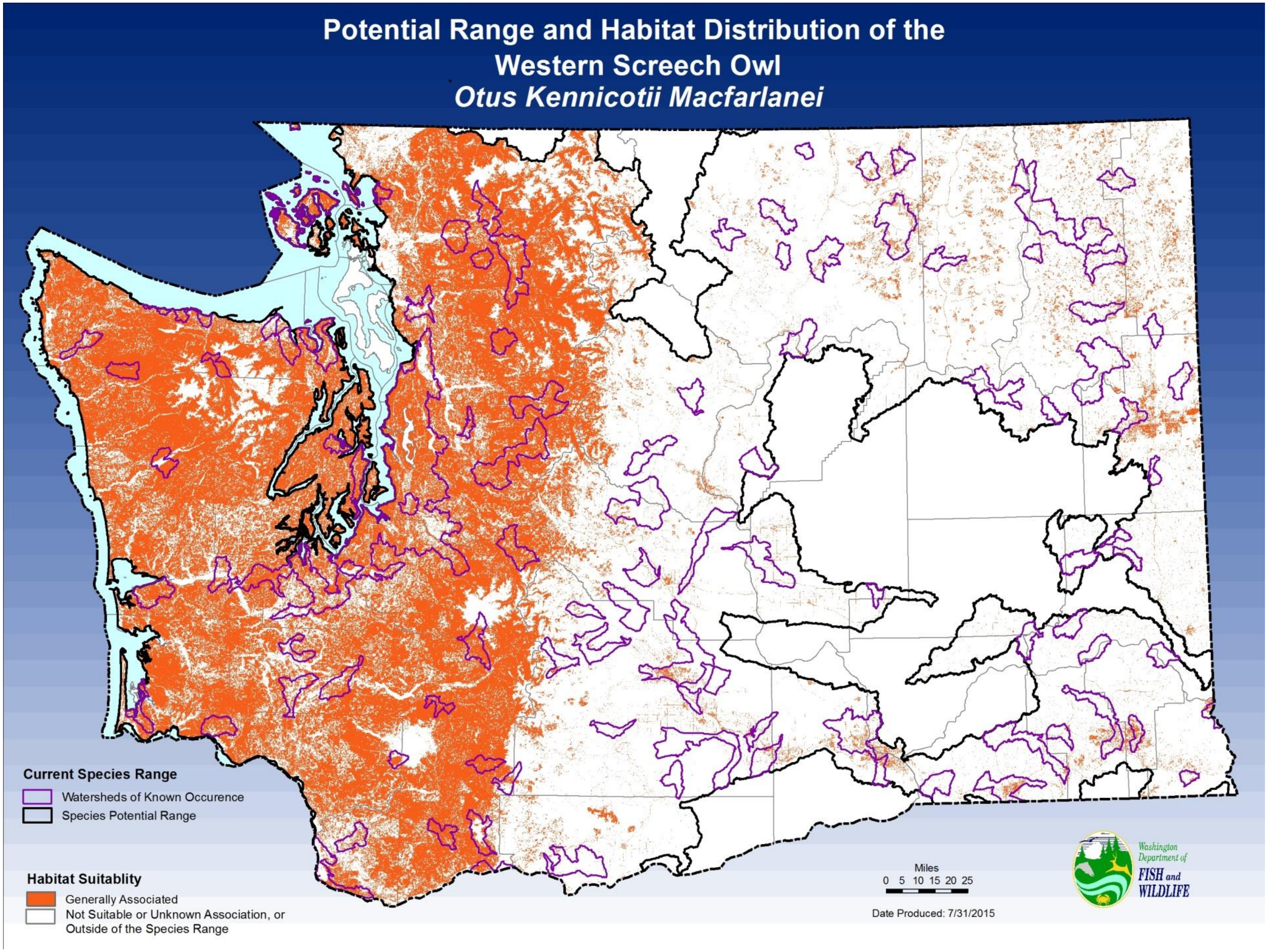
**Western Bluebird** *(Western Washington only)*



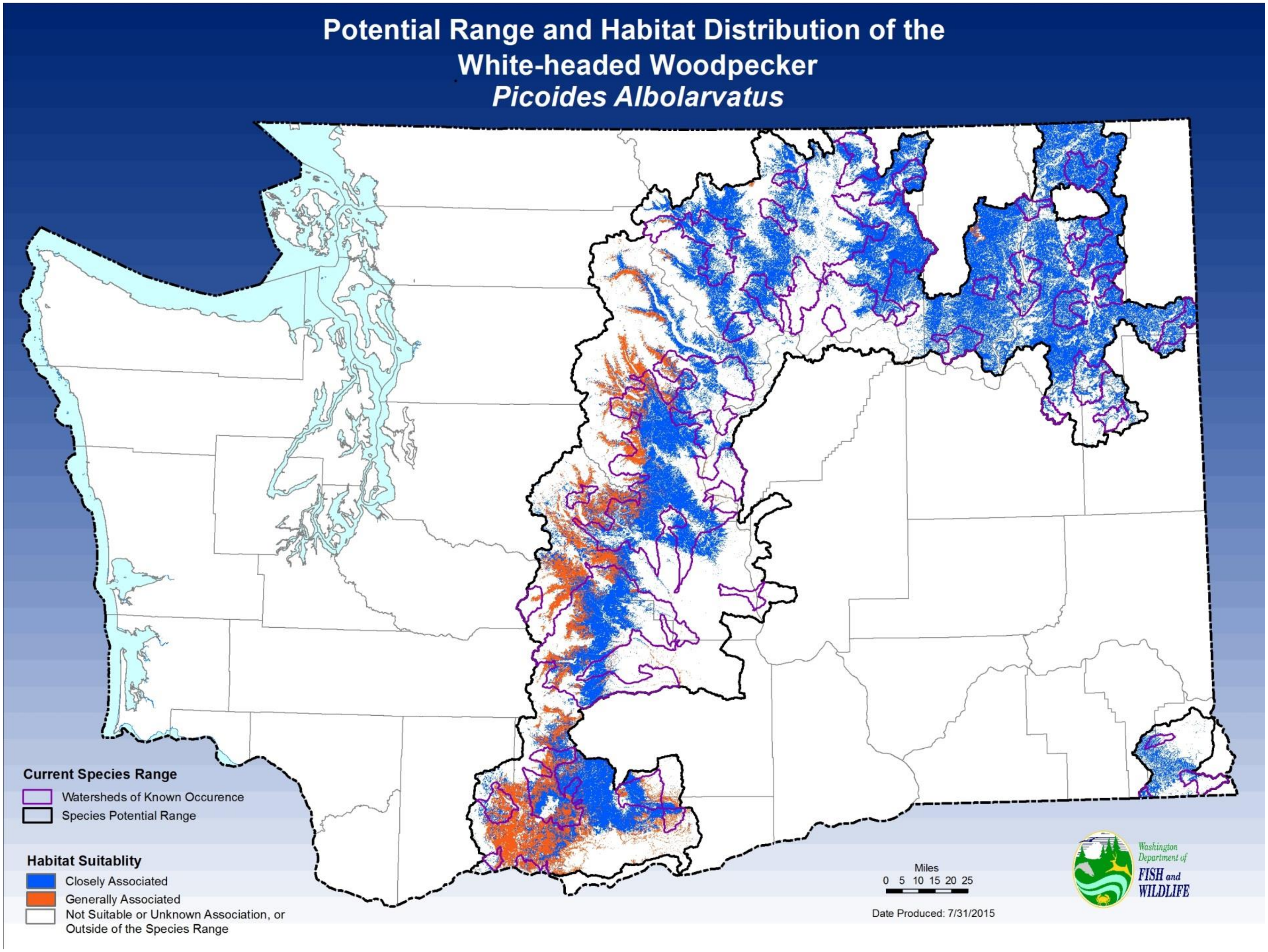
**Western Grebe**



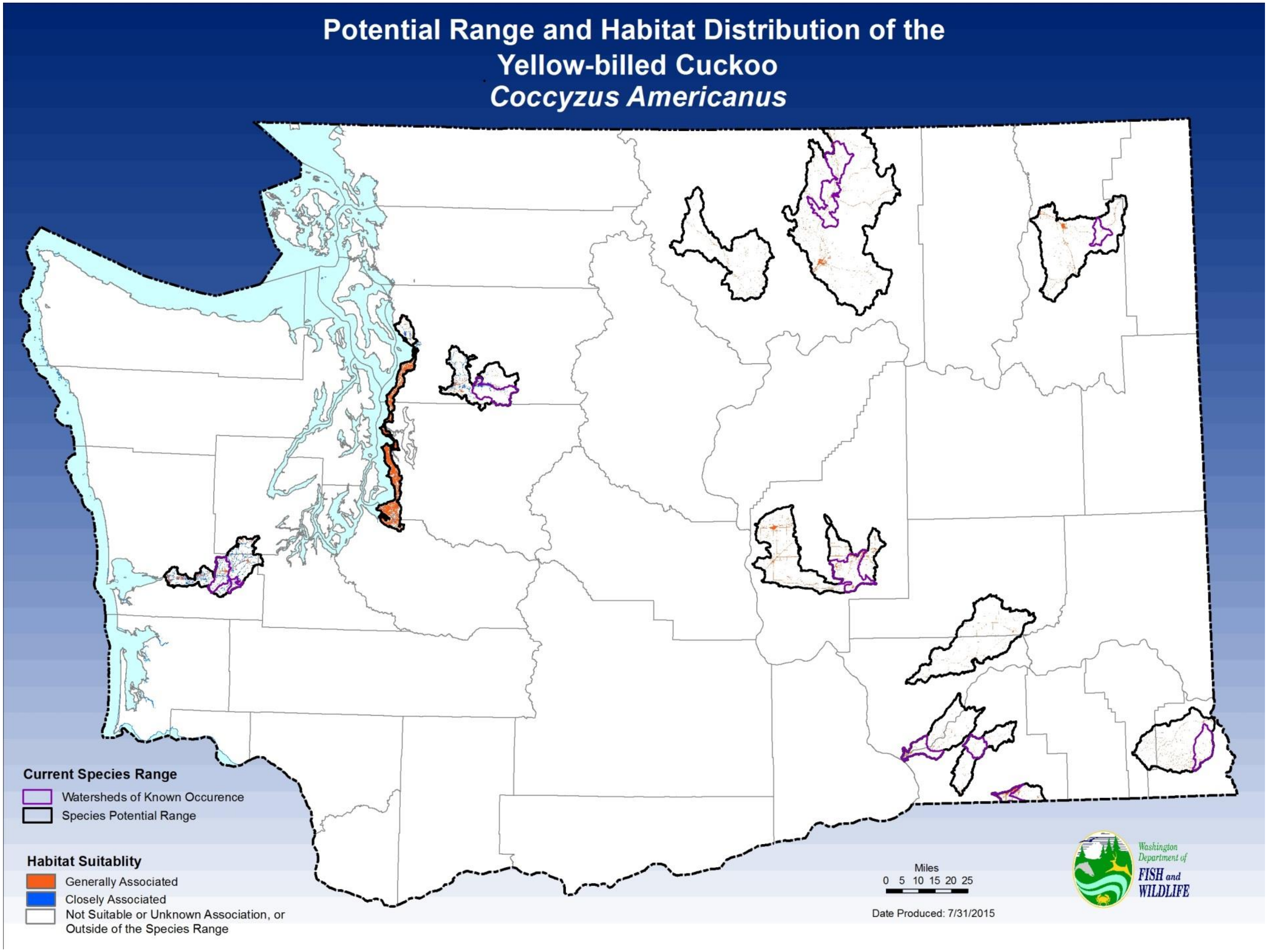
**Western Screech Owl**



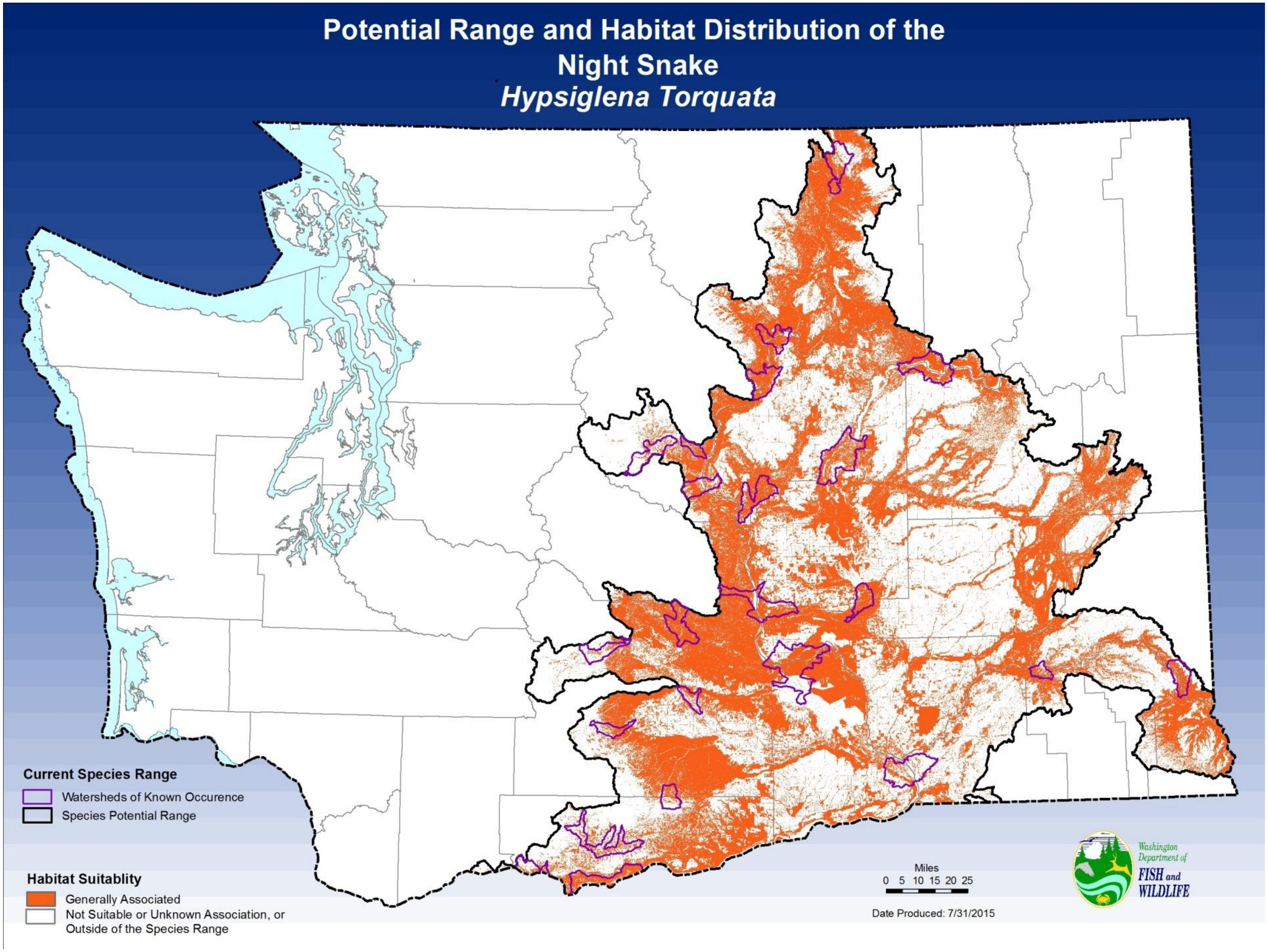
**White-headed Woodpecker**



**Yellow-billed Cuckoo**

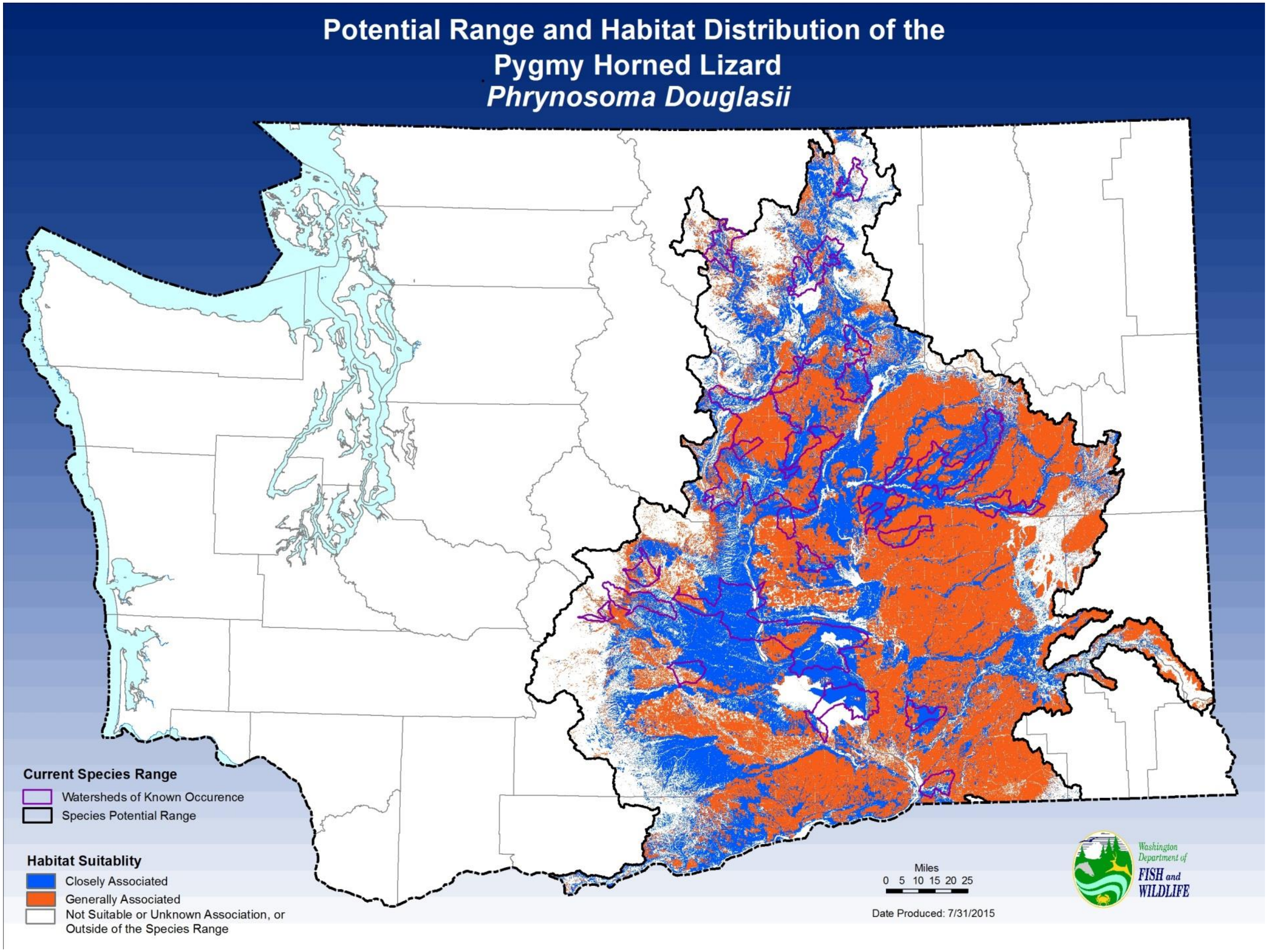


## Night Snake

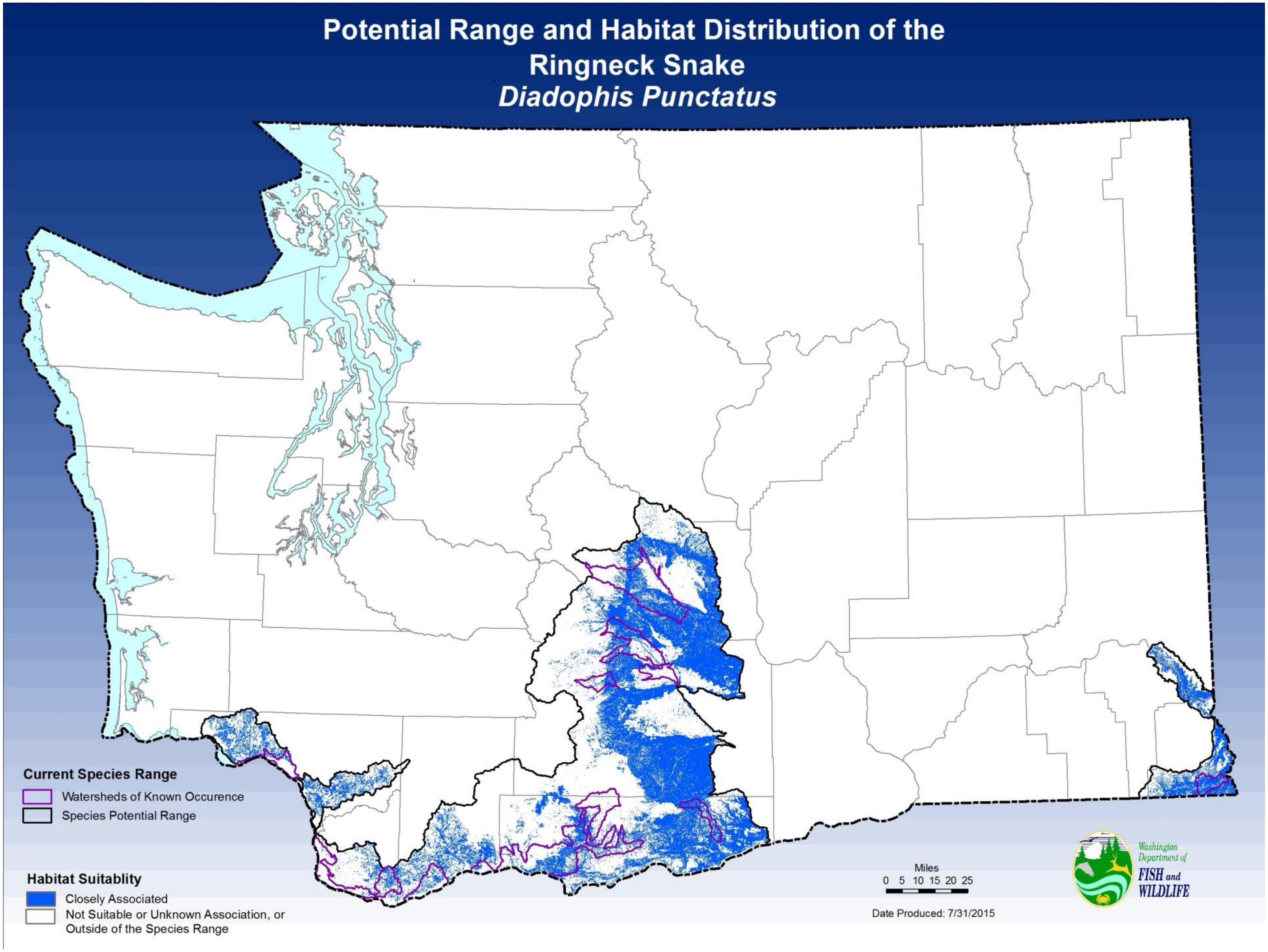


Potential Range and Habitat Distribution of the
Night Snake
Hypsiglena Torquata
Current Species Range
Watersheds of Known Occurence
Species Potential Range
Habitat Suitablity
Generally Associated
Not Suitable or Unknown Association, or
Outside of the Species Range
Miles
0 5 10 15 20 25
Date Produced: 7/31/2015
Washington Department of FISH and WILDLIFE

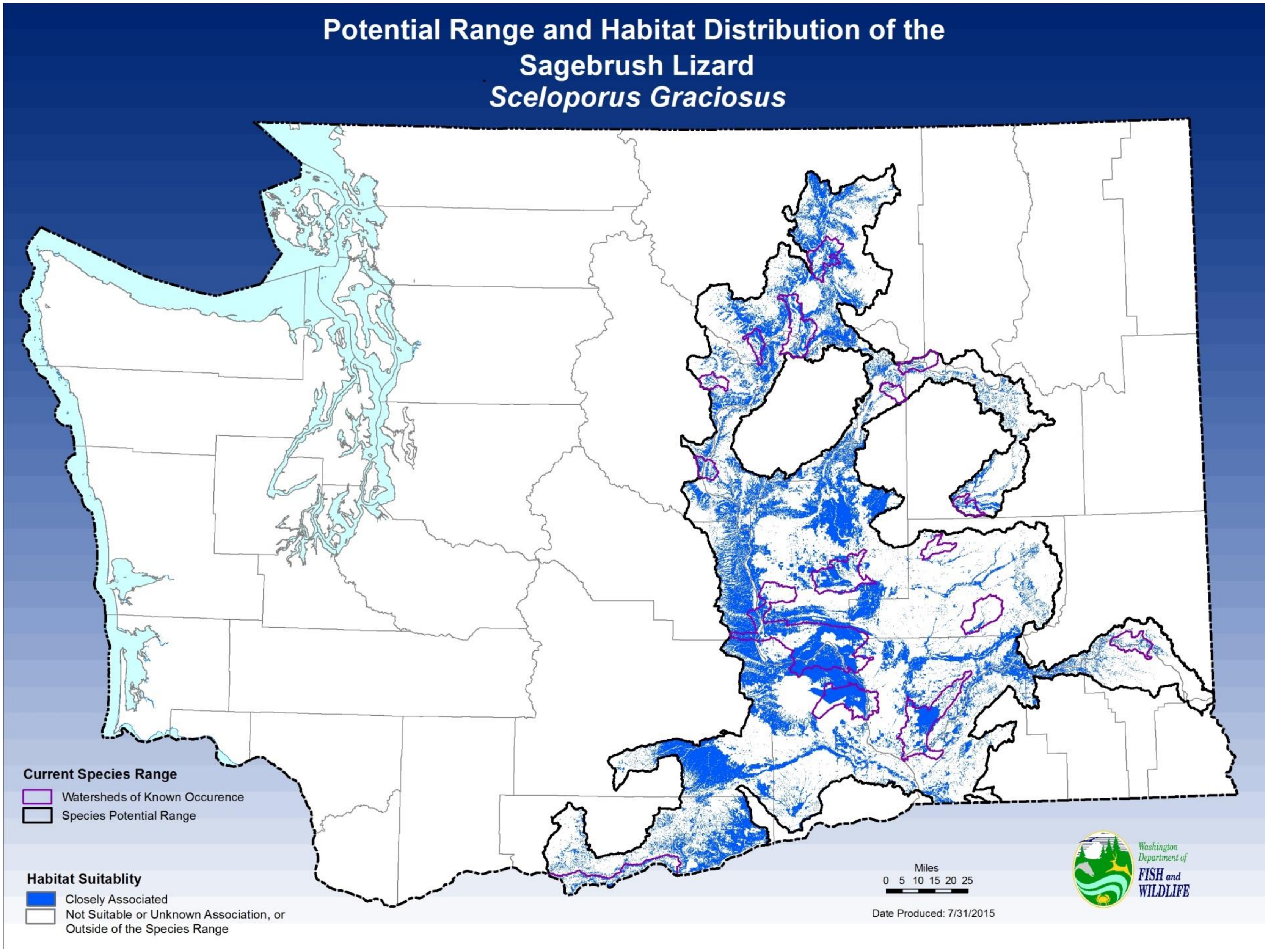
## Pygmy Horned Lizard



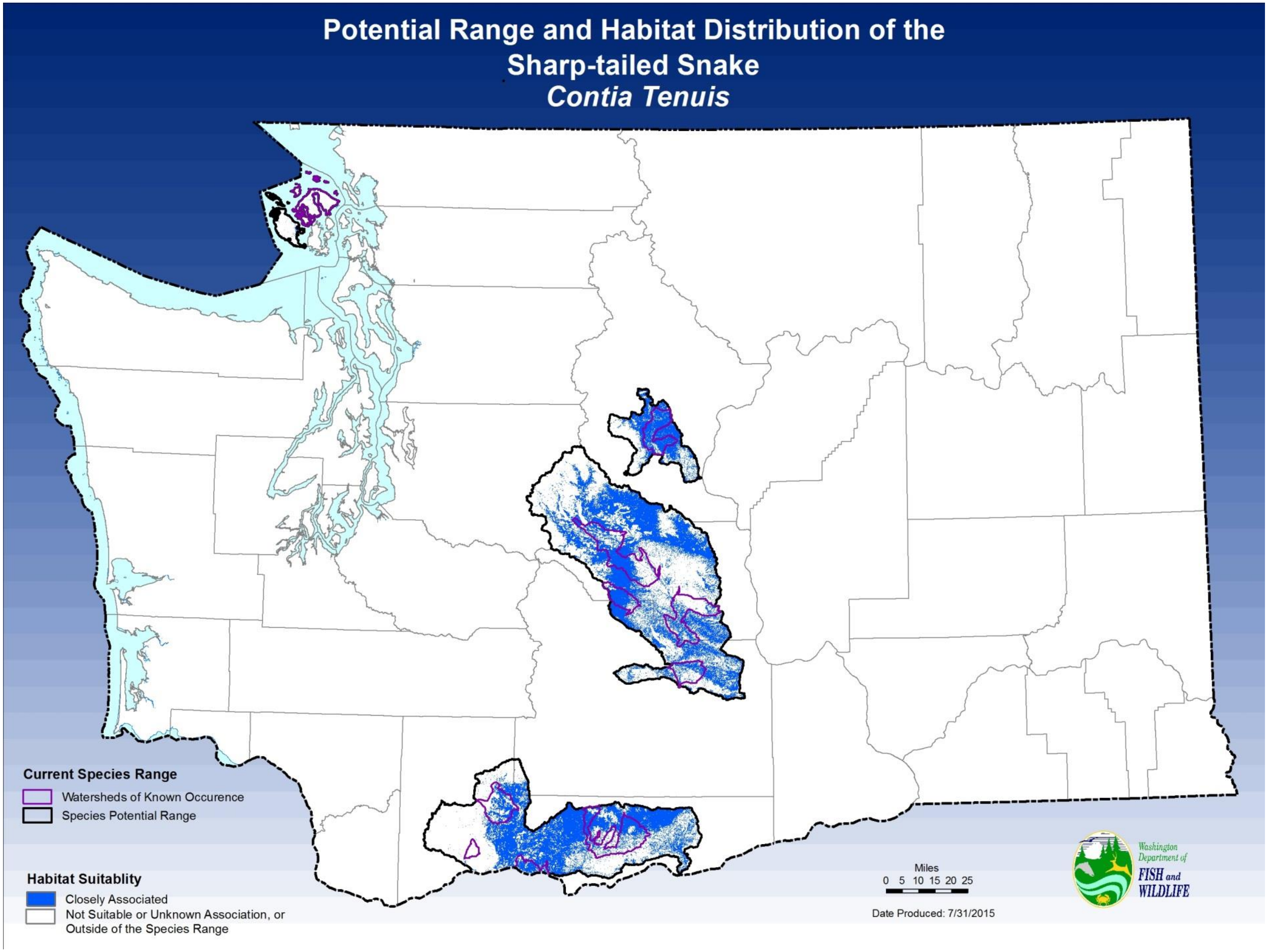
**Ringneck Snake**



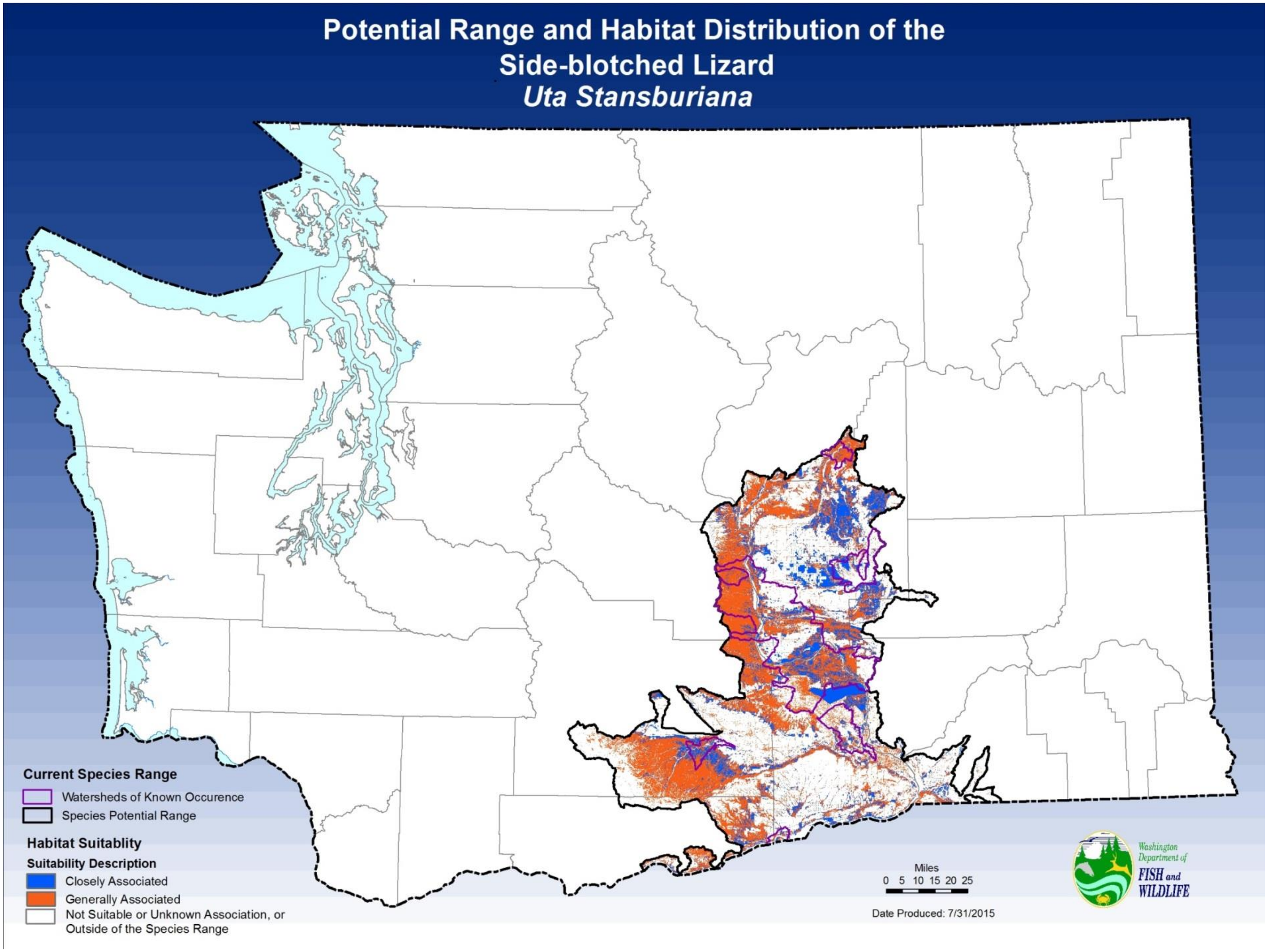
**Sagebrush Lizard**



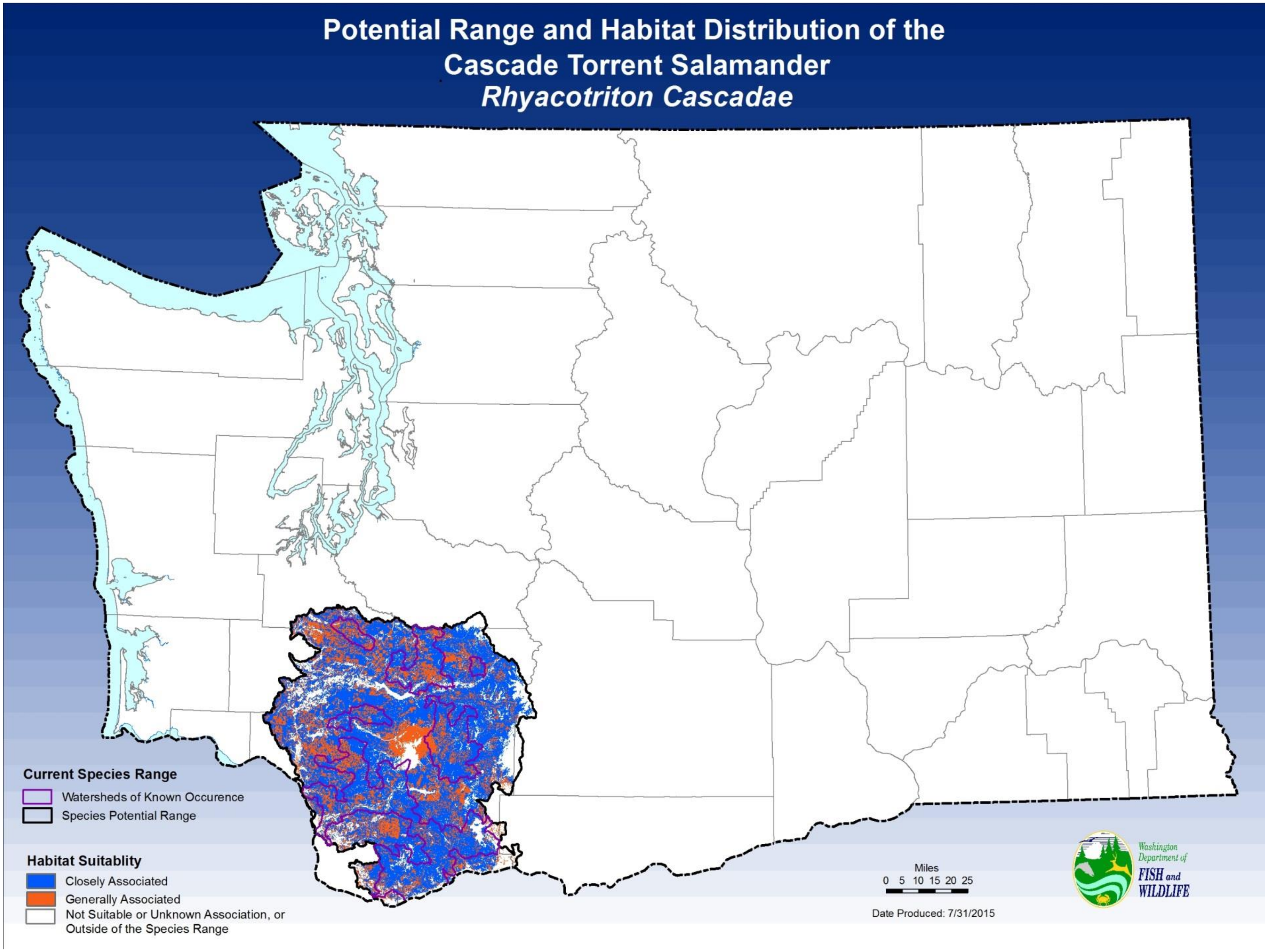
**Sharp-tailed Snake**



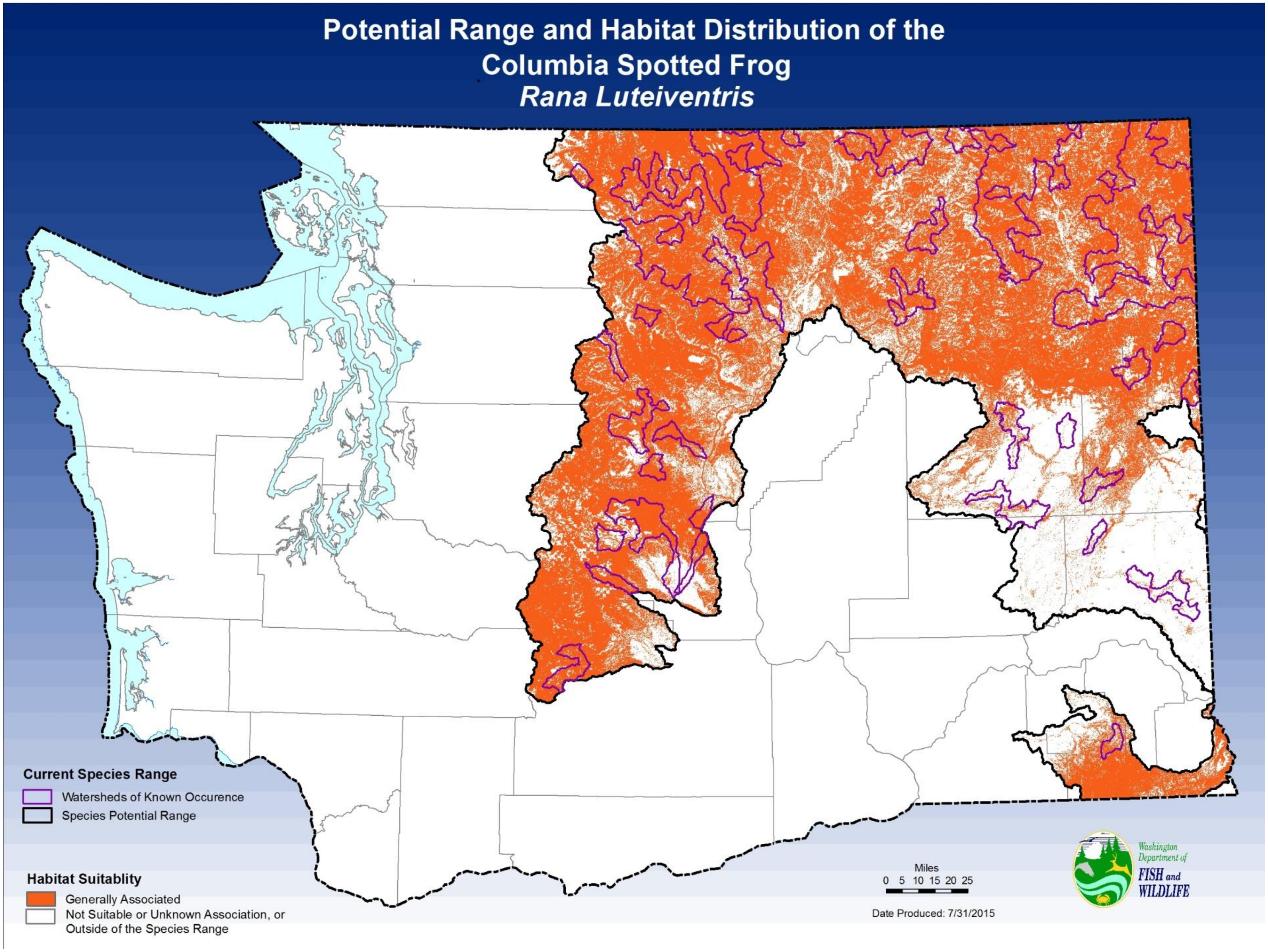
**Side-blotched Lizard**



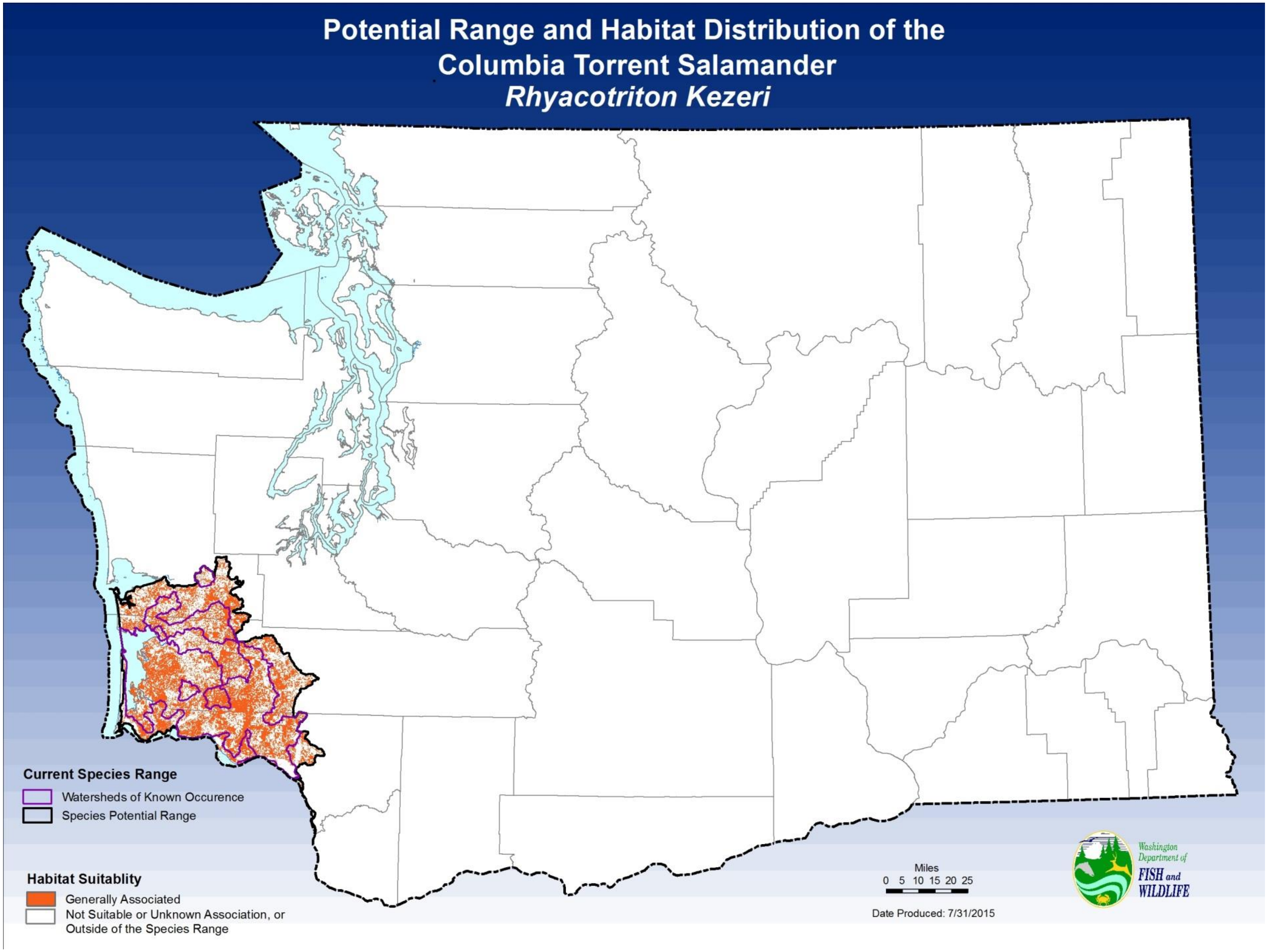
**Cascade Torrent Salamander**



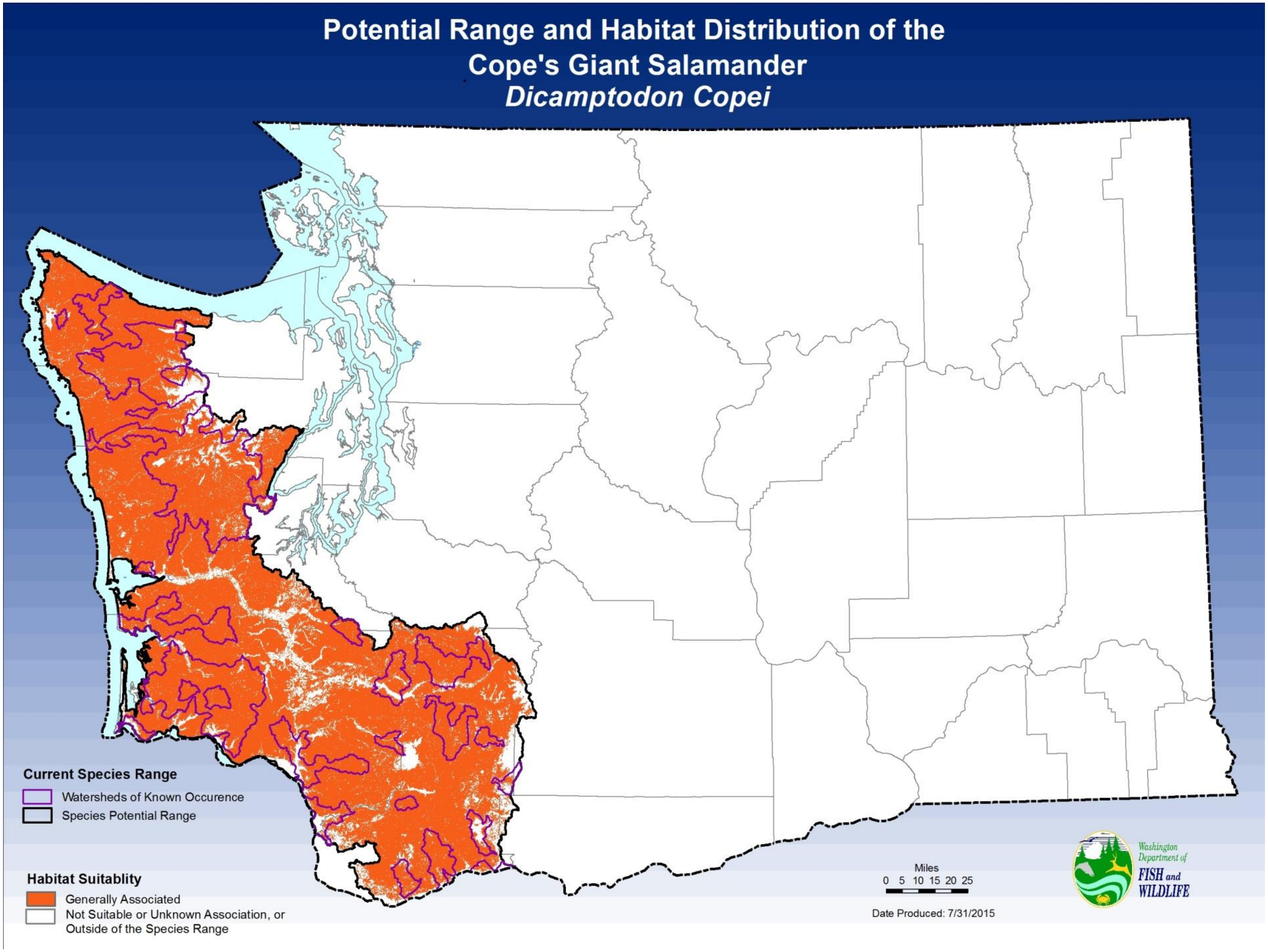
**Columbia Spotted Frog**



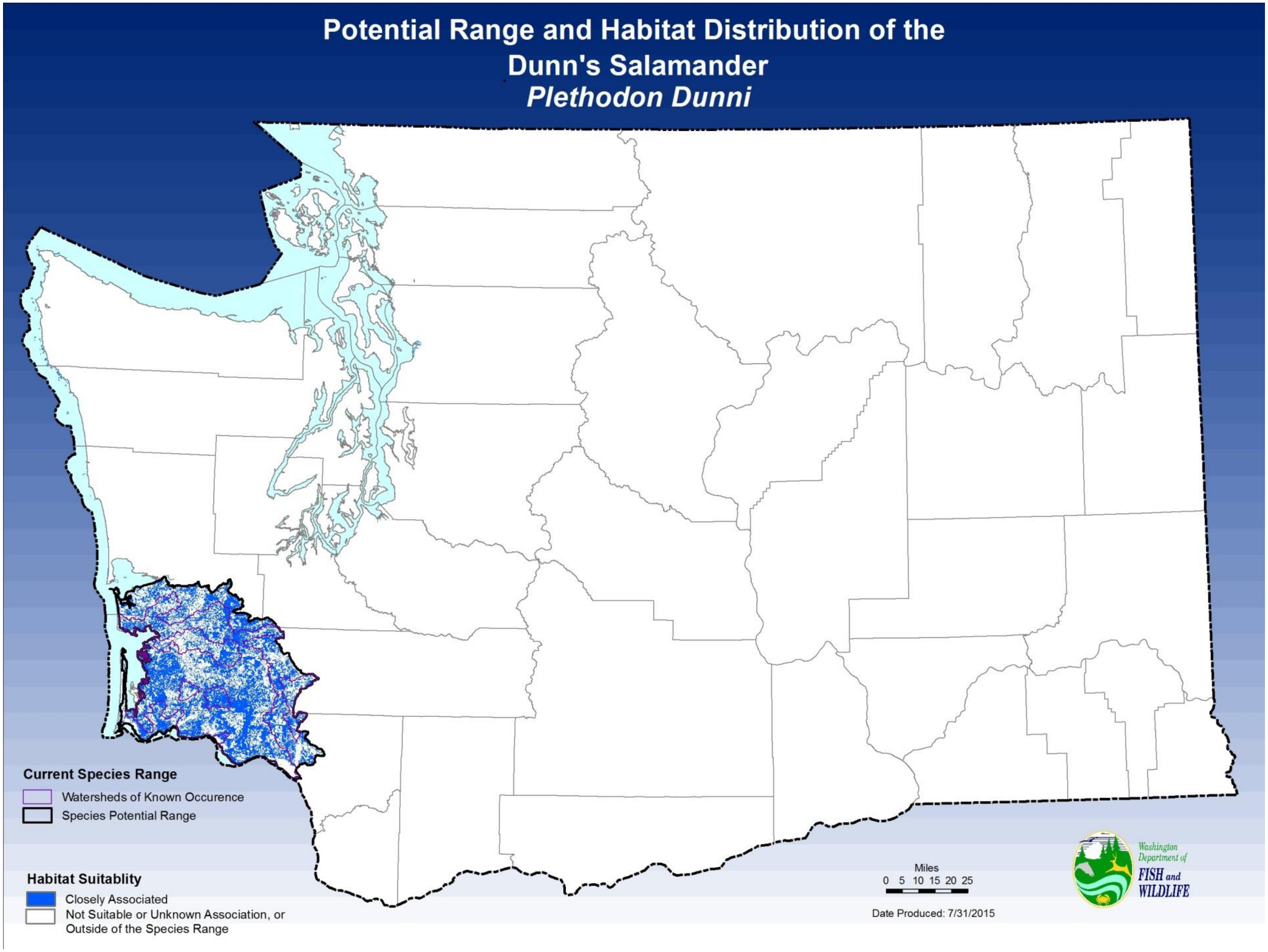
**Columbia Torrent Salamander**



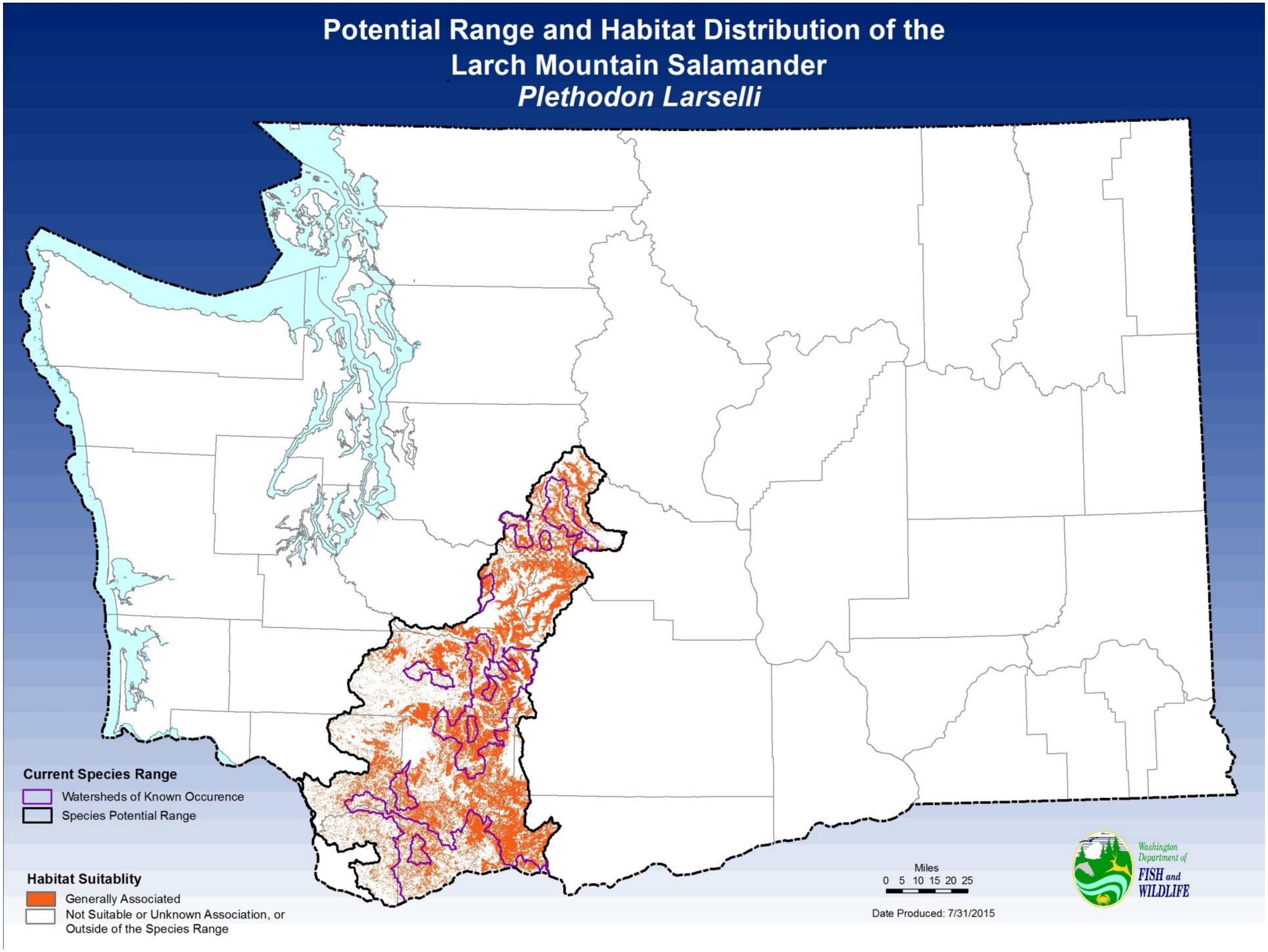
## Cope's Giant Salamander



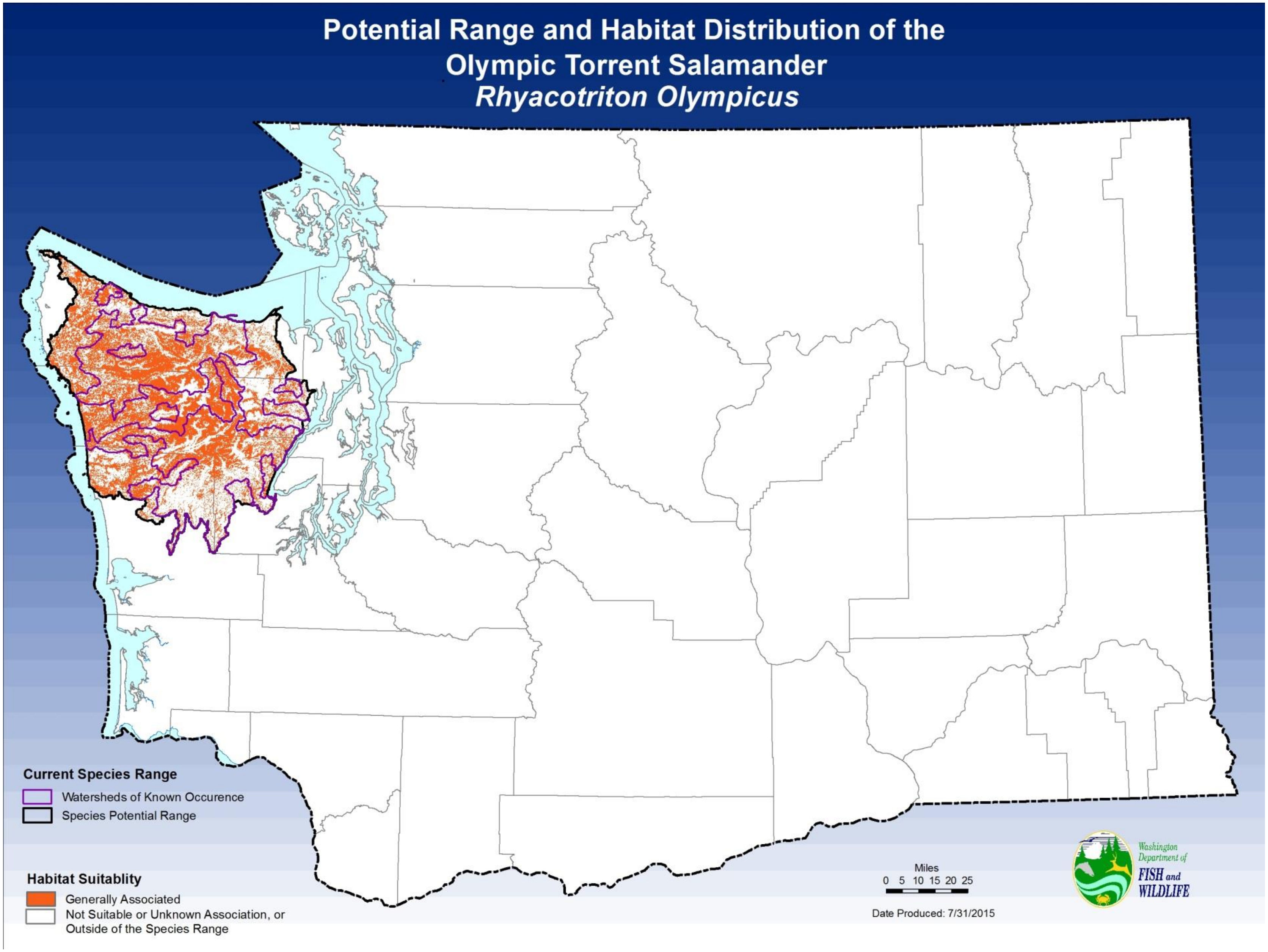
**Dunn's Salamander**



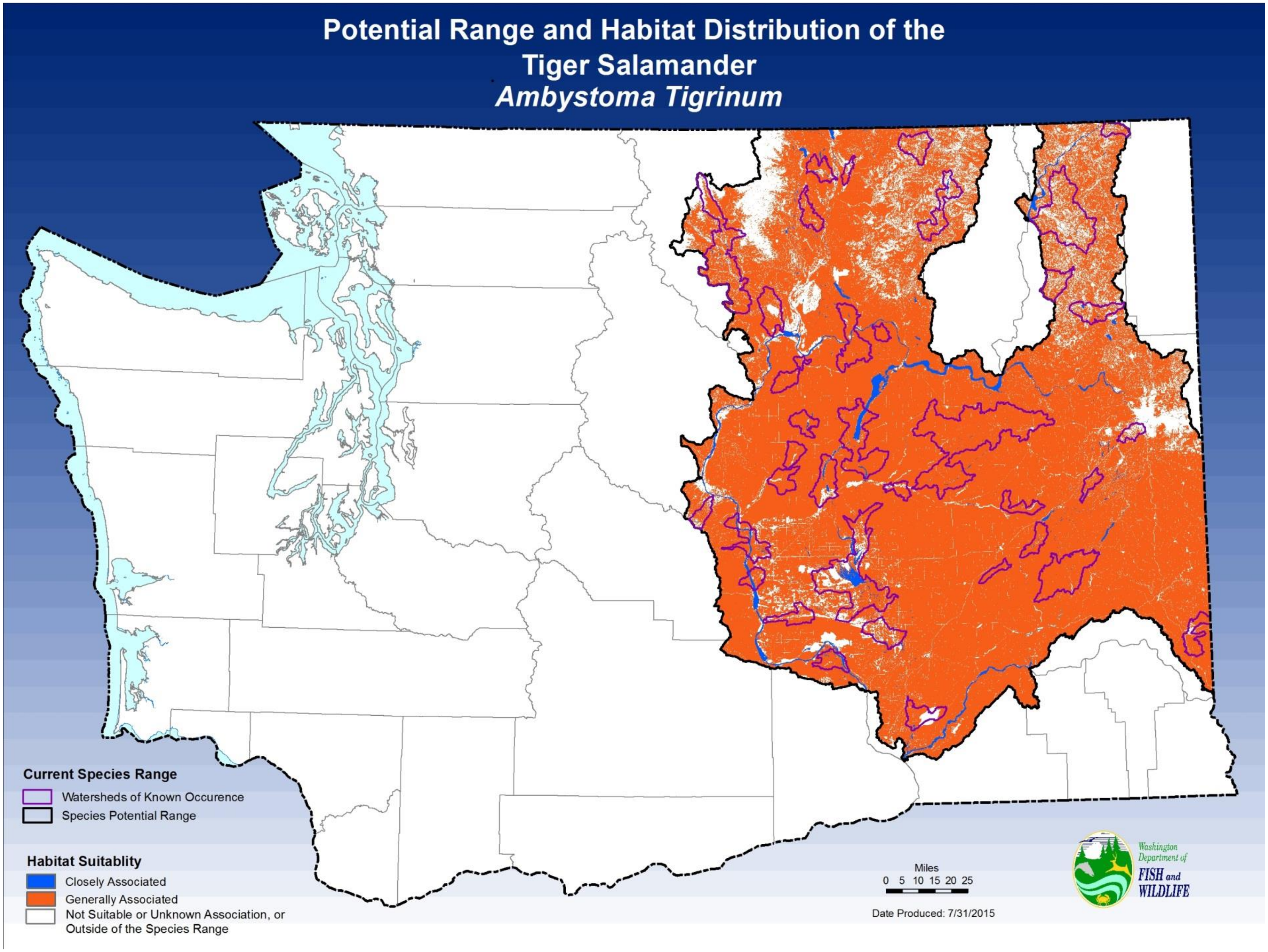
**Larch Mountain Salamander**



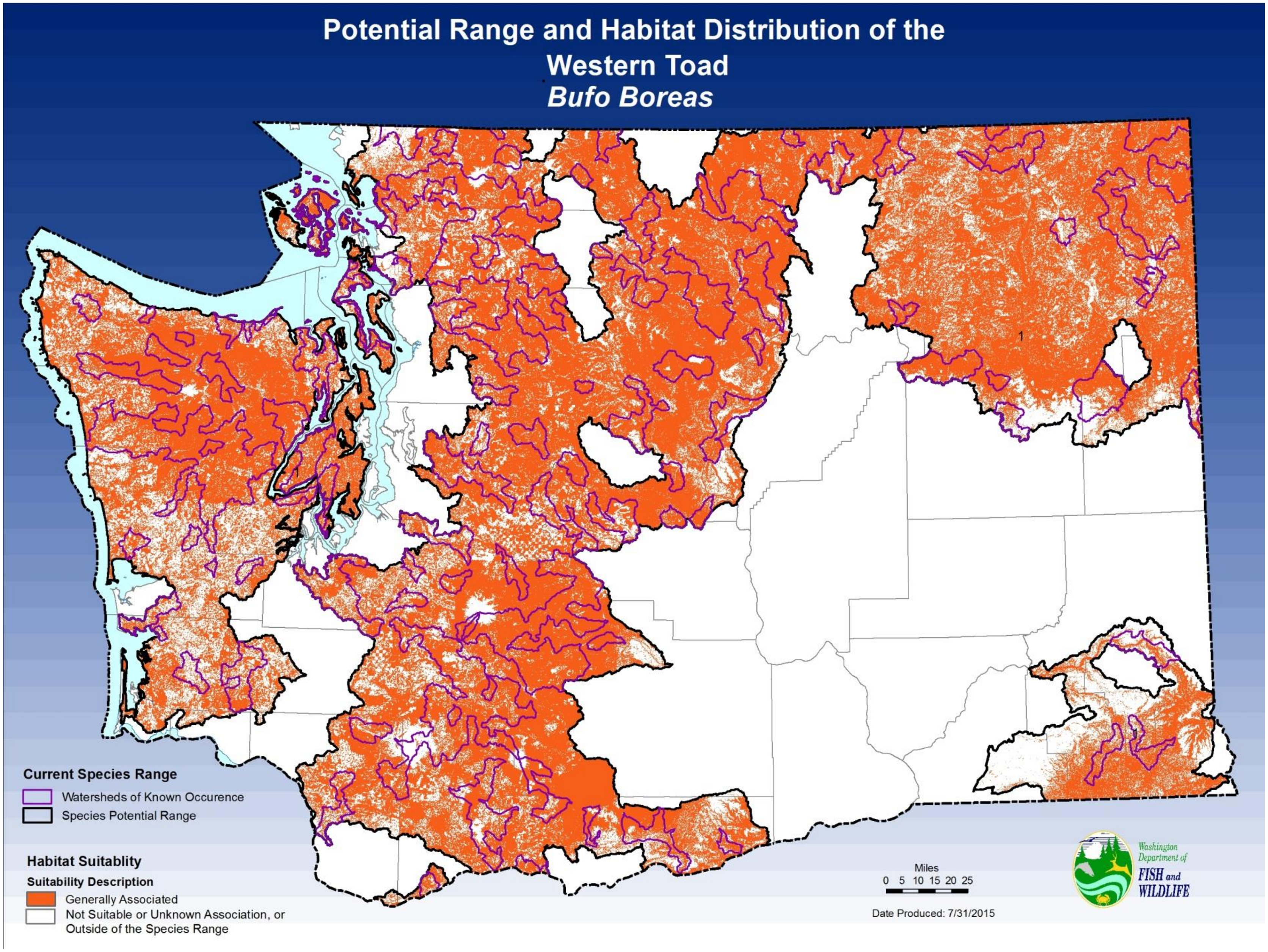
**Olympic Torrent Salamander**



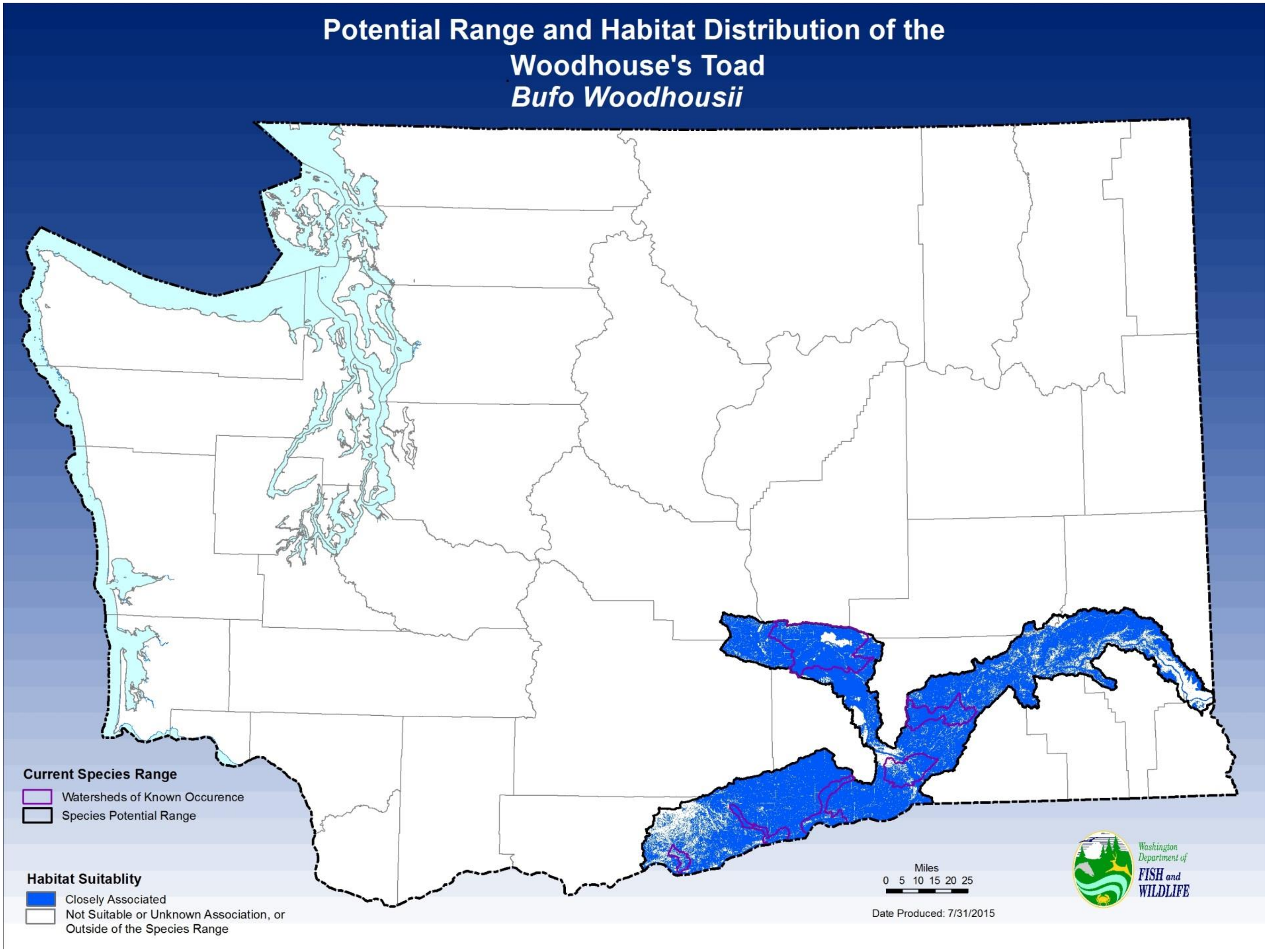
**Tiger Salamander**



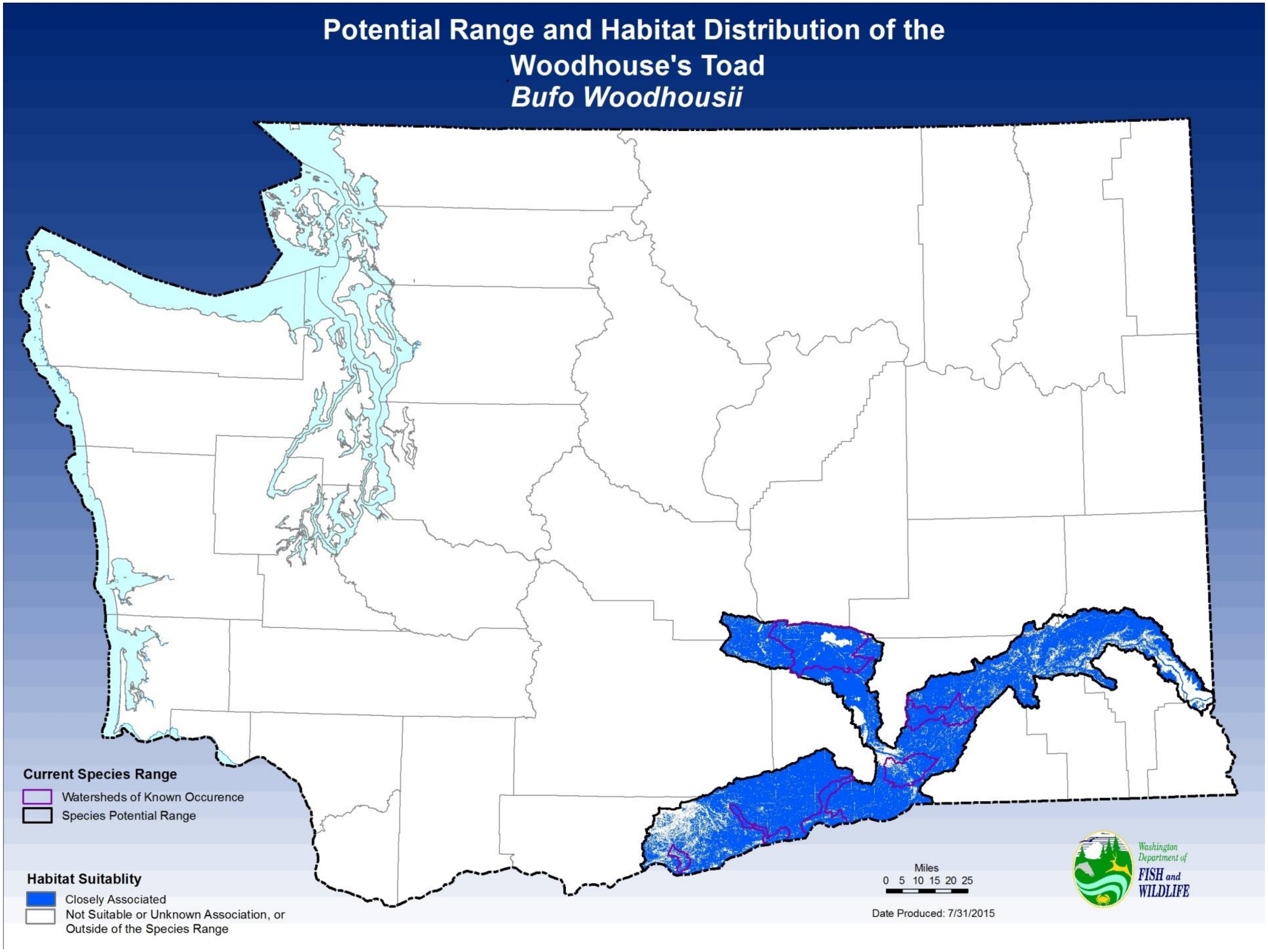
**Western Toad**



## Woodhouse's Toad



**Woodhouse's Toad**



# Appendix C

# Climate Change: Supporting Information

## Table of Contents

# Appendix C

# Climate Change: Supporting Information

## 1. Introduction and Overview

This appendix contains background materials and additional information to support the summary of climate impacts and species and habitat vulnerability presented in Chapter 5. Two major items are included here: 1) a full summary of projected climate change in Washington State in a 30-50 year time frame, with a focus on how these changes will impact fish and wildlife species and their habitats, and 2) a complete list of the vulnerability rankings for all SGCN and Ecological systems of concern, with narrative explanations and references. A complete list of references is provided at the end of the appendix.

## 2. Summary of Projected Climate Change in Washington State

Climate in the Pacific Northwest has been changing significantly over the past century as a result of natural climate variability and greenhouse gas emissions, resulting in warmer air temperatures and variable precipitation patterns. Air temperatures are projected to continue increasing over the next century, while precipitation will remain variable but largely exhibit summer declines, leading to a future with significantly altered snowpack, streamflow patterns, water availability, wildfire risk, ocean pH, and sea levels. These changes will have various impacts on terrestrial, aquatic, and marine and coastal habitats and their associated species in Washington State, potentially contributing to range and phenological shifts, biodiversity threats, habitat degradation, species displacement, changes in important stressors (e.g., invasive species, disease), and other impacts.

This overview outlines priority climate change factors and impacts to consider for the Pacific Northwest, general anticipated changes amongst the various habitat types of Washington State, and the potential effects on Washington's fish, wildlife, and plant species. A table summarizing observed and projected changes can be found at the end of this narrative overview (Table 9). Although this overview provides projections based on the most current available information, it is important to note that future greenhouse gas emissions will play a large role in determining the magnitude of projected changes. For example, emissions from the first years of the 21st century were higher than predicted by most climate models.[1] In addition, climate shifts and associated impacts may be exacerbated or ameliorated by human activities and responses (e.g., habitat destruction vs. restoration treatments).

### Climate Impacts of Concern

#### *Air Temperature*

Average annual air temperatures in the Pacific Northwest have been increasing over the past century, including increases in all seasons and in both maximum and minimum air temperatures (Table 9). Temperatures are projected to continue increasing in all seasons through the end of this century (Table 9) at rates between 0.1-0.6°C (0.2-1.0°F) per decade and exceeding the previous century's historic

[1] Raupach, M. R., Marland, G., Ciais, P., Le Quéré, C., Canadell, J. G., Klepper, G., & Field, C. B. (2007). Global and regional drivers of accelerating $CO_2$ emissions. *Proceedings of the National Academy of Sciences, 104*(24), 10288-10293.

ranges of year-to-year variability. Summer temperatures are projected to warm more rapidly than winter temperatures' and the interior of Washington state is projected to experience slightly greater warming than coastal areas. In addition, the number, mean duration, and maximum duration of extreme heat events are expected to increase, particularly in south central Washington and lowlands in western Washington.

*Secondary impacts*:[2] Temperature increases have already caused significant changes in other environmental variables, and will likely continue to alter these factors in the future (Table 1).

**Table 1: Observed and projected trends of secondary impacts caused by warming temperatures**

| Secondary Impact | Observed Change | Projected Change |
|---|---|---|
| Reduced snowpack | Snowpack declined significantly (average 25%) during the latter half of the 20th century, and although there have been recent increases this is likely due to natural variability. | April 1st snowpack is projected to continue decreasing significantly throughout this century (-53% to -65% by 2080) as warmer temperatures drive shifts from snow to rain. Snowpack losses will be greatest at lower elevations and more modest at higher elevation. |
| Earlier snowmelt | Snowmelt occurred 0-30 days earlier (depending on location) in the Cascade Mountains during the latter half of the 20th century. | Snowmelt is projected to occur increasingly earlier by 2050, potentially 3-4 weeks earlier than 20th century average. |
| Drought risk | The PNW has experienced several droughts over the last decade, some which are attributed to warmer temperatures, reduced water storage in snowpack, and elevated evaporation and evapotranspiration.[3] | Enhanced drought stress as warmer temperatures drive increased evapotranspiration and reduced snowpack storage. |
| Hydrological shifts | Over the past half-century, snow-dominated watersheds have experienced earlier snowmelt runoff and reduced snowmelt contributions. All watersheds are experiencing reduced summer flows. | Future hydrological responses will largely vary by basin type (Table 3), relative influence of groundwater input, elevation, aspect, and other factors. Warmer temperatures will likely drive shifts from snow-dominant to transient or rain-dominant basins (Figure 1), and streamflow timing will likely occur earlier in snow-dominant and transient basins. |

[2] Includes observed and projected physical, ecological, and biological changes.
[3] Bumbaco, K. A., & Mote, P. W. (2010). Three recent flavors of drought in the Pacific Northwest. *Journal of Applied Meteorology and Climatology, 49*(9), 2058-2068.

| Secondary Impact | Observed Change | Projected Change |
|---|---|---|
| Flood risk and erosion | 20th century warming caused no change in flood risk for rain-dominant basins, reduced flood risk in snow-dominant basins (due to reduced snowpack), and highly variable but generally elevated flood risk in transient basins.[4] | Increasing flood risk and erosion in transient basins. Snowmelt and rain-dominant basins will see minimal or slight increases (Table 3). |
| Soil moisture changes | Spring soil moisture recharge has been occurring earlier in the Pacific Northwest over the past half century (1943-2003). Over the same time period, July 1 soil moisture trends have been variable, and warmer areas (e.g., the Washington coast) have experienced declines. | July 1 soil moisture is largely projected to decline across Washington State (-15 to -18% by 2080) although directions and rates of change vary depending on location. For example, areas west of the Cascades are projected to experience decreased soil moisture. |
| Wildfire risk | Warmer temperatures have contributed to increasing wildfire frequency and extent in the Pacific Northwest since the 1970s. | Increased lightning activity and projected temperature increases will contribute to increased fire frequency, severity, intensity, and total area burned in the Pacific Northwest, although the magnitude of change will likely vary by eco-region and suppression efforts. Forested ecosystems are projected to experience a larger relative increase in area burned than non-forested, and western forests will likely experience larger increases in burn area and severity than eastern forests or forests of the Columbia Plateau. |
| Insect and disease risk | Warmer temperatures have contributed to more mountain pine beetle outbreaks and elevated disease exposure, increasing tree mortality. | Insects: range expansions upward in elevation, earlier arrival or emergence, and accelerated reproductive cycles.<br>Disease: increased disease incidence. |
| Range shifts | Tree seedlings have already exhibited shifts to cooler locations than parent trees.[5] | Continued northward or higher elevation shifts in species distributions. |

[4] Hamlet, A. F., & Lettenmaier, D. P. (2007). Effects of 20th century warming and climate variability on flood risk in the western US. *Water Resources Research, 43*(6).
[5] Monleon, V. J., & Lintz, H. E. (2015). Evidence of tree species' range shifts in a complex landscape. *PloS One, 10*(1), e0118069.

| Secondary Impact | Observed Change | Projected Change |
|---|---|---|
| Pheno-logical shifts | Phenological changes have already been observed, including earlier flowering and leaf unfolding. | Continued shifts in phenological timing (e.g., earlier migration, earlier algal blooms, earlier plant bloom/senescence), which can affect habitat quality and/or desynchronize life history traits with key environmental conditions (e.g., outmigration of salmon and oceanic prey availability). |

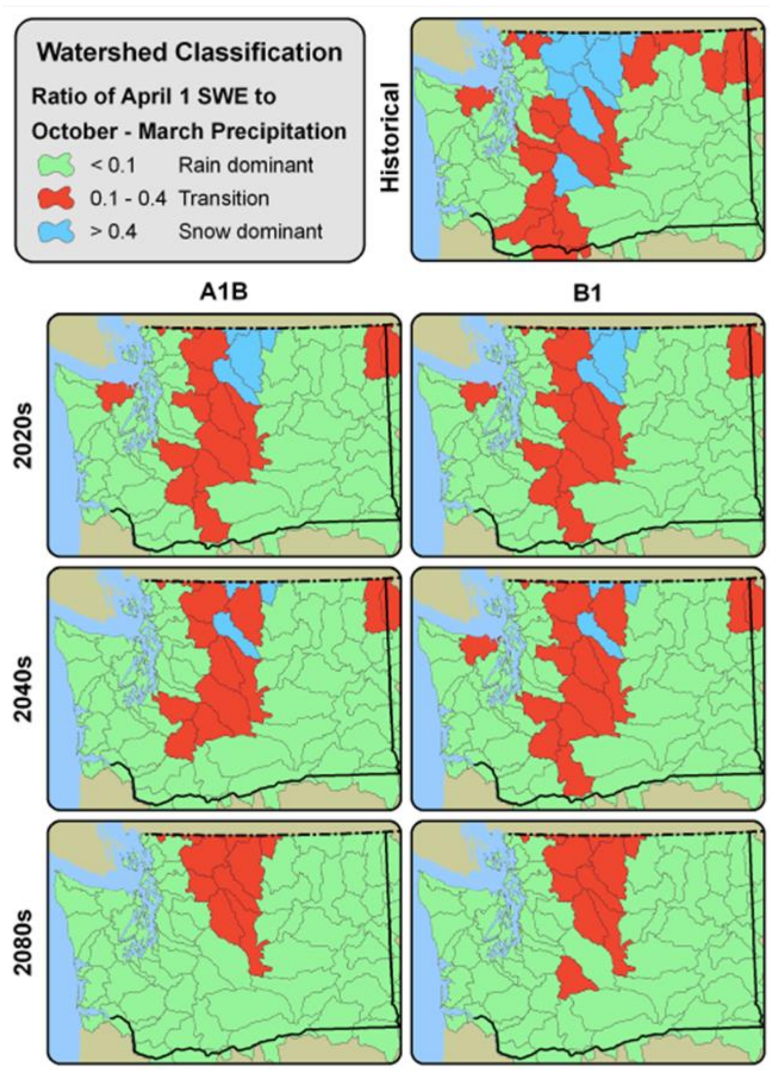



**Figure 1: Watershed Classification Maps**

Watershed Classification Maps[6] for simulated runoff in the historic period (1970-99), 2020s, 2040s,

[6] Image from page 234 of Washington Climate Impacts Group. (2009). The Washington Climate Change Impacts Assessment, M. McGuire Elsner, J. Littell, and L. Whitely Binder (eds). Center for Science in the Earth System, Joint Institute for the Study of the Atmosphere and Oceans, University of Washington, Seattle, Washington.

and 2080s in Washington State. Simulations using A1B emissions are in the lower 3 rows of the left column, while those using B1 emissions scenarios are in the lower 3 rows of the right column.

*Examples of impacts of changes in air temperature on habitats and species:*

- Declines in certain vegetation types (e.g., pine forests, Douglas fir, subalpine forests, sagebrush steppe) and expansions in others (e.g., prairie) as suitable habitat ranges shift, driving alterations in wildlife habitat availability and species distributions.
- Changes in productivity amongst many vegetation types (e.g., increases in higher elevation forests due to lengthened growing season, decreases in lower elevation forests due to heat and moisture stress).
- Shifts in phenology, affecting plant reproduction and/or productivity and animal life histories, survival, reproduction, and growth.
- Increases in wildfire frequency due to reduced fuel moisture, affecting plant survival and composition and forest-dependent wildlife species.
- Altered flow regimes (e.g., low summer flows), affecting salmon and steelhead migration, reproductive success, and habitat availability.
- Increases in forest disease risk and mortality due to exacerbated moisture stress.
- Changes in the frequency and severity of flood risk, affecting riparian vegetation community composition and structure.
- Increases in mountain pine beetle vulnerability (short-term) as beetles shift upward in elevation and trees experience increased moisture stress, with declines in vulnerability (long-term) as temperatures exceed insect thermal tolerance.
- Alterations in invasive species pressure; some species may expand, while some may decline.

***Precipitation***

Separated by the Cascade Mountains, eastern and western Washington feature distinct precipitation regimes, with western zones receiving significantly more rainfall than eastern zones. There has been no significant trend in precipitation over the past century (Table 9), as this region experiences high natural variability. Precipitation projections are highly variable, and may include either increases or decreases in annual precipitation over the next century (Table 9); these changes are small when compared to ranges of natural variability in the Pacific Northwest. There is higher certainty regarding seasonal precipitation trends; by the end of the century, winters will likely be wetter and summers will likely be drier. Precipitation intensity may also increase, particularly in the North Cascades and northeastern Washington.

*Secondary impacts*:[7] Shifts in precipitation timing, amount, and form have caused significant changes in other environmental variables, and will likely continue to alter these factors in the future (Table 2).

[7] Includes observed and projected physical, ecological, and biological changes.

**Table 2**. Observed and projected changes of secondary impacts caused by precipitation changes.

| Secondary Impact | Observed Change | Projected Change |
|---|---|---|
| Snowpack changes | Snowpack declined significantly (average -25%) during the latter half of the 20th century. | High elevation areas may potentially experience increased snowfall as a result of increasing winter precipitation. Basins with low elevation snow may experiences snowpack declines as more precipitation falls as rain. |
| Hydrological shifts | Declining summer streamflows have been recorded in all basin types since 1950. | *Streamflow*: winter streamflows will likely increase in all basins, while summer flows will likely decrease as a result of reduced summer precipitation and shifts in snowpack.<br>*Runoff*: mean annual runoff is projected to increase over the course of the century due to increased winter precipitation, with winter streamflow increases and summer streamflow decreases. Individual stream response will largely depend on basin classification (Table 3), elevation, aspect, and groundwater influx, among other factors |
| Flood risk and erosion | Variability in 20th century cool season precipitation increased flood risk in rain-dominant and transient basins. | Increases in extreme precipitation and winter precipitation could increase flood risk and erosion significantly in transient basins, with slight increases possible rain-dominant basins (Table 3). |
| Drought risk | The Pacific Northwest has experienced several droughts over the last decade, some of which are attributed to reduced winter and/or summer precipitation.[8] | Declines in summer precipitation will likely exacerbate drought stress caused by increasing temperatures and evapotranspiration. |

[8] Bumbaco, K. A., & Mote, P. W. (2010). Three recent flavors of drought in the Pacific Northwest. *Journal of Applied Meteorology and Climatology, 49*(9), 2058-2068.

| Secondary Impact | Observed Change | Projected Change |
|---|---|---|
| Soil moisture changes | July 1 soil moisture trends have been variable from 1943-2003, and warmer areas (e.g., the Washington coast) have experienced declines. | July 1 soil moisture is largely projected to decline across Washington State (-15 to -18% by 2080) although directions and rates of change vary depending on location. For example, areas west of the Cascades are projected to experience decreased soil moisture, while some areas east of the Cascades will experience soil moisture increases as increased winter precipitation/snowpack at the highest elevations recharges moisture in deep soil horizons. |
| Wildfire risk | Drier conditions have contributed to increasing wildfire frequency and extent in the Pacific Northwest since the 1970s. | Precipitation variability (particularly drier summers) and water-deficit increases over the next century will likely contribute to increasing fire frequency, severity, intensity, and total area burned in the Pacific Northwest, although the magnitude of change will likely vary by eco-region, vegetation type, and suppression effort. |
| Insect and disease risk | Moisture stress has contributed to higher forest vulnerability and mortality from insects and disease. | Insect and disease risk will likely increase with drier conditions. |

**Table 3. Historic behavior and future projected responses of various watershed types in Washington State.** *Modified from Elsner et al. (2009, pgs. 70, 92) and Climate Impacts Group (2012, pg. 5)*

| Watershed classification | Historic characteristics | Future projected responses |
|---|---|---|
| *Rain dominant* | • Peak streamflow in winter with peak precipitation (November-January)<br>• Low summer streamflow | • Slightly increased winter streamflows and flood risk<br>• Decreased summer low flows |
| *Snowmelt dominant* | • Peak streamflow with spring/early summer snowmelt (May-July)<br>• Low winter streamflow | • Slightly increased winter and spring streamflows<br>• Minimal shifts in flood risk<br>• Earlier and reduced summer peak and low flows<br>• May transition to transient classification |
| *Transient* | • Two streamflow peaks, one with peak precipitation (winter) and one with snowmelt (spring/early summer) | • Larger and more consistent winter streamflows<br>• Increased flood risk<br>• Earlier and reduced and/or loss of snowmelt-associated summer streamflows, decreased low flows<br>• May transition to rain dominant classification |

*Examples of impacts of changes in precipitation on habitats and species:*

- Shifts in soil moisture and nutrient and energy fluxes may contribute to changes in habitat distributions (e.g., declines in pine forests, Douglas fir, subalpine forests, sagebrush steppe due to moisture stress; prairie expansions due to tolerance of xeric conditions), driving shifts in wildlife habitat availability and species distributions.
- Shifts in vegetation productivity (e.g., moisture and nutrient deficits can undermine productivity).
- Increased nutrient loss due to increasing extreme precipitation events and elevated runoff.
- Decreased fuel moisture content may increase wildfire risk, affecting vegetation distribution and composition and forest-dependent wildlife species.
- Reduced annual low flows may increase aquatic organism vulnerability to water pollution and heat stress, and affect salmon and steelhead migration and reproductive success.
- Changes in frequency and severity of flood risk, affecting riparian vegetation community composition and structure, fish habitat (e.g., bull trout), and aquatic organism exposure to water pollution (e.g., sediments, pathogens, and pollutants).
- Increases in mountain pine beetle vulnerability and forest disease susceptibility due to moisture stress.

***Water Temperature***

Freshwater temperature

Stream temperatures in the northwest United States experienced a net increase from 1980-2009 largely as a result of increasing air temperatures, with rates of summer warming of 0.22°C per decade.[9] Spring and summer stream temperatures are projected to continue increasing across the state,[10,11] including increases in the frequency and duration of unfavorable temperature events (periods with water temperatures >21°C). These trends will be particularly pronounced in eastern Washington (Yakima River), the Columba River (near Bonneville Dam), the Lower Snake River, and in western Washington (Stillaguamish River, Lake Washington, Lake Union). Similar to streamflow, stream temperature changes will vary according to location, groundwater input, topography, and other factors.

*Secondary impacts*:[12] Shifts in freshwater temperature have caused significant changes in other environmental variables, and will likely continue to alter these factors in the future (Table 4).

**Table 4**. Observed and projected changes of secondary impacts caused by warming freshwater temperatures.

| Secondary Impact | Observed Change | Projected Change |
|---|---|---|
| Stratification and hypoxia | Lake and reservoir stratification is occurring earlier as a result of warmer water temperatures, extending the length of summer stratification. Stratification causes lower dissolved oxygen levels and stresses aquatic species.[13] | Enhanced spring/summer lake stratification, reduced primary productivity, and reduced oxygen solubility, contributing to increasing incidence of hypoxia. |
| Algal blooms | Longer algal growing seasons observed with warmer temperatures. | Increased likelihood of lake algal blooms. |
| Range shifts | Bull trout have exhibited range contractions to higher, cooler refugia in the Rocky Mountains in response to warmer temperatures.[14] | Cool- and cold-water habitats will likely shift further upstream. The range of warm-adapted aquatic invaders will likely expand. |

[9] Isaak, D. J., Wollrab, S., Horan, D., & Chandler, G. (2012). Climate change effects on stream and river temperatures across the northwest U.S. from 1980–2009 and implications for salmonid fishes. *Climatic Change, 113*(2), 499-524.

[10] Beer, W., & Anderson, J. (2011). Sensitivity of juvenile salmonid growth to future climate trends. *River Research and Applications, 27*(5), 663-669.

[11] Mantua, N., Tohver, I., & Hamlet, A. (2010). Climate change impacts on streamflow extremes and summertime stream temperature and their possible consequences for freshwater salmon habitat in Washington State. *Climatic Change, 102*(1-2), 187-223.

[12] Includes observed and projected physical, ecological, and biological changes.

[13] Mantua, N., Tohver, I., & Hamlet, A. (2009). Impacts of climate change on key aspects of freshwater salmon habitat in Washington State. *Washington Climate Change Impacts Assessment: Evaluating Washington's future in a changing climate. Climate Impacts Group, University of Washington, Seattle, Washington*.

[14] Eby, L. A., Helmy, O., Holsinger, L. M., & Young, M. K. (2014). Evidence of climate-induced range contractions in Bull Trout Salvelinus confluentus in a Rocky Mountain watershed, USA. *PloS one, 9*(6), e98812.

| | | |
|---|---|---|
| Phenological shifts | Fish migration (e.g., lamprey) has been documented to occur earlier in years with warmer and lower streamflow. Predator-prey mismatch has caused mortality and population declines of some freshwater species. | Continued or exacerbated behavioral changes, affecting migration, spawning timing, and/or foraging success and survival. |

*Examples of impacts of warmer water temperatures on habitats and species:*

- Declines in suitable aquatic habitat and prey availability, and exceed fish thermal limits, contributing to increased fish kills, undermined fish health (e.g., enhanced disease susceptibility), altered reproductive success, and/or inhibited migration.
- Upstream shift in suitable stream habitat for many aquatic species, potentially reducing overall habitat availability. These shifts will be largest in flat rivers and smallest in steeper streams, and most pronounced in transient river basins.
- Enhanced vulnerability to aquatic invasive species, which can displace, compete with, or prey upon native aquatic biota.
- Increased fish metabolic and growth rates provided enough food and oxygen is available.

Ocean temperature

Global sea surface temperatures have increased 0.6°C (1.1°F) since 1950, but no significant ocean warming offshore of North America was observed between 1900-2008, except in localized areas (e.g., west of Vancouver Island). However, northwest ocean temperatures are projected to increase 1.22°C (2.2°F) by the 2040s. Projections for coastal ocean temperatures are less clear due to high natural variability and upwelling influence.

*Secondary impacts*:[15] Shifts in ocean temperature have caused significant changes in other environmental variables, and will likely continue to alter these factors in the future (Table 5).

**Table 5**. Observed and projected changes of secondary impacts caused by warming ocean temperatures.

| Secondary Impact | Observed Change | Projected Change |
|---|---|---|
| Stratification and altered ocean circulation | Increased stratification, reducing vertical mixing and affecting primary productivity. | Further stratification and altered ocean mixing, affecting primary productivity. Shifts in upwelling also expected as temperatures gradients between land and sea change. |
| Algal blooms | Highest bloom activity with warmer water temperatures in Puget Sound.[16] Prolonged growth. | More frequent, earlier and longer algal blooms.[18] |

[15] Includes observed and projected physical, ecological, and biological changes.

[16] Moore, S. K., Mantua, N. J., Hickey, B. M., & Trainer, V. L. (2009). Recent trends in paralytic shellfish toxins in Puget Sound, relationships to climate, and capacity for prediction of toxic events. *Harmful Algae, 8*(3), 463-477.

| | | |
|---|---|---|
| | season and enhanced competitive advantage for dinoflagellate algal blooms, increasing bloom duration and toxicity.[17] | |
| Lower dissolved oxygen | Reduced oxygen delivery to deeper waters. | Decreased oxygen levels in the open ocean and coastal waters. |
| Reduced primary productivity | Reductions in primary productivity, expansion in surface water area with low phytoplankton biomass. | Potential reductions in primary productivity, leading to hypoxic conditions and marine food web alterations. |

*Examples of impacts of changes in ocean temperature on habitats and species:*

- Altered abundance, distribution, and composition of marine and coastal species (e.g., reduced salmon and squid abundance, northward shift of sardines).
- Altered prey availability (e.g., reduced surface prey for foraging seabirds).
- Phenological shifts, including developmental changes, age to sexual maturity, growth, and spawning changes.
- Enhanced disease risk and invasive species spread.

***Sea Level***

Global sea levels rose 1.8 (+/- 5) mm/yr between 1961-2003, with rates accelerating to 3.1 (+/- 0.7) mm/yr in the last decade of observation. In the Pacific Northwest, sea levels are largely increasing, although some areas are experiencing decreases. Rates of sea level rise are projected to continue increasing globally over the next century,[18] and Washington State could experience increases of +4 to +56 inches by 2100 (relative to 2000). However, there will be high local variability caused by vertical land deformation (i.e., uplift and subsidence), seasonal ocean elevation change (i.e., wind-enhanced sea level rise during winters and El Niño events), and other factors (e.g., groundwater withdrawal). For example, Puget Sound is projected to keep pace with global sea level rise and experience the most sea level rise by the end of the century (Table 2). The northwest Olympic Peninsula, which is experiencing significant uplift (>2 mm/yr), will see much lower increases and/or declines in sea level by 2100. The central and southern coasts, which may be experiencing moderate uplift (0-2 mm/yr), will likely experience sea level increases with magnitudes in between the other two regions during the same time period. Across the state, these general trends will fluctuate depending on changes in atmospheric circulation and wind patterns, short- and long-term land deformation events, and ice loss rates in Greenland and Antarctica. For example, sea levels can fluctuate up to 12 inches according to the El Niño Southern Oscillation or the Pacific Decadal Oscillation.

*Secondary impacts*:[19] Shifts in sea level have caused significant changes in other environmental variables, and will likely continue to alter these factors in the future (Table 6).

[17] Moore, S. K., Trainer, V. L., Mantua, N. J., Parker, M. S., Laws, E. A., Backer, L. C., & Fleming, L. E. (2008). Impacts of climate variability and future climate change on harmful algal blooms and human health. *Environmental Health, 7*(2), S4.

[18] Projected rates of global sea level rise vary, but many studies project that global sea levels will rise somewhere between 2-4 ft during the 21st century.

[19] Includes observed and projected physical, ecological, and biological changes.

**Table 6**. Observed and projected changes of secondary impacts caused by warming freshwater temperatures.

| Secondary Impact | Observed Change | Projected Change |
|---|---|---|
| Shoreline erosion/loss | Erosion rate varies by location. | Higher sea levels will generally increase erosion and/or expose new areas to erosion, contributing to shoreline loss and forced inland migration of coastal habitats. |
| Saltwater intrusion | Aquifer saltwater intrusion already occurring in some locations (e.g., Whidbey Island).[20] | More frequent saltwater intrusion into coastal aquifers and wetlands may compromise water quality and force habitat conversion to more salt-tolerant species. |
| Storm surge | Increased beach erosion with winter storms and larger wave heights. | Higher sea levels could allow storm surges to reach new areas, causing more frequent inundation and erosion. |

*Examples of impacts of sea level rise on habitats and species:*

- Shifts in coastal habitat extent and quality as a result of increased inundation and erosion (e.g., beaches, tidal flats, coastal wetlands may decline, marshes may expand).
- Habitat or breeding ground loss for some species (e.g., shorebirds), habitat increases for other species (e.g., marsh associates).
- Shifts in species composition and biodiversity in coastal habitats, as well as shifts in species interactions.
- Larger marine food webs may be affected if important food species or habitat (e.g., estuarine nursery) is lost.
- Increases in salinity associated with sea level rise may facilitate invasive species spread in estuaries and/or stress freshwater coastal species.

***Water Chemistry***

<u>Oxygen</u>

The coastal waters of Washington state have been experiencing seasonal hypoxic conditions since at least 1950,[21] and feature the lowest recorded dissolved oxygen (DO) levels of the California Current System.[22] Hypoxic conditions are most common during the upwelling season (May-October), with DO

[20] Huppert, D. D., Moore, A., & Dyson, K. (2009). Impacts of climate change on the coasts of Washington State. *Washington Climate Change Impacts Assessment: Evaluating Washington's Future in a Changing Climate*, 285-309.

[21] Connolly, T., Hickey, B., Geier, S., & Cochlan, W. (2010). Processes influencing seasonal hypoxia in the northern California Current System. *Journal of Geophysical Research: Oceans (1978–2012), 115*(C3).

[22] Peterson, J. O., Morgan, C. A., Peterson, W. T., & Lorenzo, E. D. (2013). Seasonal and interannual variation in the extent of hypoxia in the northern California Current from 1998–2012. *Limnology and Oceanography, 58*(6), 2279-2292.

levels fluctuating according to the DO content of upwelled waters, runoff nutrient input, and primary productivity.[19] Coastal hypoxia episodes may increase as a result of climate change due to warmer sea surface temperatures, which affect oxygen solubility, and intensified upwelling as a result of shifting wind patterns.[23]

*Secondary impacts*:[24] Shifts in oxygen availability have caused significant changes in other environmental variables, and will likely continue to alter these factors in the future (Table 7).

**Table 7**. Observed and projected changes of secondary impacts caused by warming freshwater temperatures.

| **Secondary Impact** | **Observed Change** | **Projected Change** |
|---|---|---|
| Dead zones | Increasing frequency and prevalence of hypoxic dead zones in coastal areas since 1960.[25] | More frequent and persistent low oxygen conditions due to warming and elevated stratification, with potential expansion into shallower waters. This is especially a concern in Hood Canal. |

*Examples of impacts of changes in oxygen on habitats and species:*

- Altered aquatic organism behavior, health, growth, reproductive success, and survival.
- Altered aquatic organism distribution and composition; sessile organisms may be less able to migrate in response to changing hypoxic conditions.
- Impaired biological, ecological, and biogeochemical processes.
- Altered prey availability.
- Reduced oxygen availability due to increased algal blooms, further contributing to hypoxic conditions.
- Increased sensitivity to pollutants and contaminants.

Acidity (pH)

Global ocean surface pH has declined 0.1 units since 1750, with rates of -0.02 units/yr in the past two decades.[26] Since 1800, outer coastal water acidity in Washington State has increased 10-40%, translating to a pH decline of -0.05 to -0.15. Global ocean surface pH, as well as pH in the North Pacific, is projected to decline an additional -0.2 to -0.3 units by 2100, translating to a 100-150% increase in ocean acidity.[27]

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[23] Morgan, E., & Siemann, D. (2010). Climate Change Effects on Marine and Coastal Habitats in Washington State *Prepared for the Ecosystems, Species, and Habitats Topic Advisory Group*. Available at: http://dfwwbolyhq01.dfw.wa.gov/conservation/climate_change/publications/marine_coastal_climate_science_summary.pdf

[24] Includes observed and projected physical, ecological, and biological changes.

[25] Diaz, R. J., & Rosenberg, R. (2008). Spreading dead zones and consequences for marine ecosystems. *Science, 321*(5891), 926-929.

[26] Feely, R. A., Doney, S. C., & Cooley, S. R. (2009). Ocean acidification: present conditions and future changes in a high-CO2 world. *Oceanography, 22*(4), 37-47.

[27] Feely, R. A., Alin, S. R., Newton, J., Sabine, C. L., Warner, M., Devol, A., . . . Maloy, C. (2010). The combined effects of ocean acidification, mixing, and respiration on pH and carbonate saturation in an urbanized estuary. *Estuarine, Coastal and Shelf Science, 88*(4), 442-449.

*Secondary impacts*:[28] Shifts in acidity have caused significant changes in other environmental variables, and will likely continue to alter these factors in the future (Table 8).

**Table 8**. Observed and projected changes of secondary impacts caused by changes in pH.

| Secondary Impact | Observed Change | Projected Change |
|---|---|---|
| Dead zones | Increasing frequency and prevalence of hypoxic dead zones in coastal areas since 1960;[29] exacerbates and exacerbated by acidification.[30] | pH decreases will contribute to the formation of dead zones. |
| Algal blooms | Increased growth and/or toxicity of algal blooms observed in more acidic waters.[31] | Increased acidity may contribute to more algal blooms.[32] |
| Nutrient and metal solubility | Lowered calcium-carbonate saturation states. | pH can change the quantity of available nutrients; too many nutrients may cause plant overgrowth and as the plants decompose, dissolved oxygen levels lower even further. More acidic water typically increases the solubility of heavy metals, making these metals more toxic to species. |

*Examples of impacts of changes in pH on habitats and species:*

- Reduced shellfish populations due to calcium carbonate declines.
- Reduced ability for plankton to form calcium carbonate shells, significantly affecting marine food webs and the survival, growth, and reproductive capacity of fish populations.
- Increased growth rates of seagrass.
- Increased risk of invasive species establishment.

[28] Includes observed and projected physical, ecological, and biological changes.
[29] Diaz, R. J., & Rosenberg, R. (2008). Spreading dead zones and consequences for marine ecosystems. *Science, 321*(5891), 926-929.
[30] Cai, W.-J., Hu, X., Huang, W.-J., Murrell, M. C., Lehrter, J. C., Lohrenz, S. E., . . . Wang, Y. (2011). Acidification of subsurface coastal waters enhanced by eutrophication. *Nature Geoscience, 4*(11), 766-770. Cai, W.-J., Hu, X., Huang, W.-J., Murrell, M. C., Lehrter, J. C., Lohrenz, S. E., . . . Wang, Y. (2011). Acidification of subsurface coastal waters enhanced by eutrophication. *Nature Geoscience, 4*(11), 766-770.
[31] Moore, S. K., Mantua, N. J., Hickey, B. M., & Trainer, V. L. (2009). Recent trends in paralytic shellfish toxins in Puget Sound, relationships to climate, and capacity for prediction of toxic events. *Harmful Algae, 8*(3), 463-477.

**Table 9.**

**Summary of key climate factors, trends, observed and projected changes, and compounding factors in Washington State.**

| Climate Factor | General Trend | Observed Changes | Projected Changes | Compounding Factors[*********] |
|---|---|---|---|---|
| Air temperature | Increasing | +0.13°F/decade (1895-2011)<br><br>Pacific Northwest (1920-2000):<br>• Annual: +0.91°C (1.64°F)<br>• Summer: +1.07°C (1.93°F)<br>• Winter: +1.83°C (3.3°F)<br>• Spring: +0.57°C (1.03°F)<br>• Fall: +0.18°C (0.32°F) | Increases, with warming most severe in summer<br><br>Pacific Northwest (relative to 1970-99):<br>2020s<br>• Annual: +1.1°C (2.0°F)<br>• Summer: +1.3-1.7°C (2.3-3.1°F)<br>• Winter: +1.1-1.2°C (2.0-2.2°F)<br>• Spring: +1.0°C (1.8°F)<br>• Fall: +1.0-1.1°C (1.8-2.0°F)<br><br>2040s<br>• Annual: +0.91°C (1.64°F)<br>• Summer: +1.9-2.7°C (3.4-4.9°F)<br>• Winter: +1.6-1.9°C (2.9-3.4°F)<br>• Spring: +1.4-1.7°C (2.5-3.1°F)<br>• Fall: +1.5-2.0°C (2.7-3.6°F)<br><br>2080s<br>• Annual: +3.0°C (5.3°F)<br>• Summer: +3.0-4.5°C (5.4-8.1°F)<br>• Winter: +2.7-3.3°C (4.9-5.9°F)<br>• Spring: +2.1-2.8°C (3.8-5.0°F)<br>• Fall: +2.4-3.4°C (4.3-6.1°F) | • Natural climatic patterns, such as the El Niño-Southern Oscillation (ENSO) and Pacific Decadal Oscillation (PDO)<br>• Increasing electrical demand for cooling and water demand for irrigation<br>• Human development |
| Precipitation | Variable | No significant trend | Annual precipitation will be variable, but there will be declines in summer precipitation<br><br>Pacific Northwest (relative to 1970-99)<br>2020s<br>• Annual: +1% (-9 to +12%)<br>• Winter: +2% (-14 to +23%) | • ENSO/PDO<br>• Increasing electrical demand for cooling and water demand for irrigation |

********* Compounding factors or synergistic effects that may exacerbate or ameliorate the effects of climate change on habitats and species.

| Climate Factor | General Trend | Observed Changes | Projected Changes | Compounding Factors********* |
|---|---|---|---|---|
| | | | • Summer: -6% (-30 to +12%)<br><br>2040s<br>• Annual: +2% (-11 to +12%)<br>• Winter: +3% (-13 to +27%)<br>• Summer: -8% (-30 to +17%)<br><br>2080s<br>• Annual: +4% (-10 to +20%)<br>• Winter: +8% (-11 to +42%)<br>• Summer: -13% (-38% to +14%) | |
| Snowpack | ↓ | Pacific Northwest: Significant declines (average -25%) during latter half of 20th century. Recent increases likely due to natural variability. | Further declines (-53% to -65% by 2080). Snowpack losses will be greatest at lower elevations and more modest at higher elevations. | • ENSO/PDO |
| Snowmelt | Earlier | Cascade Mountains: occurred 0-30 days earlier (depending on location) during latter half of 20th century. | Will occur increasingly earlier by 2050. | • ENSO/PDO |
| Drought | increasing | Pacific Northwest: experienced several droughts since 2001. Droughts attributed to several causes including: warmer temperatures, reduced snowpack and earlier snowmelt, and reduced winter and/or summer precipitation. | Increasing across the state, particularly in summer, even with potential increases in winter precipitation. | • Water withdrawals<br>• Changes in land use and land cover |
| Streamflow/runoff | Variable | Snow-dominant and transient basins: earlier snowmelt runoff, leading to lower summer base flows.<br>Rain-dominant: variable depending on annual precipitation. | Earlier streamflow timing in snow-dominant and transient basins. Annual runoff is projected to increase slightly, with increases in winter streamflow and declines in summer streamflows. Potential shifts from snow-dominant to transient or rain-dominant basins. | • ENSO/PDO<br>• Groundwater and soil moisture influence<br>• Topography<br>• Adjacent land use<br>• Water resources infrastructure |

| Climate Factor | General Trend | Observed Changes | Projected Changes | Compounding Factors********* |
|---|---|---|---|---|
| | | | | • |
| Wildfire risk | increasing | Wildfire frequency and extent have been increasing in the Pacific Northwest since the 1970s. | Increased fire frequency, severity, intensity, and total area burned. Magnitude of change will likely vary by eco-region, vegetation type, and suppression effort. | • ENSO/PDO<br>• Fire suppression<br>• Drought stress<br>• Invasive species and disease compromising tree/vegetation health |
| Freshwater temperature | ↑ | Net increase from 1980-2009; summer warming rate increased 0.22°C per decade | Increasing across the state, including increases in frequency and duration of unfavorable temperature events (periods with water temperatures >21°C) | • Low streamflows (caused by climate and/or water withdrawals)<br>• Water resources infrastructure (e.g., dams)<br>• Changes in land use and land cover |
| Ocean temperature | ↑ | Global: increased 0.6°C (1.1°F) since 1950<br><br>North America: no significant trends (1900-2008); some warming in localized areas (e.g., west of Vancouver Island) | Northwest ocean temperatures to increase 1.22°C (2.2°F) by the 2040s | • ENSO/PDO<br>• Changes in land use and land cover |
| Sea level | ↑, some areas ↓ | Global: increased 1.8 (±0.5) mm/yr between 1961-2003; rates accelerated to 3.1 (±0.7) mm/yr from 1993-2001<br><br>Washington:<br>• Friday Harbor: +0.4 in/decade<br>• Neah Bay: -0.7 in/decade (1934-2008)<br>• Seattle: +0.8 in/decade (1900-2008) | Continued increases, although some areas will experience decreases<br><br>Washington: +4 to +56 in by 2100<br>- Northwest Olympic Peninsula:<br>• 2050: 0 in (-5 to +14 in)<br>• 2100: +2 in (-9 to +35 in)<br>- Central & Southern Coast<br>• 2050: +5 in (+1 to +18 in)<br>• 2100: +11 in (+2 to +43 in)<br>- Puget Sound<br>• 2050: +6 in (+3 to +22 in)<br>• 2100: +13 in (+6 to +50 in) | • Habitat degradation of existing coastal habitat via dredging, development, pollution, and coastal modifications<br>• Sediment supply changes<br>• Development and natural barriers<br>• Land subsidence<br>• Storm wave heights<br>• ENSO/PDO |

| Climate Factor | General Trend | Observed Changes | Projected Changes | Compounding Factors********* |
|---|---|---|---|---|
| | | | | |
| Oxygen concentrations | ↓ | Seasonal hypoxia since at least 1950 during upwelling periods (May-October) | Increase due to warmer sea surface temperatures/decreased oxygen solubility and intensified upwelling | • Nutrient runoff (e.g., nitrogen)<br>• Freshwater input<br>• Reduced upwelling<br>• Stratification<br>• Removal of vegetation |
| pH | ↓ | Ocean surface pH declined 0.1 units since 1750; outer coastal acidity increased 10-40% | Decrease an additional -0.2 to -0.3 units by 2100 | • Nutrient inputs from runoff<br>• Fishing pressure<br>• Habitat destruction |

## 3. SGCN Vulnerability Rankings

### Mammal Vulnerability Rankings

| MAMMALS | | | | | | |
|---|---|---|---|---|---|---|
| **Species** | **Overall Vulnerability** | **Overall Confidence** | **Sensitivity Rank** | **Exposure Rank** | **Summary of Exposure** | **Summary of Sensitivity** |
| American Badger | Moderate | Low | Moderate | Moderate | > Increased temperatures<br>> Changes in precipitation<br>> Reduced soil moisture<br>> Altered fire regimes<br>> Increased invasive weeds | Overall, there is a lack of information about the sensitivity of the American Badger to climate change. In general, sensitivity of this species appears to be driven by prey and habitat specialization. It occurs in shrub-steppe, grassland, and semi-desert habitats, requires friable soils for burrows, and preys primarily on ground squirrels and pocket gophers. Warmer, drier conditions that harden soils may negatively affect the American Badger or its prey species' ability to burrow. Warmer and drier conditions may allow grassland expansion, creating more habitat for this species. However, warmer, drier conditions that lead to more frequent and hotter fires and/or encourage the growth of invasive weeds (e.g. cheatgrass) may degrade or alter natural habitat for this species. Altered fire regimes in the Columbia Basin will likely negatively impact some prey species such as ground squirrels. |
| American Pika | High | High | High | Moderate-High | > Increased temperatures<br>> Reduced snowpack<br>> Shifts from snow to rain | The American Pika displays high sensitivity because of its preferred habitat type and condition, very low reproductive rate, and limited dispersal ability. The American Pika requires a moderate amount of snowpack in order to provide insulation during the winter months; decreasing snowpack because of rising temperatures and shifting precipitation patterns with more rain than snow will negatively impact this species. American Pika have high energetic demands, partly because they do not hibernate; increasing temperatures and extreme heat events may affect this species’ ability to forage during the day. In addition, climate change will likely alter the composition of vegetation in montane habitats; this shift may be to plant species less suited to the species’ nutritional needs. |
| Bighorn Sheep | Moderate | High | Moderate | Moderate | > Increased temperatures<br>> Reduced snowpack<br>> Earlier snowmelt | Warmer temperatures may reinforce thermoregulatory behavior of Bighorn Sheep in order to minimize heat stress (e.g. foraging on northern and easterly slopes). Warmer temperatures, reduced snowpack and earlier snowmelt may increase foraging opportunities by extending the growing and foraging season and increasing the upper limits of plant growth (e.g. grass); increased foraging opportunities |

| MAMMALS | | | | | | |
|---|---|---|---|---|---|---|
| **Species** | **Overall Vulnerability** | **Overall Confidence** | **Sensitivity Rank** | **Exposure Rank** | **Summary of Exposure** | **Summary of Sensitivity** |
| | | | | | > Altered fire regimes | could potentially increase lamb survival. However, reduced snowpack and earlier snowmelt may also increase predation risk by allowing earlier predator access to subalpine/alpine habitats and/or by increasing predator cover via tree encroachment. Fire may moderate tree encroachment, thereby maintaining forage habitat and reducing predator risk. |
| Black-tailed Jackrabbit | Moderate | Moderate | Moderate | Moderate | > Altered fire regimes<br>> Changes in wind<br>> Increased invasive weeds<br>> Increased disease outbreaks | The Black-tailed Jackrabbit occupies habitats with a wide temperature range and minimal moisture levels (e.g. grassland, scrub, desert); they are highly capable of thermoregulating and conserving water. They are sensitive to disturbance regimes, such as fire and wind; widespread fires can remove vegetation that provides nesting and thermal cover and foraging species, while wind has been shown to affect this species feeding behavior. Increased invasive weeds (e.g. cheatgrass) have little to no forage value for this species and may contribute to increased fire, further eliminating important sagebrush habitat. Climate change may amplify effects of disease and parasites on this species. |
| Blue Whale | Low-Moderate | High | Low-Moderate | Moderate | > Increased ocean temperatures<br>> Altered circulation and/or upwelling patterns<br>> Declines in pH | Due to their migratory patterns and the wide range of ocean conditions they experience, Blue Whales are unlikely to have physiological sensitivity to climate-induced ocean changes (e.g. increased sea surface temperature, decreased pH). Their overall sensitivity will be higher due to potential changes in their primary prey, euphausiids. Blue Whales require large aggregations of euphausiids for optimal foraging, and euphausiid conditions are strongly linked with oceanographic variability. Cooler, upwelling waters support high primary production and thus euphausiid biomass, while warmer waters like those found during positive Pacific Decadal Oscillations cycles or strong El Niño lead to lower primary productivity and decreased euphausiid abundance. Therefore, increases in sea surface temperature or changes in ocean circulation, as well as declines in pH, could lead to declines in euphausiid abundance and limited prey availability for Blue Whales. Additionally, changes in peak primary productivity and euphausiid abundance could lead to alterations in Blue Whale migration timing. |
| Brush Prairie Pocket Gopher | Low-Moderate | Low | Low-Moderate | Low-Moderate | > Increased temperatures<br>> Changes in | There is no information on the sensitivity of the Brush Prairie Pocket Gopher to climate change. There is some evidence that pocket gophers in general may be sensitive to changes in temperature and precipitation |

| MAMMALS | | | | | | |
|---|---|---|---|---|---|---|
| **Species** | **Overall Vulnerability** | **Overall Confidence** | **Sensitivity Rank** | **Exposure Rank** | **Summary of Exposure** | **Summary of Sensitivity** |
| | | | | | precipitation<br>> Reduced soil moisture | that affect soil moisture and hardness, which impacts pocket gopher digging activity (i.e. burrows include foraging tunnels and chambers for nesting and food caching). |
| Cascade Red Fox | High | High | High | Moderate-High | > Increased temperatures<br>> Reduced snowpack<br>> Altered fire regimes | The Cascade Red Fox is presumably adapted to colder climates, and is restricted to alpine and subalpine ecosystems and high elevation meadows. The overall sensitivity of this species to climate change is likely driven by their dependence on these colder, high elevation habitats. Warmer temperatures and reduced snowpack may negatively impact this species by further contracting suitable habitat ranges and/or facilitating movement of Coyotes (potential competitor and predator) into the range of Cascade Red Foxes. Altered fire regimes that degrade or eliminate alpine and subalpine habitat is also likely to negatively impact this species. |
| Columbian White-tailed Deer | Moderate | Moderate | Moderate | Moderate | > Increased flooding<br>> Sea level rise<br>> Increased extreme precipitation events<br>> Increased disease outbreaks | Occupying riparian habitats, bottomlands, and tidelands, Columbian White-tailed Deer are vulnerable to periodic habitat loss and subsequent population declines due to flooding. Past flood events have caused significant population reductions, followed by slow recovery. Consistent or consecutive yearly flooding and inundation as a result of sea level rise and/or shifting storm frequencies and intensities could significantly threaten the persistence of various populations, potentially forcing migration to marginal habitat areas. However, current efforts to translocate deer and establish new populations along the lower Columbia River increases overall population resilience to flooding and inundation impacts. Sea level rise and shifts in precipitation that elevate groundwater tables may also affect available forage by extending the range of relatively unpalatable reed canary grass. Reduced habitat or forage quality as a result of climate change could also increase deer vulnerability to various diseases. |
| Destruction Island Shrew | Low-Moderate | Low | Moderate | Low-Moderate | > Reduced soil moisture<br>> Increased extreme events | Limited information is available regarding the biology and ecology of Destruction Island Shrews and their potential response to climate change. This species is likely sensitive to climate-driven changes in prey availability (e.g. insects, spiders, worms, centipedes) and habitat suitability (e.g. vegetation cover). For example, soil moisture may affect burrowing and/or suitability and availability of grassland habitat. In addition, as this species is endemic to Destruction Island, it is likely |

| MAMMALS | | | | | | |
|---|---|---|---|---|---|---|
| Species | Overall Vulnerability | Overall Confidence | Sensitivity Rank | Exposure Rank | Summary of Exposure | Summary of Sensitivity |
| | | | | | | vulnerable to extirpation during extreme events and/or unfavorable climatic periods. |
| Fin Whale | Low-Moderate | Moderate | Low-Moderate | Moderate | > Increased ocean temperatures<br>> Declines in pH | Fin Whales are likely to have low sensitivity to changes in ocean temperature and other changing oceanographic conditions (e.g. pH, salinity) due to their migratory patterns and exposure to varying ocean conditions. However, the prey they feed on, such as euphausiids and copepods, may experience population declines as a result of increases in ocean temperature and decreases in pH. Limited prey availability could lead to decreased Fin Whale fecundity and population declines, though they may be able to adapt by switching target prey species (e.g. feeding more on small finfish as opposed to krill) depending on abundance. |
| Fisher | Moderate | Moderate | Moderate | Moderate | > Increased temperatures<br>> Reduced snowpack<br>> Altered fire regimes<br>> Increased insect and disease outbreaks | Fishers exhibit some physiological sensitivity to temperature, as they behaviorally avoid extreme daily high temperatures by foraging during cooler periods of the day and seeking cooler habitats (e.g. dense canopies, riparian areas). Fishers also appear sensitive to snowpack; deep snow limits fisher movement, particularly juvenile dispersal. Reductions in snowpack could increase successful juvenile winter dispersal, alter competitive interactions (e.g. with Pacific Marten), or enhance predatory success. Warmer, drier conditions as well as altered fire regimes and insect and disease outbreaks that affect habitat extent and structural complexity influence the sensitivity of this species. Some disturbance (e.g. wind, fire, insects & disease) helps to create important habitat structures (e.g. snags, downed logs, den sites) while disturbances outside the natural range of variability may negatively impact this species. |
| Gray Whale | Moderate | High | Moderate | Moderate | > Increased ocean temperatures<br>> Declines in pH | Due to their migratory patterns and broad range of habitat, Gray Whales are unlikely to be sensitive to changes in ocean temperature or chemistry. However, their sensitivity will be increased by potential changes in prey abundance. Decreases in pH could lead to declines in small invertebrates that Gray Whales feed on. Additionally, temperature increases could also lead to declines in invertebrate prey. For Atlantic Gray Whale populations, increases in sea surface temperature were thought to cause declines in amphipods, a primary prey for gray Whales, leading to decreases in Gray Whale survival. At the northern end of their range in Alaska, Gray Whales may also experience disruptions in timing |

| MAMMALS | | | | | | |
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| **Species** | **Overall Vulnerability** | **Overall Confidence** | **Sensitivity Rank** | **Exposure Rank** | **Summary of Exposure** | **Summary of Sensitivity** |
| | | | | | | and distribution of food sources due to earlier season sea ice melt and increases in sea surface temperature. Gray Whales may also be sensitive to losses in key breeding habitat, like coastal lagoons in Mexico, due to sea level rise. |
| Gray Wolf | Low-Moderate | Moderate | Low-Moderate | Moderate | > Altered fire regimes<br>> Increased insect and disease outbreaks | The Gray Wolf is a habitat and diet generalist. This species can thrive in a variety of habitats at different elevations, including forests, tundra, deserts, swamps, mountains, and prairies, where they feed mainly on a wide range of ungulate prey (small mammals, fish, and livestock are only a small portion of prey for most wolves). They require large, contiguous habitats and are therefore somewhat vulnerable to habitat fragmentation that restricts connectivity or brings them into great contact with people. Gray Wolves also display high reproductive and dispersal capacity. Their sensitivity to climate change will depend largely on the vulnerability of ungulate prey to disturbance regimes such as fire and disease; prey abundance may decline with larger and more intense fires and/or forest die off from insects as well as timber harvest. |
| Gray-tailed Vole | N/A | N/A | Unknown | N/A | None known | There is no information on the sensitivity of Gray-tailed Voles to climate change. |
| Grizzly Bear | Moderate | High | Moderate | Moderate | > Increased temperatures<br>> Earlier snowmelt<br>> Changes in precipitation timing | Grizzly Bears are diet generalists, feeding on a variety of food items, which may decrease overall sensitivity of this species. However, where and how food sources change could potentially exacerbate human/bear conflict and mortality. Additionally, warmer temperatures, delayed snowfall, and earlier snowmelt may alter the timing of den entry and exit, which could increase the potential for bear/human conflicts in spring and fall. Altered fire regimes may remove important habitat but could also open up new areas. |
| Hoary Bat | Low-Moderate | Low | Low-Moderate | Moderate | > Altered fire regimes<br>> Changes in precipitation | The Hoary Bat displays low physiological sensitivity with a generalist's diet and a broad geographic distribution in both coniferous and deciduous forests across a wide temperature gradient from 32 to 71°F at elevations from 0 to 5315 feet in the Pacific Northwest. It is moderately sensitive to disturbance regimes, including fire and disease (e.g. white-nose syndrome). In general, climate changes that affect roosting and foraging habitat could negatively impact this species. For example, altered fire regimes could degrade or eliminate roosting habitats. Warmer, drier conditions as well as altered fire regimes and |

| MAMMALS | | | | | | |
|---|---|---|---|---|---|---|
| **Species** | **Overall Vulnerability** | **Overall Confidence** | **Sensitivity Rank** | **Exposure Rank** | **Summary of Exposure** | **Summary of Sensitivity** |
| | | | | | | increased invasive weeds may affect the availability of foraging resources to Hoary Bats. Changes in precipitation and/or water availability near maternity sites could affect reproductive output. |
| Humpback Whale | Low-Moderate | High | Low-Moderate | Moderate | > Increased ocean temperatures<br>> Declines in pH | Humpback Whales migrate over great distances and occupy a broad range of ocean conditions; they are thus unlikely to have high physiological sensitivity to changes in ocean conditions. However, they are likely to have increased sensitivity due to potential declines in preferred food sources, such as small krill like euphausiids. Humpback Whale populations have been shown to be found in areas with high euphausiid production, thus any changes or declines in this food source (e.g. declining pH or increasing ocean temperatures) could have negative impacts on Humpback Whales such as decreased reproductive success and lower fecundity. Additionally, Humpback Whales often use shallow coastal lagoons for breeding; thus, sea level rise and potential loss of coastal habitat could also negatively influence this species. |
| Keen's Myotis | Moderate-High | High | Moderate-High | Moderate | > Increased temperatures | Keen's Myotis has a specialist's diet and its sensitivity is therefore tightly linked to both the timing and abundance of its prey. This species does not migrate, which makes it very sensitive to changes in microclimate, especially during winter hibernation; changes in temperature that drive the timing and length of winter hibernation could result in a mismatch in timing of insect prey availability and emergence from hibernation. It has a small geographic distribution; however, field identification of this species is difficult because of strong similarities with the western long-eared myotis, making statements about distribution, population size, and trends less certain. Cooler temperatures may energetically stress this species. |
| Killer Whale | Southern residents: Moderate-High; Transient/ Offshore: Low-Moderate | High | Southern residents: Moderate Transient/ Offshore: Low-Moderate | Southern residents: Moderate-High; Transient/ Offshore: Moderate | > Increased ocean and fresh water temperatures<br>> Increased precipitation<br>> Increased runoff<br>> Declines in | Some Killer Whale populations occupy a wide temperature range; thus these are unlikely to experience physiological sensitivity to increasing ocean temperatures. However, their overall climate sensitivity is much higher due to potential declines in prey abundance. For the southern resident populations in particular, since they feed primarily on Chinook salmon, declines in Chinook abundance (stemming from a number of climate factors, such as increases in sea surface and fresh water temperature or higher levels of precipitation and runoff) could lead to decreases in survival and fecundity of southern resident Killer Whales. |

| MAMMALS | | | | | | |
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| **Species** | **Overall Vulnerability** | **Overall Confidence** | **Sensitivity Rank** | **Exposure Rank** | **Summary of Exposure** | **Summary of Sensitivity** |
| | | | | | pH | The transient population feeds on other marine mammals and has a larger variety of targeted prey and thus may be less sensitive; however, climate-induced changes in marine food webs (e.g. declines in small crustaceans that other marine mammals feed on due to acidification) could lead to declines in prey availability for transients. The offshore population is thought to feed mainly on sharks and other fish, but better dietary information is needed to draw firmer conclusions on impacts. |
| Kincaid Meadow Vole | Low-Moderate | Low | Low-Moderate | Moderate | > Increased temperatures<br>> Changes in precipitation | There is no information on the sensitivity of Kincaid Meadow Voles to climate change. In general, this species likely does not exhibit much physiological sensitivity to climate change. Their association with damp meadows, marshy areas along creeks, and around lakes in the Columbia Basin seems likely to increase this subspecies' sensitivity if warmer and drier conditions degrade or eliminate these habitats in this region. |
| Lynx | High | High | High | High | > Increased temperatures<br>> Reduced snowpack<br>> Earlier snowmelt<br>> Altered fire regimes<br>> Increased insect and disease outbreaks | Lynx exhibit sensitivity to warming temperatures, decreased snowpack and earlier snowmelt, and altered fire regimes. Lynx are reliant on consistent snowpack during winter months for hunting, which provides them a competitive advantage over other predators. Lynx are usually considered hare specialists; increasingly variable timing of the arrival and melting periods of snowpack may lead to local extirpations of Snowshoe Hares, potentially affecting Lynx survivorship and recruitment. However, Lynx have been known to switch prey items when hares are limiting. Altered fire regimes and insect and disease outbreaks that reduce mature stands, early seral-stage coniferous stands and/or dense understory cover further increases the sensitivity of this species. |
| Mazama Pocket Gopher | Low-Moderate | Moderate | Low-Moderate | Moderate | > Increased temperatures<br>> Reduced soil moisture<br>> Increased invasive species<br>> Altered fire regimes | There is little to no information on the sensitivity of the Mazama Pocket Gopher to climate change. Mazama Pocket Gophers may exhibit some sensitivity to warmer, drier soil moisture conditions that make burrowing more challenging. Sensitivity of this species may be enhanced if invasive species such as Scotch broom increase under future climate conditions. However, prairie and grassland habitats may expand under future climate conditions (e.g. altered fire regimes that prevent conifer encroachment and/or adaptations to warmer, drier conditions), potentially benefitting this species. |
| Merriam's | Low- | Low | Low- | Moderate | > Drought | Merriam's Shrews likely have low physiological sensitivity to climate |

| MAMMALS | | | | | | |
|---|---|---|---|---|---|---|
| **Species** | **Overall Vulnerability** | **Overall Confidence** | **Sensitivity Rank** | **Exposure Rank** | **Summary of Exposure** | **Summary of Sensitivity** |
| Shrew | Moderate | | Moderate | | > Increased flooding<br>> Altered fire regimes | change, but may be sensitive to climate-driven changes in prey (e.g. small invertebrates) and habitat (e.g. arid shrub, shrub-steppe, and grasslands) availability. This species inhabits drier habitats than other shrew species, but may be sensitive to shifts in habitat availability due to drought, flooding, and fire, as well as habitat conversion (e.g. for agriculture). |
| Minke Whale | Low-Moderate | Moderate | Low-Moderate | Moderate | > Increased ocean temperatures<br>> Declines in pH | Though limited information is available regarding the sensitivity to climate change of Minke Whales in the North Pacific, given their migration patterns and the wide range of conditions they experience, they are unlikely to have direct physiological sensitivity to climate-induced changes in ocean conditions. Their sensitivity will be higher due to potential fluctuations in preferred prey availability, like forage fish (e.g. Pacific Herring) and krill. Though warmer ocean temperatures could lead to declines in herring availability, studies have shown that Minke Whales are generalists and easily switch between different types of prey depending on abundance, which allows them to adjust well to seasonal variability in prey. Potential declines in krill abundance (e.g. declines in pH) could also increase sensitivity of Minke Whales. |
| North Pacific Right Whale | Moderate | Moderate | Moderate | Moderate | > Declines in pH<br>> Altered circulation and/or upwelling patterns | Limited information is available regarding the sensitivity of North Pacific Right Whales to climate change. In general, their overall sensitivity is likely due to changes in abundance of their primary prey, copepods. Because North Pacific Right Whales are limited in the type of prey they can consume and require large aggregations of copepods for optimal feeding, declines in copepod production that could be triggered by changing ocean circulation or potential decreases in pH could greatly impact North Pacific Right Whales. Decreases in copepod abundance could lead to decreased calf and adult survival. |
| Northern Bog Lemming | Moderate-High | High | Moderate-High | Moderate-High | > Increased temperatures<br>> Changes in precipitation<br>> Drought<br>> Altered fire regimes | The Northern Bog Lemming's physiological sensitivity to climate is likely moderate-high, as populations may have historically been reduced in size and number when the climate was warmer and the species is moderately restricted to relatively cool or cold environments in most of its range. Additionally, Washington is at the very southern edge of the species' geographic range, which may increase sensitivity to warming temperatures. The overall sensitivity of this species is likely driven by their dependence on cold, moist habitats such as peatlands and |

| MAMMALS | | | | | | |
|---|---|---|---|---|---|---|
| Species | Overall Vulnerability | Overall Confidence | Sensitivity Rank | Exposure Rank | Summary of Exposure | Summary of Sensitivity |
| | | | | | | sphagnum moss, which are sensitive to changes in temperature and precipitation that lead to reduced moisture. Altered fire regimes that degrade or eliminate habitat may also impact this species. |
| Olympic Marmot | Moderate-High | High | Moderate-High | Moderate-High | > Increased temperatures<br>> Reduced snowpack<br>> Altered fire regimes | Olympic Marmots' sensitivity to climate is likely driven by their association with subalpine meadows that are vulnerable to increasing temperatures and reduced snowpack that result in habitat alterations (e.g. increased forest encroachment into meadows). Altered fire regimes may benefit subalpine meadows by preventing conifer encroachment. Olympic Marmots are also indirectly sensitive to climate change through effects on their primary predator, Coyotes. Warmer winters and lower snowpack are thought to allow Coyotes to persist at higher elevations than they could otherwise, increasing their predation on Olympic Marmots. Some evidence suggests that Olympic Marmots may also be directly sensitive to changes in snowpack; prolonged spring snow cover may be detrimental to survival and reproduction while sparse winter snow cover increases winter mortality. |
| Pacific Marten (Coastal population) | Moderate-High | High | Moderate-High | Moderate-High | > Reduced snowpack<br>> Altered fire regimes<br>> Drought | Sensitivity of the Pacific Marten to climate change will likely be driven by its habitat specificity and reliance on deep snowpack. Altered fire regimes and/or drought that result in reductions in the distribution and connectivity of important habitat features (e.g. large diameter tree stands with high canopy cover) may negatively impact this species. Pacific Martens rely on deep and persistent snowpack to exclude predators, provide high-quality hunting conditions, and provide winter resting and denning sites. Future reductions in snowpack may affect both the Pacific Marten and its prey species due to creation of more thermally variable subnivean space, and may alter Pacific Marten spatial distributions and/or competition with Fishers. |
| Preble's Shrew | Low-Moderate | Low | Low-Moderate | Moderate | > Changes in precipitation<br>> Altered fire regimes<br>> Increased invasive weeds | Limited information is available regarding the biology and ecology of Preble's Shrews and their potential response to climate change. Preble's Shrews appear to occupy a variety of habitat types throughout their range, but may be vulnerable to climate changes (e.g. precipitation, fire) that affect occupied habitat in Washington and/or prey availability (e.g. insects). Further expansion of cheatgrass could be detrimental to this species. |
| Pygmy Rabbit | Moderate- | Moderate | Moderate- | Moderate | > Altered fire | The Pygmy Rabbit is sensitive to changes in fire regimes such as extent |

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| Species | Overall Vulnerability | Overall Confidence | Sensitivity Rank | Exposure Rank | Summary of Exposure | Summary of Sensitivity |
| | High | | High | | regimes<br>> Increased invasive weeds | and frequency, especially fire-driven spread of the invasive cheatgrass that degrades the species' primary habitat and food source, sagebrush. Climate change will cause more frequent, intense, and larger wildfires. There are documented declines in Pygmy Rabbit populations with climate-driven changes in sagebrush habitat over the last 4,000 years. |
| Sea Otter | Low-Moderate | Moderate | Low-Moderate | Moderate | > Increased ocean temperatures<br>> Declines in pH<br>> Increased winter storm intensity and high surf conditions | Limited information is available regarding the response of Sea Otters to climate change. Their sensitivity will be primarily due to changes in prey abundance (e.g. Red Urchins, clams, bivalves), particularly since Sea Otters require large amounts of prey (approximately 30% of their body mass per day) to meet their metabolic requirements. Sea Otter prey may be sensitive to decreases in pH, and declines in prey abundance could impact Sea Otters, though their sensitivity may not be as high due to their ability to switch between prey species. Additionally, increasing temperatures could promote survival of marine bacterial pathogens that infect Sea Otters and cause mortality, though there are high levels of uncertainty regarding the level of increase in and potential effects of bacterial pathogens on sea otters. Sea Otters may also be sensitive to increased winter storm intensity and resulting high surf conditions that could result in higher mortality. |
| Sei Whale | Low-Moderate | Low | Low-Moderate | Low-Moderate | > Increased ocean temperatures<br>> Altered circulation and/or upwelling patterns | Though very limited information is available regarding the sensitivity of Sei Whales to climate change, it is likely that their main sensitivity will be due to any changes in their preferred prey species (zooplankton [e.g. copepods], squid, and small schooling fish). Sei Whales feed primarily on zooplankton and are found in areas with high zooplankton concentrations; thus, any changes in zooplankton abundance, which could be caused by increases in sea surface temperature or changes in ocean circulation patterns, could limit prey availability for Sei Whales. However, because Sei Whales are able to target multiple types of prey, they may be less sensitive to changes in zooplankton abundance and may be able to switch to other prey species (e.g. small forage fish). |
| Shaw Island Townsend's Vole | N/A | N/A | Unknown | N/A | None known | There is no information on the sensitivity of Shaw Island Townsend's Voles to climate change. |
| Silver-haired Bat | Low-Moderate | Low | Low | Moderate | > Altered fire regimes | The Silver-haired Bat has a broad geographic distribution throughout North America and displays a preference for old-growth forests and |

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| Species | Overall Vulnerability | Overall Confidence | Sensitivity Rank | Exposure Rank | Summary of Exposure | Summary of Sensitivity |
| | | | | | | riparian areas between 0 to 6000 feet in elevation, although they also use caves and abandoned mines. There are both migratory individuals and year-round residents in Washington; during spring migration, there has been documented mortality at wind energy facilities. In general, climate changes that affect roosting and foraging habitat could negatively impact this species. For example, altered fire regimes that degrade or eliminate tree-roosting habitats such as large trees and snags may affect the Silver-haired Bat. |
| Sperm Whale | Low-Moderate | Moderate | Low-Moderate | Low-Moderate | > Increased ocean temperatures<br>> Altered circulation and/or upwelling patterns | Though limited information is available regarding the sensitivity of Sperm Whales to climate change, their overall sensitivity is likely to be influenced by changes in the availability of their primary prey, squid. For Sperm Whales in the Gulf of California, abundance was linked to distribution and abundance of squid, and in the North Sea, higher sea surface temperatures and declines in squid abundance were thought to have potential links to increased Sperm Whale strandings. Thus, potential declines in squid populations (which could be prompted by changes in sea surface temperature or ocean circulation) could impact Sperm Whale populations. Given that males and females tend to occupy different habitats and ranges (with females preferring warmer, more southerly waters and males having a broader range), male and female Sperm Whales may exhibit different levels of sensitivity. |
| Spotted Bat | Low-Moderate | Low | Low-Moderate | Low-Moderate | > Changes in precipitation<br>> Altered fire regimes | The Spotted Bat occupies a wide range of habitats in Washington from forests (e.g. ponderosa pine, Douglas-fir) and shrub-steppe to cliffs and water sources (e.g. marshes, open water, riparian areas) from 1000 to 2800 feet in elevation. There is limited information about this species' population size and trends and reproductive and wintering behavior, although there is some evidence that the Spotted Bat moves to lower elevations to overwinter. They appear to roost almost exclusively in the crevices of steep cliffs, which may make them vulnerable to recreational rock climbing or other manmade or natural destruction of cliff habitat (e.g. road construction, rockslides). Changes in precipitation that limit water availability directly or result in a decrease of prey could negatively affect this species. Increased fire and shrub-steppe degradation in the Columbia Basin could reduce habitat quality for this species. |
| Townsend's | Moderate- | Moderate | Moderate- | Moderate | > Increased | Townsend’s Big-eared Bats are found throughout much of the western |

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| **Species** | **Overall Vulnerability** | **Overall Confidence** | **Sensitivity Rank** | **Exposure Rank** | **Summary of Exposure** | **Summary of Sensitivity** |
| Big-eared Bat | High | | High | | temperatures<br>> Changes in precipitation<br>> Altered fire regimes<br>> Drought | United States; the species' distribution appears to be tightly linked to the presence of suitable roosting habitat and hibernacula located near foraging habitat. Roosting habitat selection is driven by temperatures within structures; in Washington, this habitat includes lava tube caves, mines, old buildings, bridges, and concrete bunkers. Increased temperatures may therefore reduce the availability of suitable hibernacula, forcing this species to move out of its current range to higher elevations or latitudes. Approximately 90% of the Townsend's Big-eared Bat's diet is composed of moths, making this species sensitive to prey availability (e.g. pesticides used to control outbreaks of moths). Altered disturbance regimes such as fire and drought that can destroy habitat will likely negatively impact this species. Changes in precipitation that limit water availability directly or result in a decrease of prey could negatively affect this species. In arid regions, periods of drought near maternity sites could affect reproductive output. |
| Townsend's Ground Squirrel | Moderate | Moderate | Moderate | Moderate | > Increased temperatures<br>> Changes in precipitation<br>> Drought<br>> Altered fire regimes<br>> Increased invasive species | Sensitivity of Townsend's Ground Squirrel is likely driven by their association with shrub-steppe, sagebrush, and grassland habitats. Warmer temperatures and changes in precipitation, including drought, could alter the phenology of important food plants, affecting the Townsend's Ground Squirrel's ability to accumulate adequate fat reserves before hibernation. Warmer, drier conditions that lead to more frequent and hotter fires and/or encourage the growth of invasive weeds (e.g. cheatgrass) may degrade or alter natural habitat for this species. Some evidence suggests that those individuals occurring in sagebrush habitat may be less sensitive to the impacts of drought (e.g. less decline in persistence and density, produce young) than those occurring in grassland habitats. |
| Washington Ground Squirrel | Moderate | Moderate | Moderate | Moderate | > Increased temperatures<br>> Changes in precipitation<br>> Drought<br>> Altered fire regimes<br>> Increased | Similar to Townsend's Ground Squirrel, sensitivity of Washington Ground Squirrels is likely driven by their association with shrub-steppe and grassland habitats, although they are able to inhabit a number of habitat subtypes which may decrease sensitivity. Warmer temperatures and changes in precipitation, including drought, could alter the quality and quantity of important forage plants, affecting juvenile survival as well as the ability to accumulate adequate fat reserves before hibernation. A series of drought years reduced the occurrence of |

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| **Species** | **Overall Vulnerability** | **Overall Confidence** | **Sensitivity Rank** | **Exposure Rank** | **Summary of Exposure** | **Summary of Sensitivity** |
| | | | | | invasive species | Washington Ground Squirrels in 1994. Warmer, drier conditions that lead to more frequent and hotter fires and/or encourage the growth of invasive weeds (e.g. cheatgrass) may degrade or alter natural habitat for this species. |
| Western Gray Squirrel | Low-Moderate | Moderate | Low-Moderate | Moderate | > Increased temperatures<br>> Changes in precipitation<br>> Altered fire regimes<br>> Increased disease outbreaks | Sensitivity of the Western Gray Squirrel in Washington is partially driven by their association with Oregon white oak habitats. Habitat quality in Washington is generally thought to be relatively poor due to a lower number of large-seeded, mast-bearing tree species, affecting Western Gray Squirrel population numbers. However, Oregon white oak habitats are projected to expand under warmer, drier conditions and may benefit Western Gray Squirrels in Washington. Altered fire regimes that further degrade habitat quality increase the sensitivity of this species. For example, the large Carlton Complex fire in the Okanogan in 2014 destroyed Western Gray Squirrel habitat and caused direct mortality to the species. Additionally, this species is sensitive to disease outbreaks (e.g. mange, Western equine encephalitis virus), which could become more frequent with warmer temperatures. |
| Western Spotted Skunk | Low | Low | Low | N/A | None known | There is little to no information on the sensitivity of the Western Spotted Skunk to climate change. Overall, it appears that this species exhibits low sensitivity due to its generalist diet and ability to occupy different habitats (e.g. wooded areas, tallgrass prairies, rocky canyons). |
| White-tailed Jackrabbit | Moderate | Moderate | Moderate | Moderate | > Drought<br>> Altered fire regimes | The White-tailed Jackrabbit appears to be fairly tolerant of a wide temperature range in a variety of habitats within a broad range of elevations from 130 to 14000 feet, including prairie grassland, shrubland steppe, and montane shrublands. In areas in which populations of the White-tailed and Black-tailed Jackrabbits overlap and compete, the White-tailed Jackrabbit tends to move to higher elevations. Drought conditions that alter foraging habitats (e.g. bunchgrasses, rabbitbrush) may negatively impact this species. Altered fire regimes in the Columbia Basin could negatively affect this species. |
| Wolverine | Moderate-High | High | High | Moderate | > Increased temperatures<br>> Reduced snowpack | Wolverines exhibit sensitivity to temperature and declines in snowpack. Wolverines are obligatorily associated with persistent spring snow cover, which provides critical thermal advantages such as predator refugia for denning females and young, preventing competition with other scavengers, and important prey caching/refrigeration areas. |

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| **Species** | **Overall Vulnerability** | **Overall Confidence** | **Sensitivity Rank** | **Exposure Rank** | **Summary of Exposure** | **Summary of Sensitivity** |
| | | | | | | Temperature appears to play a role in fine-scale habitat selection, and may affect prey caching success. Warming temperatures and declines in snowpack could lead to decreased habitat patch size, quality, and connectivity; reduced success of caching/refrigeration of carrion prey with subsequent impacts on survivorship and recruitment; limited den sites and/or loss of thermal refugia important for juvenile survival; and/or increased dispersal costs. |
| Woodland Caribou | High | High | High | High | > Increased temperatures<br>> Changes in precipitation<br>> Altered fire regimes<br>> Reduced snowpack<br>> Earlier snowmelt<br>> Increased insect and disease outbreaks | Woodland Caribou occupy higher elevations and rely on old-growth Engelmann spruce/subalpine fir and western redcedar/western hemlock forests that support arboreal lichens, which constitute a large portion of the Woodland Caribou diet. In combination with fire, warmer temperatures, precipitation changes, climate-driven increases in forest disease and insect mortality, and reduced snowpack and earlier snowmelt are likely to alter suitable habitat and predation risk for Woodland Caribou. Fire creates younger-age stands and edge habitat that attract deer, elk, and Moose; higher ungulate densities increases associated predator density, and these predators (e.g. bears, Gray Wolves, Cougars) prey opportunistically on Woodland Caribou. Woodland Caribou require deep, consolidated snow for movement at higher elevations during winter. Reduced snowpack and earlier snowmelt will affect the seasonal movements of Woodland Caribou and other ungulates, likely increasing predation risk by extending the length of time Woodland Caribou share habitat with other ungulates. In general, warmer and drier conditions will favor the expansion of deer, elk, and Moose by increasing overwinter survival, exacerbating predation risk and shifts in Woodland Caribou habitat. |

Please be in touch if you'd like to view the excel spreadsheet.

## Bird Vulnerability Rankings

| BIRDS | | | | | | |
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| **Species** | **Overall Vulnerability** | **Overall Confidence** | **Sensitivity Rank** | **Exposure Rank** | **Summary of Exposure** | **Summary of Sensitivity** |
| American White Pelican | Low | Moderate | Low | Low | > Increases in precipitation that lead to flooding | American White Pelicans may be sensitive to climate change through changes to their breeding habitat. Increases in precipitation could affect flooding regimes in lakes and potentially limit nesting areas, although this species is highly adapted to take advantage of changing situations. Sensitivity may be increased by direct physiological responses to increases in temperature, such as potential vulnerability of chicks and juveniles to higher temperatures and earlier migration timing of adults, although this is highly uncertain. |
| Bald Eagle | Low-Moderate | Moderate | Low-Moderate | Moderate | > Altered fire regimes<br>> High wind events<br>> Increased temperatures<br>> Changes in precipitation/ Altered hydrology | Bald Eagles may experience some sensitivity due to habitat and foraging requirements. Nest sites may be affected by altered disturbance regimes (e.g. fire and wind) while warmer temperatures and changes in precipitation could limit food availability and quality (i.e. salmon carcasses). However, Bald Eagles are opportunistic foragers and may be able to switch prey species. |
| Band-tailed Pigeon | Low-Moderate | Low | Low-Moderate | Low-Moderate | > Increased temperatures<br>> Changes in precipitation<br>> Altered fire regimes<br><br>> This species is considered "climate threatened" (i.e. projected to lose >50% of current global range | Very little information exists regarding sensitivity of Band-tailed Pigeons to climate change. In general, this species may exhibit some sensitivity due to habitat requirements. Warmer temperatures and changes in precipitation that lead to declines in water levels may adversely affect this species. Similarly, altered fire regimes that lead to loss of forested habitat could negatively impact the species. |

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| **Species** | **Overall Vulnerability** | **Overall Confidence** | **Sensitivity Rank** | **Exposure Rank** | **Summary of Exposure** | **Summary of Sensitivity** |
| | | | | | by 2080) in the Audubon Birds and Climate Change Report. | |
| Barrow's Goldeneye | Moderate-High | Moderate | Moderate -High | Moderate -High | > Altered fire regimes<br>> Declines in pH and dissolved oxygen<br>> Reduced snowpack | Barrow's Goldeneye dependence on specific nesting, breeding, and wintering sites significantly increases this species' sensitivity to climate change. Disturbances such as fire could result in nesting tree loss, and changes in water chemistry (e.g. dissolved oxygen, pH) or temperature may lead to declines in food availability (e.g. mussels, aquatic insects, crustaceans, clams, etc.). Diminished snowpack that leads to wetland drying could also impact this species. |
| Black Scoter | Moderate | Low | Moderate | Moderate | > Increased ocean temperatures<br>> Declines in pH, salinity, and/or dissolved oxygen | Very limited information is available regarding sensitivity of Black Scoter to climate change, particularly in Washington. Generally, this species appears to exhibit some sensitivity to climate change due to potential impacts on food availability. For example, changes in sea surface temperature, oxygen, salinity, and/or pH could lead to declines in marine forage (e.g. Pacific Herring, mussels). |
| Brown Pelican | Low-Moderate | Moderate | Low-Moderate | Moderate | > Sea level rise<br>> Increased ocean temperatures<br>> Altered circulation and/or upwelling patterns | Brown Pelicans are likely to have low physiological sensitivity to climate change. Their sensitivity may be increased by disturbances to coastal roosting sites from rising sea levels (e.g. sandbars and sand spits), which could limit availability of preferred roosting sites and force Brown Pelicans to select lower-quality roosting sites further away from foraging areas, though Brown Pelicans have been shown to adapt well to habitat disturbances. Sensitivity will also be affected by changes in preferred prey availability (e.g. Pacific Sardines, mackerel), which are likely to shift depending on ocean circulation patterns, such as El Niño Southern Oscillation (ENSO) and Pacific Decadal Oscillation (PDO). Warmer ocean temperatures and decreases in coastal upwelling could lead to declines in small forage fish, and thus limited prey availability for Brown Pelicans. |

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| **Species** | **Overall Vulnerability** | **Overall Confidence** | **Sensitivity Rank** | **Exposure Rank** | **Summary of Exposure** | **Summary of Sensitivity** |
| Burrowing Owl | Low-Moderate | Low | Low-Moderate | Low-Moderate | > Increased temperatures<br>> Changes in precipitation | Burrowing Owls may exhibit low to moderate sensitivity due to climatic effects on breeding ranges, and decreasing habitat availability from land development pressures. Temperature-driven changes may cause this species to lose up to 77% of its existing breeding range and alter its winter range with only 33% remaining intact by 2080. Although temperature and precipitation changes may affect the availability of its preferred prey (insects), the Burrowing Owl has a generalist's diet, including other birds, small mammals (e.g. mice, voles), frogs, salamanders, and snakes. This species also depends upon other species such as American Badgers, prairie dogs and ground squirrels to create its nesting burrows. |
| Cinnamon Teal | Moderate | Low | Moderate | Moderate | > Increased temperatures<br>> Reduced snowpack<br>> Altered hydrology | Very limited information is available regarding sensitivity of Cinnamon Teal to climate change, particularly in Washington. Generally, their overall sensitivity is likely due to potential impacts on habitat availability and quality. Habitat factors such as amount of food and floods (i.e. spring floods and American Beavers) have been linked to breeding success. Declines in snowpack or altered flow regimes that affect these habitat factors could impact the number of Cinnamon Teal broods. If this species exhibits low phenotypic plasticity in terms of timing of breeding (i.e. less able to track environmental change), climate warming could also affect its breeding success due to timing mismatch. |
| Clark's Grebe | Moderate | Low | Moderate | Moderate | > Declines in pH<br>> Changes in water level (e.g. water drawdowns or declines in precipitation) | Though there is limited information available regarding the sensitivity of Clark's Grebe to climate change, their primary sensitivity will occur through potential changes in small fish and invertebrate prey species that they target. Declines in pH could lead to declines in invertebrate prey and changes in water level in lakes and marshes could also lead to declines in available prey. This species also exhibits some sensitivity to fluctuating water level (high or low), which could lead to loss of eggs and nesting sites. In Washington, greater water drawdowns in reservoirs (i.e. because of expanded agricultural irrigation caused by climate change) may lead to increased nest loss. |
| Columbian Sharp-tailed Grouse | Moderate | Moderate | Moderate | Moderate | > Increases in spring precipitation | Columbian Sharp-tailed Grouse may exhibit some physiological sensitivity as young chicks may experience mortality due to prolonged wet spring weather. Overall sensitivity of this species is likely driven by |

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| **Species** | **Overall Vulnerability** | **Overall Confidence** | **Sensitivity Rank** | **Exposure Rank** | **Summary of Exposure** | **Summary of Sensitivity** |
| | | | | | > Altered fire regimes<br>> Changes in precipitation overall<br>> Increased invasive weeds | habitat specialization (e.g. grassland or shrub-steppe). Habitat suitability for this species could decrease or shift in response to altered fire regimes, invasive species spread (i.e. cheatgrass), and/or changes in precipitation. |
| Common Loon | Low-Moderate | Low | Moderate | Low-Moderate | > Increased temperatures (air and ocean)<br>> Altered global climate patterns (i.e. El Niño) | Though limited information is available regarding the sensitivity of Common Loons to climate change, they may experience some direct sensitivity to climate change through northward contractions of their range with increasing temperatures and altered migration timing. Their sensitivity may be increased by changes to their prey and habitat. For instance, Pacific Herring, a primary food source for Common Loons, have previously experienced declines during El Niño years, leading to high mortality for Common Loons. More frequent and stronger El Niño conditions could lead to greatly decreased food supply for Common Loons. |
| Dusky Canada Goose | Low-Moderate | Low | Low-Moderate | Low-Moderate | > Uncertain. Loss of agricultural foraging habitats is primary threat. Winter wheat production is likely to increase in the short-term. | The physiological sensitivity of this species is likely low. However, their overall sensitivity may be slightly higher due to their winter habitat and foraging requirements. Changes in food abundance and availability on wintering grounds such as agricultural crop lands could affect mortality and survival rates, although impacts of climate change on these habitats is unclear. |
| Ferruginous Hawk | Low-Moderate | Low | Low-Moderate | Low-Moderate | > Drought<br>> Increased storminess and winds | Little to no information exists regarding Ferruginous Hawk physiological sensitivity to temperature and precipitation. Overall sensitivity of this species may be enhanced due to prey specialization (i.e. jackrabbits, cottontail rabbits, ground squirrels, prairie dogs, pocket gophers) and habitat requirements (i.e. grasslands). Droughts that lead to declines in prey may adversely affect this species. Warmer |

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| **Species** | **Overall Vulnerability** | **Overall Confidence** | **Sensitivity Rank** | **Exposure Rank** | **Summary of Exposure** | **Summary of Sensitivity** |
| | | | | | | temperatures may benefit this species due to grassland expansion. Increased extreme weather events (e.g. heavy rain and high winds) may affect hawk reproduction and survival. |
| Flammulated Owl | Moderate | Moderate | Moderate | Moderate | > Increased temperatures<br>> Changes in precipitation<br>> Altered fire regimes | Flammulated Owls may be sensitive to temperature and moisture; upper limits of Flammulated Owl occupancy may be set by low nocturnal temperatures or high humidity, while lower limits may be set by high diurnal temperatures or high humidity. In addition, changes in temperature may alter the availability of primary prey species (e.g. insects), which may influence their distribution. Flammulated Owls are habitat specialists, requiring old-growth ponderosa pine and/or Douglas-fir stands, making them vulnerable to changes in habitat extent and quality due to shifting wildfire regimes, precipitation changes, and habitat loss or degradation. |
| Golden Eagle | Moderate | High | Moderate | Moderate | > Increased temperatures<br>> Altered fire regimes | Golden Eagles may experience some sensitivity to warmer temperatures. For example, nest success and brood size is inversely related to days with temperatures >90°F. Sensitivity of this species is also influenced by foraging requirements (e.g. prey abundance and habitat), which can affect nest success and ability to lay eggs. Golden Eagles prey on hares, rabbits, ground squirrels, prairie dogs, and marmots, among others, and their ability to forage can be negatively affected when prey habitat is lost (e.g. wildfires) and/or prey abundance declines. |
| Great Gray Owl | Moderate | Low | Moderate | Moderate | > Increased temperatures<br>> Altered fire regimes<br>> High wind events | The plumage of Great Gray Owls may make this species somewhat sensitive to warmer temperatures, although featherless portions of the Great Gray Owl's underwing may help dissipate heat. Great Gray Owls may also exhibit some sensitivity to disturbance regimes such as fire and wind that destroy suitable habitat. |
| Greater Sage-grouse | Moderate-High | Moderate | Moderate -High | Moderate | > Drought and/or moisture stress<br>> Increased | Greater Sage-grouse may exhibit some physiological sensitivity to drought conditions, which could result in decreased nest success and/or reduced chick survival. However, their overall sensitivity will be higher due to habitat and foraging requirements. Changes that reduce the availability and quality of sagebrush habitat (e.g. increased |

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| **Species** | **Overall Vulnerability** | **Overall Confidence** | **Sensitivity Rank** | **Exposure Rank** | **Summary of Exposure** | **Summary of Sensitivity** |
| | | | | | temperatures<br>> Altered fire regimes | temperatures, drought and/or moisture stress, altered fire regimes), which Greater Sage-grouse depend on for forage, nesting, and brood-rearing, will adversely impact this species. |
| Harlequin Duck | Moderate-High | Low | Moderate -High | Moderate -High | > Changes in precipitation (timing and amount)<br>> Earlier snowmelt<br>> Increased flood events<br>> Increased water temperatures<br>> Declines in pH | The overall sensitivity of this species is likely moderate-high due to habitat (i.e. inland freshwater areas for breeding and coastal areas for wintering) and forage (i.e. aquatic invertebrates, Pacific Herring spawn) specialization. Breeding habitats and success as well as forage could be altered by flood events, while changes in temperature and pH could affect availability of key forage species. Additionally, earlier snowmelt can result in phenological mismatch with Harlequin Duck breeding ecology. |
| Lewis' Woodpecker | Low-Moderate | Moderate | Low-Moderate | Moderate | > Increased temperatures<br>> Altered fire regimes | Warmer temperatures and precipitation changes influence sensitivity of Lewis' Woodpecker by affecting prey availability and habitat extent. Warmer temperatures are linked with higher surface-bark insect abundance and enhanced forage opportunities, which are thought to control the timing of Lewis' woodpecker breeding more than photoperiod. Altered wildfire regimes may affect habitat extent, although this species is often classified as a specialist in burned pine forest habitat. |
| Loggerhead Shrike | Low | Moderate | Low | Low-Moderate | > Increased temperatures<br>> Drought<br>> Increased storminess and/or high wind events | Loggerhead Shrikes likely exhibit low physiological sensitivity to climate change, although very little information currently exists on this topic. They are more sensitive to changes in prey abundance, habitat availability, and competition as a result of climate change. Loggerhead Shrikes prey on insects, reptiles, and small mammals and birds; insect prey, in particular, may vary in availability in response to temperature and drought. Loggerhead Shrikes favor open habitats with low-stature vegetation and available trees and shrubs for nesting; prairie/grassland habitats may expand with climate change, benefitting this species. They also successfully inhabit many altered systems (e.g. agricultural |

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| **Species** | **Overall Vulnerability** | **Overall Confidence** | **Sensitivity Rank** | **Exposure Rank** | **Summary of Exposure** | **Summary of Sensitivity** |
| | | | | | | fields). Wind, drought, and/or cold/wet weather events may contribute to nest or brood loss from nest damage or shifts in prey availability. |
| Long-tailed Duck | Low-Moderate | Low | Low-Moderate | Moderate | > Increased ocean temperatures<br>> Sea level rise<br>> Declines in dissolved oxygen and pH | Very limited information is available regarding sensitivity of Long-tailed Ducks to climate change, particularly in Washington. Generally, Long-tailed Ducks may exhibit some sensitivity to climate change due to potential impacts on food availability. Increases in temperature or sea level as well as changes in water chemistry that affect food sources such as Pacific Herring, crustaceans, mussels, etc. could impact this species. |
| Marbled Godwit | Moderate | Moderate | Moderate | Moderate | > Increased temperatures<br>> Sea level rise | Marbled Godwits may experience some phenological sensitivity to increases in air temperature, as warmer temperatures could alter their migration timing and length of overwintering season in Washington. Temperature-induced alterations in migration timing may also affect breeding season timing and productivity. Overall sensitivity will be higher due to their dependence on intertidal sand and mudflats as foraging sites, which may decrease in extent due to sea level rise and coastal inundation. Because of their long legs, Marbled Godwits may be able to withstand coastal sea level changes by foraging in deeper waters. |
| Marbled Murrelet | Moderate | Moderate | Moderate | Moderate | > Increased ocean temperatures<br>> Increased storminess and winds<br>> Altered fire regimes | The main sensitivities of Marbled Murrelets to climate change will likely be due to potential changes in prey availability and habitat. Increasing sea surface temperatures could lead to declines in target prey abundance (e.g. Pacific Herring, Pacific Sand Lance, crustaceans) and declines in Marbled Murrelet productivity, though their ability to target multiple types of prey may help this species adapt to shifts in prey abundance. Alterations in nesting habitat, which occurs in inland mature and old growth forests, could also lead to declines in populations. Potential increased storminess and higher winds could impact nesting sites, as could drier, warmer conditions that lead to increased fires and more fragmented habitat for nesting. |
| Mountain Quail (Eastern WA only) | Moderate | Low | Moderate | Moderate | > Increased temperatures<br>> Changes in precipitation | Mountain Quail inhabit dry areas and are dependent upon surface and preformed water availability. They exhibit sensitivity to increased temperatures or changes in precipitation that limit water supply. Increased fire severity and frequency that results in the conversion of |

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| **Species** | **Overall Vulnerability** | **Overall Confidence** | **Sensitivity Rank** | **Exposure Rank** | **Summary of Exposure** | **Summary of Sensitivity** |
| | | | | | > Altered fire regimes | suitable habitat also increases the overall sensitivity of this species. |
| Northern Spotted Owl | Moderate-High | Moderate | Moderate -High | West-side: Moderate East-side: Moderate -High | > Increased temperatures<br>> Altered fire regimes<br>> Increased insect outbreaks | This species exhibits some sensitivity to increased temperatures both directly (i.e. physiologically) and indirectly through effects on prey availability. This species also exhibits some sensitivity to altered disturbance regimes (i.e. fire and insect outbreaks) that lead to habitat changes. For example, in the eastern Cascades in Oregon, high severity wildfire has reduced the number of Northern Spotted Owls pairs in a USFS Ranger Unit. However, it appears that dense old forests may be relatively stable on the west side of the Cascades, while more active management may help address fire risk in dry east-side forests. |
| Oregon Vesper Sparrow | Low-Moderate | Low | Moderate | Low-Moderate | > Temperature changes (increase or decrease)<br>> Changes in precipitation<br>> Altered fire regimes | Oregon Vesper Sparrow sensitivity is largely driven by their dependence on open habitats, seeds, and insects. They nest and forage on the ground in open habitats (e.g. grasslands or shrublands with patchy vegetation and some bare ground). Increasing fire frequency, temperatures, and more variable precipitation may decrease habitat availability, quality and connectivity and/or alter foraging opportunities. They may have some physiological sensitivity; for example, low temperatures can undermine nestling growth by increasing thermoregulatory costs and/or decreasing insect prey availability. |
| Peregrine Falcon | Low | High | Low | Low | > No specific climate factors identified as it is a generalist | Overall sensitivity of Peregrine Falcons is likely low as this species utilizes a variety of habitat types and forages on a diversity of species. |
| Purple Martin | Low-Moderate | Low | Moderate | Low | > Changes in precipitation<br>> Drought<br>> Increased temperatures (possibly) | Purple Martins are sensitive to climate-driven changes in habitat and prey availability. Low temperature periods, particularly in conjunction with precipitation, limit foraging opportunities and are the largest contributor to Purple Martin mortality. Drought can also affect food availability. Warming temperatures are causing earlier spring insect availability peaks, but Purple Martins are long-distance migrants, and have not yet shown adaptive response in migration timing in response |

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| **Species** | **Overall Vulnerability** | **Overall Confidence** | **Sensitivity Rank** | **Exposure Rank** | **Summary of Exposure** | **Summary of Sensitivity** |
| | | | | | | to earlier spring food availability, at least in eastern U.S. populations. This mismatch between spring arrival and peak food availability contributes to undermined reproductive success and mortality; further studies are needed to see if selective pressures will advance migration timing for this species. Purple Martins nest in snags in secondary cavities formed by woodpeckers in montane areas and the Pacific lowlands; high habitat specificity makes them more vulnerable to climate change, although increasing fire frequency may increase habitat in burned forests. |
| Pygmy Nuthatch | Moderate | Moderate | Moderate | Moderate | > Altered fire regimes<br>> Increased temperatures | Pygmy Nuthatches likely exhibit physiological sensitivity to cold temperatures, but utilize controlled hypothermia, communal roosting, and sheltered roosting cavities to survive cold periods. Pygmy Nuthatches are likely more sensitive to climate changes that affect foraging and nesting opportunities. Low- and moderate-severity, high-frequency fire helps maintain mature, open ponderosa pine habitat preferred by this species, but severe fire can destroy habitat in the short-term and inhibit ponderosa pine regeneration. Warming temperatures and xeric conditions may facilitate habitat expansion to higher elevations and into previously mesic areas, but can also lead to mortality of mature ponderosa pine individuals, affecting foraging and nesting opportunities. Warmer temperatures will likely increase insect foraging opportunities. |
| Red Knot | Moderate-High | Moderate | Moderate | Moderate -High | > Timing mismatches in favorable food, habitat, and weather conditions<br>> Sea level rise<br>> Declines in pH<br>> Increased storminess | Red Knots are unlikely to have direct physiological sensitivity to changes in climate during their migration through Washington. However, their overall sensitivity will be higher due to their habitat and foraging requirements. Prime foraging areas, like mudflats, may decline due to sea level rise and coastal flooding of these habitats. Additionally bivalve populations, a major source of prey, may experience declines due to ocean acidification as well as changes in period of tide flat exposure and area of tide flat exposure. Preferred roosting sites such as sand islands and marshes may also become more limited due to rising sea level and/or increased storminess. In particular, changes in temperature leading to migration timing mismatches (i.e. timing of departure and arrival to coincide with favorable food, habitat and weather conditions) will negatively affect |

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| **Species** | **Overall Vulnerability** | **Overall Confidence** | **Sensitivity Rank** | **Exposure Rank** | **Summary of Exposure** | **Summary of Sensitivity** |
| | | | | | | this species. |
| Red-necked Grebe | Low-Moderate | Low | Moderate | Low-Moderate | > Sea level rise<br>> Increased storminess<br>> Declines in pH | Very limited information is available regarding the sensitivity of Red-necked Grebes to climate change, particularly in Washington. Though Red-necked Grebes are unlikely to have direct physiological sensitivity to climate change, their sensitivity may be increased by climate-related changes in nesting and roosting habitat and prey availability. Sea level rise and coastal erosion could lead to declines in protected winter habitat. Increased storminess or wind may enhance vulnerability of nests. Additionally, juveniles feed mainly on invertebrates (e.g. crustaceans, mollusks); thus, any declines in these populations due to ocean acidification could limit prey availability for juvenile Red-necked Grebes. |
| Rock Sandpiper | Low-Moderate | Moderate | Low-Moderate | Moderate | > Sea level rise<br>> Increases in wave action | Rock Sandpipers are likely to have low physiological sensitivity to increases in air temperature. However, their overall sensitivity will be higher due to their dependence on habitats that may be negatively impacted by climate change. Rising sea levels and increased wave action may disturb prime foraging area and lead to declines in food sources (e.g. intertidal mussels). Additionally, during their Alaskan breeding season, declines in sea ice due to rising air and ocean temperatures could limit breeding and roosting habitat. |
| Sage Thrasher | Moderate-High | Moderate | Moderate-High | Moderate | > Increased invasive weeds<br>> Altered fire regimes<br>> Increased temperatures<br>> Changes in precipitation<br>> Drought | As sagebrush obligates, Sage Thrashers are sensitive to climate changes that affect the extent of sagebrush habitat. Increasing fire frequencies, which are perpetuated by invasive species (e.g. cheatgrass), may reduce breeding habitat. Invasive species also degrade foraging opportunities in the sagebrush understory. Warming temperatures, precipitation variability, and drought are also likely to contribute to reductions in sagebrush habitat, negatively affecting Sage Thrasher reproduction and foraging. |
| Sagebrush Sparrow | Moderate-High | Low | Moderate-High | Moderate | > Increased invasive weeds<br>> Altered fire regimes<br>> Increased | Very limited information is available regarding sensitivity of Sagebrush Sparrows to climate change, particularly in Washington, and particularly due to recent taxonomic separation from Bell's Sparrow. However, as sagebrush obligates that require relatively intact and undisturbed sage for breeding, Sagebrush Sparrows are likely |

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| **Species** | **Overall Vulnerability** | **Overall Confidence** | **Sensitivity Rank** | **Exposure Rank** | **Summary of Exposure** | **Summary of Sensitivity** |
| | | | | | temperatures<br>> Changes in precipitation<br>> Drought | vulnerable to any climate changes that affect the extent, quality, and connectivity of sagebrush habitats. Increasing fire frequencies (due to climate change and perpetuated by invasive species, e.g. cheatgrass), warming temperatures, precipitation variability, and drought are likely to contribute to reductions in sagebrush habitat, negatively affecting this species. Sagebrush Sparrows may also be physiologically sensitive to warming temperatures; they avoid nesting on hot southwest aspects, and position nests to maintain airflow (which is hypothesized to ameliorate high temperatures during nesting periods). |
| Sandhill Crane (Greater) | Moderate | Low | Moderate | Moderate | > Drought<br>> Altered hydrology | Sandhill Cranes appear to have low physiological sensitivity to changes in climate, although very little information currently exists on this topic. Sandhill Cranes generally require wetlands for nesting and some feeding, and prefer open water with little emergent vegetation for roosting. They are likely more sensitive to drought, low flows, or flooding that decrease available nesting, foraging, or roosting habitat. |
| Short-eared Owl (Western WA only) | Low | Low | Low-Moderate | Low | > No specific climate factors identified, although changes prey availability will negatively impact this species. | The Short-eared Owl has low physiological sensitivity due to its wide geographic distribution throughout North America, South America, Eurasia, and Africa; temperature does not appear to be a limiting factor for this species. Barn Owls may be direct competitors in some locations and displace Short-eared Owl populations. Variation in Short-eared Owl population size has been attributed to variations in small mammal abundance, thus this species is sensitive to changes in prey availability. |
| Short-tailed Albatross | Low | Low | Low-Moderate | Low | > Altered circulation and upwelling patterns | Although Short-tailed Albatross are unlikely to have physiological sensitivity to climate change and their breeding habitat is also unlikely to be affected by climate change, their sensitivity will be increased by potential shifts in prey availability. Given that Short-tailed Albatross primarily forage in areas with strong upwelling and high oceanic productivity along the continental shelf, potential shifts in ocean circulation could limit the availability of prey (e.g. squid, crustaceans, flying fish). Additionally, potential northward shifts of primary prey species like squid could result in a northward shift in Short-tailed Albatross populations. |

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| **Species** | **Overall Vulnerability** | **Overall Confidence** | **Sensitivity Rank** | **Exposure Rank** | **Summary of Exposure** | **Summary of Sensitivity** |
| Slender-billed White-breasted Nuthatch | Low-Moderate | Low | Low-Moderate | Low-Moderate | > Increased temperatures<br>> Changes in precipitation<br>> Altered fire regimes | This species likely has low physiological sensitivity to climate change, but little information is available. As a near-obligate of oak woodlands, this species is likely more sensitive to changes in mature oak woodland nesting and foraging habitat as a result of climate change. Snags and large, mature trees provide superior forage grounds and more space for nesting cavities, which are created by woodpeckers. Increased fire frequencies may help restore more open, mature oak habitat by reducing oak density and conifer encroachment. Fire and wind events may also create important edge openings preferred by this species. Temperature increases and precipitation changes may affect insect prey availability. Any reductions in oak habitat in response to climate change would likely negatively affect this species, for although they will nest in mixed deciduous-coniferous woodlands, past oak woodland loss has been associated with species extirpation from portions of Washington (e.g. Puget Sound). |
| Spruce Grouse | High | High | Moderate-High | High | > Altered fire regimes<br>> Increased insect and disease outbreaks | Sensitivity of Spruce Grouse appears to be driven by their dependence on high elevation conifer forests. Spruce Grouse prefer relatively young successional stands of dense conifers, and populations appear to fluctuate over time in response to the degree of maturation of post-fire regrowth. Altered fire regimes and insect and disease outbreaks that lead to habitat degradation increase the sensitivity of Spruce Grouse to climate change. |
| Streaked Horned Lark | Moderate | Moderate | Moderate | Moderate | > Increased temperatures<br>> Altered hydrology<br>> Altered sediment accretion and erosion patterns (coastal) | Streaked Horned Larks likely exhibit physiological sensitivity to warmer temperatures; they have been documented to alter behavior during warm periods (e.g. forage in shade, use wings to shade nests) and heat events have interrupted breeding season in other states. Streaked Horned Larks prefer open habitats with ample bare ground and very sparse, low stature vegetation. Populations in grassland areas may benefit from increasing fire frequencies that reduce vegetative cover and shrub/tree encroachment. Populations nesting on the banks of the Columbia River may be vulnerable to shifting flow regimes and flood peaks. Populations in beach/dune habitats along the Washington coast are vulnerable to changing sediment accretion and erosion patterns, which can change in response to hydrological shifts, current changes, changing precipitation patterns, and human management practices. |

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| Species | Overall Vulnerability | Overall Confidence | Sensitivity Rank | Exposure Rank | Summary of Exposure | Summary of Sensitivity |
| Surf Scoter | Moderate-High | Moderate | Moderate-High | Moderate | > Increased ocean temperature<br>> Sea level rise<br>> Declines in dissolved oxygen and pH | Surf Scoter ducklings may exhibit some physiological sensitivity to climate change, as local weather conditions can affect survival. However, the overall sensitivity of Surf Scoters is primarily due to dependencies on specific breeding and foraging habitats that could be affected by climate change. Increases in temperature or sea level as well as changes in water chemistry may alter prey species composition and Pacific Herring spawn as well as alter subtidal foraging habitats. Surf Scoters are a late-nesting species and may also exhibit reduced flexibility in their timing of breeding, increasing their overall sensitivity to climate change. |
| Tufted Puffin | Moderate | Moderate | Moderate | Moderate | > Increased ocean temperatures<br>> Increased storminess<br>> Sea level rise | The main ways in which Tufted Puffins will be sensitive to climate change are through alterations to their breeding habitat and food supply. Predicted increases in sea surface temperature could lead to declines in abundance of zooplankton and small forage fish that this species preys upon. During breeding season Tufted Puffins stay close to their young and forage very close to breeding sites; thus, local declines in prey availability could lead to slower growth rates and reproductive failure, since adults will not be able to travel long distances to find alternate food sources. Additionally, sea level rise could impact breeding and foraging habitat for Tufted Puffins by altering the intertidal and subtidal areas where they deposit eggs and forage. Nesting habitat (i.e. burrowing sites) could also be impacted by increased storm frequency, which could result in damage and destruction of nesting areas. |
| Upland Sandpiper | Moderate | Low | Moderate | Moderate | > Increased temperatures<br>> Changes in precipitation | Very limited information is available regarding the sensitivity of Upland Sandpipers to climate change, particularly in Washington. In the Midwest, Upland Sandpipers have exhibited some sensitivity to increasing temperatures, with earlier spring migration arrival positively correlated with increasing temperature. Declines in their preferred grassland and wet meadow habitat have already contributed to possible extirpation of the Upland Sandpiper in Washington; climate changes such as altered precipitation patterns that lead to further habitat loss will negatively impact this species. Altered fire regimes that remove shrubs and promote grasses may benefit this species. |
| Western | Low- | Low | Low- | Low- | > | Significant historical declines of Western Bluebird populations in |

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| **Species** | **Overall Vulnerability** | **Overall Confidence** | **Sensitivity Rank** | **Exposure Rank** | **Summary of Exposure** | **Summary of Sensitivity** |
| Bluebird (Western WA only) | Moderate | | Moderate | Moderate | Colder/wetter spring conditions<br>> Increased storminess (frequency or intensity) | western Washington are linked with wet conditions that affected prey availability, as well as habitat loss due to human activity. This species likely exhibits physiological sensitivity to temperature (particularly cold temperatures); adults elevationally migrate in response to shifting temperatures, and nestlings may become hypothermic during cold, wet periods. In addition, insect foraging opportunities decline during inclement weather, contributing to nestling mortality via starvation. Western Bluebirds nest in snag and tree cavities, and wildfire likely maintains preferred open woodland-prairie habitat and snag nesting opportunities, although it can eliminate specific nesting trees. Open woodland-prairie habitat in the Northwest may expand with drier conditions. |
| Western Grebe | Moderate | Low | Moderate | Moderate | > Changes in water level (e.g. increased water drawdowns or changes in precipitation)<br>> Increased temperatures (air and ocean) | Disturbances to nesting habitats and declines in prey availability are the primary pathways through which Western Grebes will exhibit sensitivity to climate change. This species also exhibits some sensitivity to fluctuating water level (high or low), which could lead to declines in nesting habitats. In Washington, increased nest loss due to greater water drawdowns in reservoirs could occur due to the need for expanded agricultural irrigation caused by climate change. Also, damage associated with increased declines in preferred forage fish prey (primarily Pacific Herring) during the non-breeding season are thought to have led to a southern shift of the species to California, and further decreases in Pacific Herring (e.g. warmer ocean temperatures) could lead to additional Western Grebe population declines. Increases in air temperature could also prompt shifts in Western Grebe migration timing. |
| Western High Arctic Brant | Moderate | Moderate | Moderate | Moderate | > Sea level rise<br>> Increased ocean temperatures<br>> Increased storminess<br>> Changes in salinity | This species likely exhibits moderate sensitivity to climate due to its habitat and foraging requirements. In particular, food abundance at wintering areas appears to have a direct effect on population reproduction. Key foraging areas such as eelgrass beds may decrease or increase due to changes in temperature or salinity, or sea level rise. Extreme events (e.g. severe winter weather) that reduce food abundance and availability could also affect this species (e.g. mortality). |
| Western | Moderate | Low | Moderate | Moderate | > Increased | Western Screech Owls may exhibit some physiological sensitivity to |

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| **Species** | **Overall Vulnerability** | **Overall Confidence** | **Sensitivity Rank** | **Exposure Rank** | **Summary of Exposure** | **Summary of Sensitivity** |
| Screech Owl | | | | | temperatures<br>> Changes in precipitation timing<br>> Drought<br>> Altered fire regimes<br>> Increased insect outbreaks | increased drought, as Western Screech Owl populations in southwestern Arizona declined 70% in 3 years during a drought. Changes in the timing of precipitation and warmer temperatures may alter timing of prey availability and abundance, with potential impacts on Western Screech Owl fecundity. Similar to the Northern Spotted Owl, this species may be sensitive to altered disturbance regimes (i.e. fire and insect outbreaks) that lead to habitat changes. |
| Western Snowy Plover | Moderate-High | Moderate | High | Moderate | > Sea level rise<br>> Increased coastal erosion<br>> Increased storminess/storm surge | The dependence of Western Snowy Plovers on coastal beaches and marshes as habitat for breeding and nesting increases their sensitivity to climate change. Sea level rise, beach erosion, and storm surges may cause declines in suitable habitat and decreases in local carrying capacity. Additionally, increased rainfall and storms could lead to declines in nesting success. |
| White-headed Woodpecker | Low-Moderate | Moderate | Low-Moderate | Moderate | > Increased temperatures<br>> Altered fire regimes<br>> Changes in precipitation | Sensitivity of White-headed Woodpeckers is influenced by warmer temperatures and precipitation changes that affect prey availability and habitat extent. Warmer temperatures are linked with higher surface bark insect abundance and enhanced forage opportunities. White-headed Woodpeckers require montane coniferous forests dominated by pines, which may be sensitive to precipitation changes and altered wildfire regimes, although these impacts could benefit the species (e.g. by providing more snags). Higher nesting and incubation success has been associated with warmer temperatures. |
| White-tailed Ptarmigan | High | High | High | High | > Increases in winter minimum temperatures<br>> Increased temperatures overall | Physiological sensitivity of White-tailed Ptarmigan is likely low-moderate as this species is well-adapted to high altitude climatic variation and harsh conditions, although it has been shown that high winter minimum temperatures can retard population growth rates. The sensitivity of this species will primarily be driven by its dependence on high elevation habitats likely to be affected by or shrink in response to climate change, as well as its dependence on willow for foraging. |

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| **Species** | **Overall Vulnerability** | **Overall Confidence** | **Sensitivity Rank** | **Exposure Rank** | **Summary of Exposure** | **Summary of Sensitivity** |
| | | | | | > Reduced snowpack | |
| White-winged Scoter | Moderate | Moderate | Moderate | Moderate | > Increased ocean temperature<br>> Sea level rise<br>> Declines in dissolved oxygen and pH | Sensitivity of White-winged Scoters to climate change is primarily driven by their dependence on coastal estuaries, bays, and open coastlines with shallow water over shellfish beds and/or sand or gravel bottoms for foraging. Changes in ocean temperature, water chemistry, or sea level rise that affect food supply or foraging habitats could impact this species. White-winged Scoters are a late-nesting species and may also exhibit reduced flexibility in breeding timing, increasing their overall sensitivity to climate change. |
| Yellow-billed Cuckoo | Low-Moderate | Low | Low-Moderate | Moderate | > Increased temperatures<br>> Increased drought and/or temperature change. | In Washington, Yellow-billed Cuckoos are likely sensitive to climate change through impacts in the availability of food resources. Warming temperatures may decrease the availability of food resources such as lepidopterans and/or lead to earlier spring peaks in food abundance which Yellow-billed Cuckoos may miss. Changes in precipitation or temperature may affect the peak timing of insect emergence or the timing of Yellow-billed Cuckoo arrival from wintering grounds, resulting in reduced food availability and possible impacts to breeding success. |

### Reptile and Amphibian Vulnerability Rankings

| REPTILES AND AMPHIBIANS | | | | | | |
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| **Species** | **Overall Vulnerability** | **Overall Confidence** | **Sensitivity Rank** | **Exposure Rank** | **Summary of Exposure** | **Summary of Sensitivity** |
| California Mountain Kingsnake | Low-Moderate | Low | Moderate | Low-Moderate | > Changes in precipitation<br>> Altered fire regimes | No information exists regarding the sensitivity of this species to climate change. Due to its occurrence in moist microhabitats in Oregon white oak-ponderosa pine forest, this species may have some sensitivity to altered precipitation and fire regimes that result in habitat loss or degradation. In Washington, species distribution is extremely small (around 20 miles) and is at the northern extent of the range, and occurrence is isolated and disjunct from the rest of the range by 200 miles. |
| Cascade | High | High | High | High | > Increased | Cascade Torrent Salamanders are likely highly sensitive to climate |

| REPTILES AND AMPHIBIANS | | | | | | |
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| **Species** | **Overall Vulnerability** | **Overall Confidence** | **Sensitivity Rank** | **Exposure Rank** | **Summary of Exposure** | **Summary of Sensitivity** |
| Torrent Salamander | | | | | temperatures (air and water)<br>> Changes in precipitation<br>> Reduced snowpack<br>> Shifts from snow to rain<br>> Earlier snowmelt | change due to their inability to tolerate desiccation and specialized habitat requirements. Declines in water availability and timing (e.g. reduced snowpack and earlier snow melt), as well as increased sedimentation (e.g. shifts from snow to rain), could decrease suitable headwater habitat for this species. This species may also be physiologically limited by high temperatures. |
| Columbia Spotted Frog (Columbia Basin only) | Moderate-High | Moderate | Moderate -High | Moderate | > Changes in precipitation (rain and snow)<br>> Altered hydrology | Though there is very limited information available regarding the sensitivity of the Columbia Spotted Frog to climate change, their main sensitivity is likely to stem from any climate-induced changes in their pond and stream breeding habitat. If streams and ponds become drier, this could limit available breeding and juvenile habitat for this species, particularly for juveniles who are unable to travel long distances to more suitable habitat. Changes in precipitation patterns could also affect the Columbia Spotted Frog through alterations in breeding timing, egg survival, and availability of prey. However, predicted increases in temperature and milder winters may positively impact this species, as studies have shown that warmer and less severe winters are linked to increases in survival and breeding probability. |
| Columbia Torrent Salamander | Moderate-High | Moderate | High | Moderate -High | > Increased temperatures (air and water)<br>> Changes in precipitation<br>> Reduced snowpack<br>> Shifts from snow to rain<br>> Earlier snowmelt | Similar to Cascade Torrent Salamanders, Columbia Torrent Salamanders are likely highly sensitive to climate change due to their inability to tolerate desiccation and specialized habitat requirements. Declines in water availability and timing (e.g. reduced snowpack and earlier snow melt), as well as increased sedimentation (e.g. shifts from snow to rain), could decrease suitable headwater habitat for this species. This species appears to prefer north-facing, steep slopes, suggesting that this species may be sensitive to higher water temperatures and drier microclimates. |

| REPTILES AND AMPHIBIANS | | | | | | |
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| **Species** | **Overall Vulnerability** | **Overall Confidence** | **Sensitivity Rank** | **Exposure Rank** | **Summary of Exposure** | **Summary of Sensitivity** |
| Cope's Giant Salamander | Moderate-High | Moderate | Moderate -High | Moderate -High | > Increased temperatures<br>> Changes in precipitation<br>> Shifts from snow to rain | Cope's Giant Salamanders appear sensitive to temperature and precipitation factors that cause microhabitat desiccation as well as high flow events that degrade aquatic habitat. Elevated temperatures (although one study has shown these salamanders may tolerate a wider temperature range), increased solar radiation, and moisture loss, as well as declines in stream flow that reduce aquatic habitats, will likely negatively affect this species. Additionally, the species' occurrence in rain-on-snow transient zones makes it particularly sensitive to rain-on-snow events that result in high flow events and increased sedimentation.<br>Range contractions are projected for the southern Cascades ecoregion, with possible expansions in the northern Cascades and/or low-mid elevation southern coastal streams. |
| Dunn's Salamander | Moderate-High | Low | Moderate -High | Moderate | > Increased temperatures<br>> Changes in precipitation<br>> Reduced snowpack<br>> Earlier snowmelt | Little to no information exists regarding sensitivity of the Dunn's Salamander to climate change. This species may exhibit some sensitivity to warmer temperatures; however, its overall sensitivity is likely driven by its dependence on moist microhabitats that could be lost or degraded due to changes in snowpack amount and runoff timing. |
| Green Sea Turtle | Moderate | Moderate | Moderate -High | Low-Moderate | > Increased temperatures (air and ocean)<br>> Declines in pH | Green Sea Turtles will be sensitive to climate change through a number of pathways. The species may respond directly to increases in temperature by shifts in sex ratios; warmer temperatures promote higher levels of female young. Increases in sea surface temperature could also lead to changes in migration patterns, nesting and hatch timing, and prompt mismatches between Green Sea Turtle abundance and prey availability. Increases in sand temperature could lead to higher levels of hatchling mortality. Indirectly, increases in sea surface temperature and decreases in pH could lead to alterations of macroalgal species that Green Sea Turtles prey upon and limit prey availability. Nesting habitat may also be impacted by sea level rise, increased storms, and coastal inundation, which could lead to lower reproductive success. The broad migratory range of Green Sea Turtles may allow them to search out different suitable nesting habitat, |

| REPTILES AND AMPHIBIANS | | | | | | |
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| **Species** | **Overall Vulnerability** | **Overall Confidence** | **Sensitivity Rank** | **Exposure Rank** | **Summary of Exposure** | **Summary of Sensitivity** |
| | | | | | | although nesting occurs outside of Washington. |
| Larch Mountain Salamander | Moderate-High | Moderate | High | Moderate | > Increased temperatures<br>> Changes in precipitation | Sensitivity of Larch Mountain Salamanders to climate change is likely driven by its specialized habitat requirements; it prefers forested talus environments. This species also exhibits physiological sensitivity to temperature and precipitation, seeking out suitable microclimates (e.g. active at the surface during periods of high humidity and moderate temperature) as needed. Warmer and drier conditions could negatively affect this species through loss of suitable habitat, population isolation due to inability to disperse, and/or direct mortality because they depend on moist skin surfaces for oxygen uptake. |
| Leatherback Sea Turtle | Moderate | Moderate | Moderate -High | Low-Moderate | > Increased temperatures (air and ocean)<br>> Changes in upwelling/circulation | Leatherback Sea Turtles will be sensitive to climate change through a number of pathways. They may respond directly to increases in temperature by shifts in sex ratios; warmer temperatures promote higher levels of female young. Increases in sea surface temperature could also lead to changes in migration patterns, northward species shift, and alterations in nesting and hatch timing, which could prompt mismatches between Leatherback Sea Turtle abundance and prey availability. Increases in sand temperature could lead to higher levels of hatchling mortality. Indirectly, increases in sea surface temperature and potential changes in upwelling and ocean circulation could affect the jellyfish that Leatherback Sea Turtles tend to prey upon and limit prey availability. Nesting habitat may also be impacted by sea level rise, increased storms, and coastal inundation, which could lead to lower reproductive success. The broad migratory range of Leatherback Sea Turtles may allow them to search out different suitable nesting habitat; they have low nest-site fidelity and thus may be able to switch nesting sites depending on conditions, although nesting occurs outside of Washington. |
| Loggerhead Sea Turtle | Moderate-High | Moderate | Moderate -High | Moderate | > Increased temperatures (air and ocean)<br>> Declines in pH | Loggerhead Sea Turtles will be sensitive to climate change through a number of pathways. They may respond directly to increases in temperature by shifts in sex ratios; warmer temperatures promote higher levels of female young. Increases in sea surface temperature could also lead to changes in migration patterns and alterations in nesting and hatch timing, which could prompt mismatches between turtle abundance and prey availability; Loggerhead Sea Turtles were |

| REPTILES AND AMPHIBIANS | | | | | | |
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| **Species** | **Overall Vulnerability** | **Overall Confidence** | **Sensitivity Rank** | **Exposure Rank** | **Summary of Exposure** | **Summary of Sensitivity** |
| | | | | | | found to have decreased nesting abundance with warmer sea surface temperature. Increases in sand temperature could lead to higher levels of hatchling mortality. Indirectly, increases in sea surface temperature and decreases in pH could affect invertebrates (e.g. crabs, crustaceans, mollusks) that Loggerhead Sea Turtles prey on and potentially limit prey availability. Nesting habitat may also be impacted by sea level rise, increased storms, and coastal inundation, which could lead to lower reproductive success. The broad migratory range of Loggerhead Sea Turtles may allow them to search out different suitable nesting habitat, although nesting does not generally occur in Washington. |
| Night Snake | N/A | N/A | Unknown | Moderate | > Altered fire regimes<br>> Increased invasive weeds | No information exists regarding the sensitivity of this species to climate change. Due to a lack of information on status and distribution in Washington, it is also difficult to estimate habitat sensitivities to climate change. In general, individuals associated with shrub-steppe vegetation are sensitive to altered fire regimes and invasive weeds that degrade or eliminate habitat. |
| Northern Leopard Frog | Moderate-High | Moderate | Moderate -High | Moderate | > Increased temperatures<br>> Changes in precipitation<br>> Altered hydrology | There is very limited information available regarding the sensitivity of Northern Leopard Frogs to climate change. They may experience some sensitivity to potential increases in temperature, which could lead to earlier timing of mating and breeding. Their sensitivity will be increased by potential climate-induced changes in their pond habitat. Adults need deep water, seasonal ponds, and wetlands for breeding habitat, and potential warmer and drier conditions could lead to declines in available breeding habitat. Drier conditions could even lead to localized population extinctions if breeding ponds become too shallow or disappear completely. |
| Olympic Torrent Salamander | High | High | High | Moderate -High | > Increased temperatures (air and water)<br>> Changes in precipitation<br>> Reduced snowpack<br>> Shifts from | Overall sensitivity of this species is likely high due to high physiological sensitivity and specific habitat requirements—they are associated with permanent, high elevation, silt-free cold water sources with steep gradients. Increasing water temperatures and moisture loss will negatively impact this species, as it is desiccation-intolerant and cannot survive where water temperatures are too high. Reduced snowpack and shifts from snow to rain that lead to high flow events, erosion and scouring could reduce headwater riparian habitat for the Olympic Torrent Salamander. |

| REPTILES AND AMPHIBIANS | | | | | | |
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| Species | Overall Vulnerability | Overall Confidence | Sensitivity Rank | Exposure Rank | Summary of Exposure | Summary of Sensitivity |
| | | | | | snow to rain | |
| Oregon Spotted Frog | Moderate-High | Low | Moderate -High | Moderate | > Increased temperatures<br>> Changes in precipitation<br>> Altered hydrology | Very limited information is available regarding the sensitivity of the Oregon Spotted Frog to climate change. Its main sensitivity is likely to be due to changes in pond and wetland habitat. This species prefers shallow water ponds and vegetated pools for breeding and tadpole development. Potential warmer and drier conditions could lead to alterations in or disappearance of shallow ponds and changes in vegetation, which could impact breeding and tadpole survival. Additionally, warmer temperatures could lead to increases in invasive warm water predators that prey upon Oregon Spotted Frogs, like American Bullfrogs and some invasive fish species, thus leading to potential population declines. |
| Pygmy Horned Lizard | Moderate | Low | Moderate | Moderate | > Increased temperatures<br>> Altered fire regimes<br>> Increased invasive weeds | Little to no information exists regarding sensitivity of the Pygmy Horned Lizard to climate change. Physiological sensitivity of this species may be low to moderate, as it is inactive during cold weather or extended periods of heat. It appears to exhibit behavioral thermoregulation and burrows when inactive. Its inability to disperse long distances may increase sensitivity of this species. Overall sensitivity of this species is likely driven by its occurrence in shrub-steppe habitats, which are sensitive to altered fire regimes and invasive weeds. |
| Ring-necked Snake | Low-Moderate | Low | Low-Moderate | Moderate | > Changes in precipitation (rain and snow)<br>> Altered fire regimes | Overall, there is a lack of information regarding sensitivity of the Ring-necked Snake to climate change. Individuals that occur in shrub-steppe habitats are often associated with riparian areas, and may have higher sensitivity due to drying habitat or altered fire regimes that degrade or eliminate habitat. |
| Rocky Mountain Tailed Frog | Moderate-High | Moderate | Moderate -High | Moderate -High | > Increased stream temperatures<br>> Changes in precipitation<br>> Altered fire regimes<br>> Altered | Though there is limited information available regarding the sensitivity of the Rocky Mountain Tailed Frog to climate change, particularly for Washington populations, this species may exhibit some sensitivity to predicted increases in stream temperature with climate change. Rocky Mountain Tailed Frogs breed in streams and tadpoles spend many summers in stream habitat. Increases in stream temperature during the summer could lead to declines in tadpoles and adults. Both adults and juveniles may be able to avoid summer increases by migrating to |

| REPTILES AND AMPHIBIANS | | | | | | |
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| **Species** | **Overall Vulnerability** | **Overall Confidence** | **Sensitivity Rank** | **Exposure Rank** | **Summary of Exposure** | **Summary of Sensitivity** |
| | | | | | hydrology (i.e. increased flooding) | areas of the stream with cooler water, and some studies have shown an ability to withstand increases in stream temperature. Additionally, potential warmer and drier conditions and increases in wildfires could alter this species' preferred forest habitat and lead to reductions in population size. Increases in winter and spring precipitation could also lead to increased flooding events, disturbing available habitat for juveniles. |
| Sagebrush Lizard | Moderate-High | Low | Moderate -High | Moderate | > Altered fire regimes<br>> Increased invasive weeds | Little to no information exists regarding sensitivity of the Sagebrush Lizard to climate change. It is likely that their overall sensitivity is greater since they are vegetated sand dune specialists. This habitat is vulnerable to invasive grasses or altered fire regimes that eliminate habitat. |
| Sharp-tailed Snake | Moderate | Low | Moderate | Moderate | > Increased temperatures<br>> Changes in precipitation<br>> Altered fire regimes | Overall, there is a lack of information regarding sensitivity of the Sharp-tailed Snake to climate change. Sensitivity of this species may be influenced by its occurrence along edges of coniferous or open hardwood forest, which are sensitive to warming temperatures, moisture stress, and changing fire patterns. This species may also exhibit some sensitivity to warmer temperatures and changes in precipitation since they are often associated with moist habitats. |
| Side-blotched Lizard | Moderate | Moderate | Moderate | Moderate | > Increased temperatures<br>> Changes in precipitation<br>> Altered fire regimes<br>> Increased invasive weeds | Side-blotched Lizards appear to exhibit low reproductive sensitivity to climate, as warming temperatures (particularly warmer nights during breeding season) may increase reproductive output and subsequent survival. Further, Side-blotched Lizards appear to select specific temperature microhabitats, indicating behavioral thermoregulation. However, this species may exhibit some physiological sensitivity to changes in precipitation and warming winter temperatures (e.g. if warmer temperatures increase energetic demands). Overall sensitivity of this species is somewhat higher due to its association with shrub-steppe habitats, which are sensitive to altered fire regimes and invasive weeds that degrade or eliminate habitat. |
| Striped Whipsnake | Low-Moderate | Low | Low-Moderate | Moderate | > Changes in precipitation<br>> Increased invasive weeds | Overall, there is a lack of information regarding sensitivity of the Striped Whipsnake to climate change. Sensitivity of this species may be influenced by its occurrence in shrub-steppe habitats, which are sensitive to changes in precipitation, invasive weeds, and altered fire regimes. |

| REPTILES AND AMPHIBIANS | | | | | | |
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| **Species** | **Overall Vulnerability** | **Overall Confidence** | **Sensitivity Rank** | **Exposure Rank** | **Summary of Exposure** | **Summary of Sensitivity** |
| | | | | | > Altered fire regimes | |
| Tiger Salamander | Moderate-High | High | High | Moderate | > Increased temperatures<br>> Changes in precipitation and/or reduced snowpack<br>> Drought | Little information exists regarding sensitivity of the Tiger Salamander to climate change, particularly in Washington. This species likely exhibits sensitivity to warmer and drier conditions that reduce aquatic breeding habitat, lead to desiccation, and/or result in an inability to move. Warmer temperatures and a decrease in total annual precipitation (including snow), as well as an increase in drought, has led to wetland desiccation and significant population declines in Yellowstone National Park. Timing of reproduction may also be affected by increasing temperatures. |
| Van Dyke's Salamander | Moderate-High | Moderate | High | Moderate | > Increased temperatures<br>> Changes in precipitation<br>> Reduced snowpack | Van Dyke's Salamanders are physiologically sensitive to heat and desiccation; this sensitivity to temperature and moisture changes is driven by respiration requirements; they depend on moist skin surfaces for oxygen uptake, although they can behaviorally regulate exposure by moving underground during times of higher temperatures and less precipitation. Sensitivity of this species is further increased due to their requirement of cool, forested stream habitat. Changes in hydrology (e.g. declines in snowpack or precipitation) that reduce seeps and springs habitat could negatively impact this species. |
| Western Pond Turtle | Low-Moderate | Low | Low-Moderate | Moderate | > Increased temperatures<br>> Changes in precipitation (rain and snow)<br>> Altered hydrology<br>> Increased invasive weeds | Overall, there is a lack of information regarding sensitivity of the Western Pond Turtle to climate change. Sensitivity of this species may be affected by warming temperatures that influence offspring sex ratios, increasing the number of females even with small increases in temperature (<3˚F). However, it is possible that warming could benefit this species by providing more warm days for developing embryos, as Western Pond Turtles in Puget Sound are at the northern extreme of their range. Their dependence on aquatic habitats increases sensitivity of this species, as these habitats are likely to be affected by increasing temperatures and altered hydrology. Invasive weeds that overgrow nesting areas further increase sensitivity of this species. |
| Western Toad (W WA only) | Moderate | Moderate | Moderate to Moderate -High w/ | Moderate | > Changes in precipitation (rain and snow) | Sensitivity of the Western Toad to climate change is primarily driven by its dependence on intermittent and permanent aquatic habitats (e.g. streams, seeps, wetlands, ponds, etc.) that may be lost or degraded due to changes in precipitation and altered hydrology. Desiccation of |

| REPTILES AND AMPHIBIANS | | | | | | |
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| **Species** | **Overall Vulnerability** | **Overall Confidence** | **Sensitivity Rank** | **Exposure Rank** | **Summary of Exposure** | **Summary of Sensitivity** |
| | | | synergistic impacts | | > Altered hydrology | streams and pools along dispersal routes may create barriers to movement. Synergistic impacts such as climate changes combined with disease outbreaks increases sensitivity of this species. Physiological sensitivity of this species is unclear—some references cite sensitivities to temperature and moisture conditions, while others cite high adaptability to changes in these conditions.<br><br>Greatest impacts to montane wetland-reliant taxa will most likely occur when landscapes primarily contain shallow wetlands at high risk of drying and are composed of multiple wetland types but deeper habitats are unsuitable (e.g. presence of introduced fish) |
| Woodhouse's Toad | Moderate-High | Moderate | Moderate-High | Moderate | > Increased temperatures<br>> Changes in precipitation<br>> Increased invasive weeds<br>> Altered fire regimes | Juvenile toads avoid high temperatures and prefer lower temperatures when food is limited or under dry conditions. Tadpoles may be sensitive to low pH levels. Woodhouse's Toad may be better adapted to warmer, drier conditions due to their dry, leathery skin and ability to burrow to reduce exposure to high temperatures, although they need friable soils to burrow. Sensitivity of Woodhouse's Toad is greater due to their shrubland habitat specialization and dependence on wetlands and ponds for breeding, as well as low ability to disperse. Declines in shrub-steppe and wetland habitats due to climate change (i.e. changes in precipitation, invasive weeds, altered fire regimes) negatively affect this species. |

## Fish Vulnerability Rankings

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| **Species** | **Overall Vulnerability** | **Overall Confidence** | **Sensitivity Rank** | **Exposure Rank** | **Summary of Exposure** | **Summary of Sensitivity** |
| Bluntnose Sixgill Shark | Low-Moderate | High | Low-Moderate | Moderate | > Increased ocean temperatures<br>> Decreased oxygen | Though limited information is available regarding the sensitivity of Bluntnose Sixgill Sharks to climate change (particularly in Washington), there are a number of ways in which this species may be sensitive to changing ocean conditions. In general, increases in temperature may affect movement and migration patterns. The use of Puget Sound by juvenile Bluntnose Sixgill Sharks and their high site fidelity within Puget |

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| **Species** | **Overall Vulnerability** | **Overall Confidence** | **Sensitivity Rank** | **Exposure Rank** | **Summary of Exposure** | **Summary of Sensitivity** |
| | | | | | | Sound could make them sensitive to climate-related changes, such as increases in temperature or potential decreases in oxygen, which could potentially lead to declines in prey availability (e.g. other sharks and rays, fish). Because they are scavengers that target a wide range of prey, they may be able to shift prey species due to changes in abundance, but the high site fidelity of juveniles within Puget Sound, as well as their life history characteristics (slow growth, long generation times, low fecundity) may increase their sensitivity to climate-induced changes in Puget Sound. However, it appears Puget Sound Bluntnose Sixgill Sharks are part of a larger, much more broadly distributed population, suggesting possible resilience to climate impacts. |
| Bocaccio (Puget Sound/Georgia Basin DPS) | Moderate-High | Moderate | Moderate | Moderate-High | > Increased ocean temperatures<br>> Sea level rise<br>> Declines in pH<br>> Decreased oxygen | The main sensitivity of Bocaccio to climate change is likely to stem from changes to their prey base and resultant reductions in the likelihood of successful recruitment events. Warmer ocean conditions could lead to decreases in prey (e.g. krill, copepods) for both juveniles and adults, prompting decreases in adult fecundity and juvenile survival. Warmer waters could also lead to decreased success of recruitment events. Additionally, nearshore habitat loss due to sea level rise could impact juvenile survival, as juveniles tend to use nearshore habitat as nursery and foraging area. Deepwater coral habitat, which many adult Bocaccio use, may also decrease due to acidification, further reducing available habitat. Decreased oxygen levels may have direct physiological effects on Bocaccio, leading to higher levels of mortality across various life stages. Due to their long life cycles and generation times, adults may be able to persist through short term pulses of negative ocean conditions (e.g. years with warmer sea surface temperature), though conversely, their low productivity could make it difficult for populations to recover from climate-related declines. |
| Broadnose Sevengill Shark | Moderate | Moderate | Moderate | Moderate | > Increased ocean temperatures<br>> Altered circulation patterns<br>> Decreased | Though limited information is available regarding the sensitivity of Broadnose Sevengill Sharks to climate change (particularly in Washington), there are a number of ways in which this species may be sensitive to changing ocean conditions. In general, increases in temperature may affect movement and migration patterns of sharks. Currently the warmer summer waters of Willapa Bay, where most Broadnose Sevengill Sharks are found, are thought to have foraging and |

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| **Species** | **Overall Vulnerability** | **Overall Confidence** | **Sensitivity Rank** | **Exposure Rank** | **Summary of Exposure** | **Summary of Sensitivity** |
| | | | | | oxygen | reproductive benefits for sharks, but shifts in temperature, changes in ocean circulation that lead to decreased productivity, or decreases in oxygen and resulting declines in prey availability could make this area less optimal. Because Broadnose Sevengill Sharks target a broad range of prey, they may be more adaptable to shifts in prey composition, but their high site fidelity to particular areas in Willapa Bay, as well as their life history characteristics (slow growth, long generation times, low fecundity) may increase their sensitivity to any climate-induced changes in habitat conditions. Overall, the generalist nature of their diet, ability to migrate to and from California and use diverse estuaries, and general hardiness suggest limited climate-related impacts. |
| Brown Rockfish | Moderate-High | Moderate | Moderate | Moderate-High | > Increased ocean temperatures<br>> Sea level rise<br>> Declines in pH<br>> Decreased oxygen | The main sensitivity of Brown Rockfish to climate change is likely to stem from changes to their prey base. Warmer ocean conditions could lead to decreases in prey (e.g. zooplankton) for both juveniles and adults, prompting decreases in adult fecundity and juvenile survival. Additionally, nearshore habitat loss due to sea level rise could impact juvenile survival, as juveniles tend to use nearshore habitat as nursery and foraging area. Deepwater coral habitat, which many adult rockfish use, may also decrease due to acidification, further reducing available habitat. Decreased oxygen levels may have direct physiological effects on Brown Rockfish, leading to higher levels of mortality across various life stages. Due to their long life cycles and generation times, adults may be able to persist through short term pulses of negative ocean conditions (e.g. years with warmer sea surface temperature), though conversely, their low productivity could make it difficult for populations to recover from climate-related declines. |
| Bull Trout - Coastal Recovery Unit | Moderate-High | High | Moderate-High | Moderate | > Increased water temperatures<br>> Altered runoff timing<br>> Increased winter/spring flood events<br>> Lower | Sensitivity of Bull Trout is primarily driven by water temperature. Bull Trout are the southernmost species of Western North American char and have lower thermal tolerance than other salmonids they co-occur with. The upper incipient lethal temperature for Bull Trout was found to be 70˚F, whereas the optimal temperatures for growth were in the range of 50-59˚F. Thus Bull Trout have a similar thermal optima to the salmonids they co-occur with, yet a lower thermal tolerance, indicating they have a narrower thermal niche and higher sensitivity to temperature. Indeed the geographic distribution of Bull Trout, and the |

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| **Species** | **Overall Vulnerability** | **Overall Confidence** | **Sensitivity Rank** | **Exposure Rank** | **Summary of Exposure** | **Summary of Sensitivity** |
| | | | | | summer flows | persistence of populations during contemporary warming has been most strongly related to maximum water temperature. The ability of Bull Trout to persist in sub-optimally warm temperatures likely depends on food abundance. As temperature increases metabolic costs, the extent to which Bull Trout can maintain positive energy balance depends on its ability to find food. Bull Trout historically relied heavily on salmon as a food resource and may be less resilient to temperatures in areas where foraging opportunities of salmon eggs and juveniles have declined. Invasive chars (Brook and Lake Trout) now reside in many headwater streams and lakes, and may exclude Bull Trout from these potential coldwater refuges, increasing their sensitivity to warming. Bull Trout sensitivity to flows is likely to occur during two critical periods: 1) direct effects of altered runoff timing and magnitude on emerging fry in late winter/spring, and 2) indirect effects of low summer flows on all life phases of Bull Trout by mediating the duration and magnitude of thermal stress events. |
| Bull Trout - Mid-Columbia Recovery Unit | Moderate-High | High | Moderate-High | Moderate | > Increased water temperatures<br>> Altered runoff timing<br>> Increased winter/spring flood events<br>> Lower summer flows | Sensitivity of Bull Trout is primarily driven by water temperature. Bull Trout are the southernmost species of Western North American char and have lower thermal tolerance than other salmonids they co-occur with. The upper incipient lethal temperature for Bull Trout was found to be 70˚F, whereas the optimal temperatures for growth were in the range of 50-59˚F. Thus Bull Trout have a similar thermal optima to the salmonids they co-occur with, yet a lower thermal tolerance, indicating they have a narrower thermal niche and higher sensitivity to temperature. Indeed the geographic distribution of Bull Trout, and the persistence of populations during contemporary warming has been most strongly related to maximum water temperature. The ability of Bull Trout to persist in sub-optimally warm temperatures likely depends on food abundance. As temperature increases metabolic costs, the extent to which Bull Trout can maintain positive energy balance depends on its ability to find food. Bull Trout historically relied heavily on salmon as a food resource and may be less resilient to temperatures in areas where foraging opportunities of salmon eggs and juveniles have declined. Invasive chars (Brook and Lake trout) now reside in many headwater streams and lakes, and may exclude Bull Trout from these |

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| **Species** | **Overall Vulnerability** | **Overall Confidence** | **Sensitivity Rank** | **Exposure Rank** | **Summary of Exposure** | **Summary of Sensitivity** |
| | | | | | | potential coldwater refuges, increasing their sensitivity to warming. Bull Trout sensitivity to flows is likely to occur during two critical periods: 1) direct effects of altered runoff timing and magnitude on emerging fry in late winter/spring, and 2) indirect effects of low summer flows on all life phases of Bull Trout by mediating the duration and magnitude of thermal stress events. |
| Burbot | Moderate | Low | Moderate | Moderate | > Increased water temperatures<br>> Altered flow regimes | Burbot is a cold-adapted species whose distribution, behavior, and physiology is limited by warmer water temperatures. Warmer water temperatures limit dispersal to more southerly locations and influence behavior and physiology in current habitat. Burbot have been documented to seek out cool-water thermal refugia near lake inflows, and warmer water temperatures have been documented to decrease survival and have variable impacts on growth of hatchery-raised individuals. Shifts in streamflow may affect spawning migrations and/or spawning synchrony of this winter-spawning species. For example, reduced streamflows and lake/reservoir levels can reduce or degrade spawning and rearing habitat, while high winter flows may impede upstream movements of adult Burbot. |
| Canary Rockfish (Puget Sound/Georgia Basin DPS) | Moderate-High | Moderate | Moderate | Moderate-High | > Increased ocean temperatures<br>> Sea level rise<br>> Declines in pH<br>> Decreased oxygen | The main sensitivity of Canary Rockfish to climate change is likely to stem from changes to their prey base. Warmer ocean conditions could lead to decreases in prey (e.g. copepods, crustaceans, euphausiid eggs) for both juveniles and adults, prompting decreases in adult fecundity and juvenile survival. Additionally, nearshore habitat loss due to sea level rise could impact juvenile survival, as juveniles tend to use nearshore habitat as nursery and foraging area. Deepwater coral habitat, which many adult rockfish use, may also decrease due to acidification, further reducing available habitat. Decreased oxygen levels may have direct physiological effects on Canary Rockfish, leading to higher levels of mortality across various life stages. Due to their long life cycles and generation times, adults may be able to persist through short term pulses of negative ocean conditions (e.g. years with warmer sea surface temperature), though conversely, their low productivity could make it difficult for populations to recover from climate-related declines. |
| China Rockfish | Moderate- | Moderate | Moderate | Moderate- | > Increased | The main sensitivity of China Rockfish to climate change is likely to stem |

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| **Species** | **Overall Vulnerability** | **Overall Confidence** | **Sensitivity Rank** | **Exposure Rank** | **Summary of Exposure** | **Summary of Sensitivity** |
| | High | | | High | ocean temperatures<br>> Sea level rise<br>> Declines in pH<br>> Decreased oxygen | from changes to their prey base. Warmer ocean conditions could lead to decreases in prey (e.g. zooplankton) for both juveniles and adults, prompting decreases in adult fecundity and juvenile survival. Additionally, nearshore habitat loss due to sea level rise could impact juvenile survival, as juveniles tend to use nearshore habitat as nursery and foraging area. Deepwater coral habitat, which many adult rockfish use, may also decrease due to acidification, further reducing available habitat. Decreased oxygen levels may have direct physiological effects on China Rockfish, leading to higher levels of mortality across various life stages. Due to their long life cycles and generation times, adults may be able to persist through short term pulses of negative ocean conditions (e.g. years with warmer sea surface temperature), though conversely, their low productivity could make it difficult for populations to recover from climate-related declines. |
| Columbia River Chum Salmon ESU | Moderate | High | Moderate | Moderate | > Increased water temperatures (freshwater and sea surface)<br>> Increased winter/spring flood events | Washington is near the southern extent of the geographic range for chum salmon, which suggests they may be sensitive to increases in water temperature (freshwater and ocean). Chum salmon incubate embryos in freshwater, but juveniles migrate to estuaries as age-zeros, typically during the spring; the spawning migrations of adult fish typically occur in late fall. Thus Columbia River chum salmon are unlikely to be exposed to thermal stress in the freshwater phase of their life history. However, altered freshwater thermal regimes could affect chum salmon by altering their phenology and potentially creating mismatch between arrival in estuaries and the timing of ideal ecological conditions in estuarine habitats. Chum salmon will likely be most sensitive to changes in marine thermal regimes. In general, Pacific salmon survival is positively related to sea surface temperatures (SST) at the northern extent of their distribution, and negatively related at the southern extent. However, recent evidence suggests that chum salmon may be less sensitive to SST at the southern extent of their range compared with pink and sockeye. Chum salmon spawn in late fall at southern latitudes and their embryos are vulnerable to flood events that can scour redds or bury them in silt. Chum may be vulnerable to altered flow regimes that include increased flood severity, particularly in watersheds where land use has enhanced stream flashiness. |

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| **Species** | **Overall Vulnerability** | **Overall Confidence** | **Sensitivity Rank** | **Exposure Rank** | **Summary of Exposure** | **Summary of Sensitivity** |
| Copper Rockfish | Moderate-High | Moderate | Moderate | Moderate-High | > Increased ocean temperatures<br>> Sea level rise<br>> Declines in pH<br>> Decreased oxygen | The main sensitivity of Copper Rockfish to climate change is likely to stem from changes to their prey base. Warmer ocean conditions could lead to decreases in prey (e.g. zooplankton) for both juveniles and adults, prompting decreases in adult fecundity and juvenile survival. Additionally, nearshore habitat loss due to sea level rise could impact juvenile survival, as juveniles tend to use nearshore habitat as nursery and foraging area. Deepwater coral habitat, which many adult rockfish use, may also decrease due to acidification, further reducing available habitat. Decreased oxygen levels may have direct physiological effects on Copper Rockfish, leading to higher levels of mortality across various life stages; in the past, Copper Rockfish have exhibited high mortality rates during extreme hypoxic events. Due to their long life cycles and generation times, adults may be able to persist through short term pulses of negative ocean conditions (e.g. years with warmer sea surface temperature), though conversely, their low productivity could make it difficult for populations to recover from climate-related declines. |
| Eulachon (southern DPS) | Moderate-High | Moderate | High | Moderate | > Altered runoff timing and magnitude<br>> Increased water temperatures (fresh and ocean) | Eulachon are vulnerable to climate-driven changes in both their oceanic rearing and freshwater spawning habitat. Eulachon exhibit site fidelity to specific spawning rivers, limiting the opportunity for adults and juveniles to move in response to changing nearshore-rearing and spawning habitat conditions. Eulachon spawn prior to the spring freshet, and egg hatch is correlated with peak spring flows to facilitate emigration. Precipitation changes, reduced snowpack, and earlier snowmelt all contribute to shifts in streamflow timing and magnitude, which could alter Eulachon spawning time and/or cause earlier emigration. Early emigration could contribute to oceanic prey mismatch and Eulachon mortality if larvae/juveniles arrive to marine rearing habitat prior to coastal upwelling initiation, which is projected to occur later in response to warmer ocean temperatures. Warming ocean temperatures may also affect eulachon forage opportunities and marine survival by affecting the abundance and composition of copepod communities, key prey for larval eulachon. Warming ocean temperatures have also facilitated the expansion of Pacific Hake, which prey upon and compete with Eulachon. |
| Green | Low- | Low | Low- | Moderate | > Increased | Limited information is available regarding the sensitivity of Green |

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| **Species** | **Overall Vulnerability** | **Overall Confidence** | **Sensitivity Rank** | **Exposure Rank** | **Summary of Exposure** | **Summary of Sensitivity** |
| Sturgeon (southern DPS) | Moderate | | Moderate | | ocean temperatures > Declines in pH | Sturgeon to climate change (particularly in Washington). Green Sturgeon are wide-ranging migrants, spawning in California and appearing in Washington's coastal waters, estuaries and watersheds in late summer. Although they may be sensitive to hydrological and temperature shifts in their natal watersheds, vulnerability to climate change in Washington is likely linked with changes in the marine environment. In general, water temperatures influence fish distribution, physiology, and biology. Green Sturgeon likely exhibit some physiological sensitivity to water temperature increases. A study in the Klamath and Rogue River basins found that bioenergetic performance peaked at water temperatures between 59-66°F. A separate study theorized that Green Sturgeon utilize warmer estuarine habitats in Washington during summer to maximize growth potential. Climate change impacts (e.g. decreased pH) may also affect Green Sturgeon prey (e.g. benthic organisms such as shrimp, amphipods, small fish, mollusks). |
| Greenstriped Rockfish | Moderate-High | Moderate | Moderate | Moderate-High | > Increased ocean temperatures > Sea level rise > Decreased oxygen | The main sensitivity of Greenstriped Rockfish to climate change is likely to stem from changes to their prey base. Warmer ocean conditions could lead to decreases in prey (e.g. copepods, larger crustaceans and cephalopods for adults) for both juveniles and adults, prompting decreases in adult fecundity and juvenile survival. Additionally, nearshore habitat loss due to sea level rise could impact juvenile survival, as juveniles tend to use nearshore habitat as nursery and foraging area. As Greenstriped Rockfish tend to prefer soft sediment and muddy, sandy areas as habitat, they will be less sensitive to loss of deepwater coral habitat due to decreased pH than other rockfish species. Decreased oxygen levels may have direct physiological effects on Greenstriped Rockfish, leading to higher levels of mortality across various life stages. Due to their long life cycles and generation times, adults may be able to persist through short term pulses of negative ocean conditions (e.g. years with warmer sea surface temperature), though conversely, their low productivity could make it difficult for populations to recover from climate-related declines. |
| Hood Canal Summer | Moderate-High | High | Moderate-High | Moderate-High | > Increased water | Washington  is near the southern extent of the geographic range for chum salmon, which suggests they may be sensitive to increases in |

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| **Species** | **Overall Vulnerability** | **Overall Confidence** | **Sensitivity Rank** | **Exposure Rank** | **Summary of Exposure** | **Summary of Sensitivity** |
| Chum Salmon ESU | | | | | temperatures (freshwater and sea surface)<br>> Increased winter/spring flood events<br>> Lower summer flows | water temperature (freshwater and ocean). Chum salmon incubate embryos in freshwater, but juveniles migrate to estuaries as age-zeros, typically during the spring; the spawning migrations of adult fish typically occur in early fall. Thus chum salmon may be sensitive to lower summer flows during adult migration to spawning areas. Altered freshwater thermal regimes could affect chum salmon by altering their phenology and potentially creating mismatch between arrival in estuaries and the timing of ideal ecological conditions in estuarine habitats. Chum salmon will likely be most sensitive to changes in marine thermal regimes. In general, Pacific salmon survival is positively related to sea surface temperatures (SST) at the northern extent of their distribution, and negatively related at the southern extent. However, recent evidence suggests that chum salmon may be less sensitive to SST at the southern extent of their range compared with pink and sockeye. Chum salmon embryos are vulnerable to flood events that can scour redds or bury them in silt. Chum may be vulnerable to altered flow regimes that include increased flood severity, particularly in watersheds where land use has enhanced stream flashiness. |
| Inland Redband Trout (landlocked populations) | Moderate-High | Low | Moderate | Moderate-High | > Increased water temperatures<br>> Altered timing/magnitude of spring runoff<br>> Lower summer flows | In general, there is little information on Inland Redband Trout sensitivity to climate change. Inland Redband Trout are likely sensitive to increasing water temperatures and altered flow regimes. While Inland Redband Trout can persist in desert streams that often exceed 68˚F through what appears to be local physiological adaptation, increased water temperatures pose a threat to this species because though their thermal optima is higher than other salmonids, their thermal maxima is similar. Further, warming temperatures may lead to increased non-native species invasion or competition with native “cool water” fishes such as cyprinids and catostomids. Inland Redband Trout spawn in the spring, thus their embryos and recently emerged fry may be sensitive to changes in the timing and magnitude of spring runoff. Lower summer flows may decrease habitat volume and access to headwater reaches for this species. Inland Redband Trout exhibit broad phenotypic (e.g. age at maturity, frequency and timing of spawning, temperature tolerance, etc.) and life history diversity, which may decrease overall sensitivity of this species. |

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| **Species** | **Overall Vulnerability** | **Overall Confidence** | **Sensitivity Rank** | **Exposure Rank** | **Summary of Exposure** | **Summary of Sensitivity** |
| Lake Chub | Moderate | Low | Moderate | Moderate | > Increased water temperatures<br>> Altered flow regimes<br>> Increased sedimentation | Although little information regarding the sensitivity of Lake Chub to climate change is available for Washington, analyses from other regions (e.g. Wyoming, South Dakota, Colorado) indicate that this species may be vulnerable to changes in water temperature, water levels, and turbidity. Lake Chub occupy cool, clear water, spawn in stream or lake margins, and are obligatory sight feeders. Water temperatures affect developmental rates and likely influence spawning timing. Shifting flow regimes (including low flows and flood frequency/ magnitudes), drought conditions, and warming temperatures could affect rearing success and adult survival, particularly for fragmented or isolated populations. In addition, post-wildfire sedimentation could affect water turbidity and affect foraging success. |
| Leopard Dace | Moderate-High | Low | Moderate | Moderate-High | > Increased water temperatures<br>> Lower summer flows<br>> Altered timing/magnitude of spring floods | Although little information is available regarding the sensitivity of Leopard Dace to climate change (particularly in Washington), as a cool-water associate, this species is likely sensitive to increasing water temperatures (upper lethal limit is 73°F). As a summer spawning species that occupies creeks, shallow lacustrine habitats, and low- to medium-sized rivers, Leopard Dace may also be vulnerable to decreasing summer streamflows, particularly if they exacerbate temperature increases. Increasing temperatures and shifting flow and flood regimes may also affect prey availability (e.g. aquatic insect larvae, earthworms). For example, spring floods were found to be a key delivery mechanism of earthworms, which constitute a large portion of Leopard Dace spring diet. |
| Lower Columbia Chinook Salmon ESU | Moderate-High | High | Moderate-High | Moderate-High | > Increased freshwater temperatures<br>> Lower summer flows<br>> Increased winter/spring flood events | In general, Chinook salmon appear sensitive to warmer water temperatures, low flows, and high flows. Warmer water temperatures can affect physiological performance and energy budgets, as well as developmental rates and the timing of key lifecycle transitions (i.e. phenology). Lower stream flows have been linked to mass mortality events of Chinook salmon. Extreme high flows can reduce the likelihood of egg survival during incubation, and both low and high flows can affect adult migration.<br><br>Temperature: Chinook salmon appear sensitive to elevated freshwater temperatures both as juveniles rearing in tributary streams and as |

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| **Species** | **Overall Vulnerability** | **Overall Confidence** | **Sensitivity Rank** | **Exposure Rank** | **Summary of Exposure** | **Summary of Sensitivity** |
| | | | | | | adults migrating up river networks to spawn. Water temperatures positively affect metabolic costs, so warming reduces the amount of time a spawning adult can persist in freshwater and decreases the total distance a fish can migrate on a given level of energy stores. Indeed, Chinook salmon that migrate slower, and accrue more energy loss, have higher mortality rates in the Columbia River. In addition to energetic effects, temperatures in excess of ~63˚F (the approximate temperature at which the maximum rate of physiological processes is observed for Chinook salmon) begin to thermally stress individuals, making them more vulnerable to pathogens and other health issues. Episodes of high water temperature have led to large mortality events in several river systems within or adjacent to the Columbia River Basin. In the Columbia River, cool tributaries provide refuge from heat stress for migratory Chinook salmon, and may reduce the sensitivity of this species to warming temperatures. However, time spent in thermal refugia can come at a price, such as increased exposure to angling pressure, later arrival at spawning grounds, and other factors.<br><br>Warming temperatures in the streams where Chinook salmon rear can have negative effects even when temperatures are not near the thermal maxima of the species. For example, the strength of density dependence in fish growth was positively related to water temperature, which corroborates the mechanistic predictions of bioenergetics models. This suggests warming temperatures decrease the carrying capacity of streams for rearing juvenile salmonids. Because Chinook salmon rear in streams for up to 3 years, they are vulnerable to heat stress during low flow periods of late summer and fall. However, the life history diversity of this species (particularly the diversity in age at maturity) likely enhances resilience to mortality events such as extreme flows or temperatures.<br><br>The variation in sensitivity among Chinook salmon populations and life histories is difficult to predict. Upriver populations are potentially more sensitive to water temperature and/or low flows because of their increased cumulative exposure to thermal stress and the higher |

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| **Species** | **Overall Vulnerability** | **Overall Confidence** | **Sensitivity Rank** | **Exposure Rank** | **Summary of Exposure** | **Summary of Sensitivity** |
| | | | | | | metabolic demands of a longer migration. However, these populations are likely better adapted to deal with thermal and energetic stress compared to lower Columbia River populations. For example, lower river populations (particularly ocean-type/fall run stocks) have lower energy stores and may be just as vulnerable to temperature-induced increases in metabolic costs as are upriver populations. In terms of run timing, stream- and ocean-type life histories (i.e. spring and fall runs, respectively) each have their own unique sensitivities to temperature. Stream-type fish rear longer in freshwater, and thus have greater cumulative exposure to potential water temperature-related stressors in tributary streams. However, ocean-type individuals migrate to sea at a smaller size (typically age-zero fry) and may be more vulnerable to any energetic impacts of warmer temperatures in lower rivers and estuaries. As adults, stream-type individuals migrate during the cooler months of the year in spring and then reside upriver before spawning in the fall; whereas ocean-type fish migrate during the warmest part of the year in late summer and fall, but spawn immediately afterward and therefore spend much less time running negative energy budgets in freshwater. Thus stream-type adults are relatively more vulnerable to heat stress and energy demands during summer residence, whereas ocean-type adults are more vulnerable to stress during migration itself. Assessing how each life history has responded to contemporary variation in climate is challenging because of confounding factors: stream-type populations are located higher in river systems and have been heavily affected by their increased cumulative exposure to dams<br><br>Flow regimes: Low flows during the summer and fall may be stressful for migrating adults. Mass mortality events in both fall and spring-run Chinook salmon have been linked to high temperatures due to low flows. Some salmon populations may also depend on high flows to allow passage to upstream spawning areas. For example, spring-run (stream-type) Chinook often migrate to spawning grounds during the high flows that occur from late-winter through early-summer. However, high flow events during the fall and winter can scour the gravels where embryos incubate, reducing egg-to-fry survival. Increased severity of winter |

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| **Species** | **Overall Vulnerability** | **Overall Confidence** | **Sensitivity Rank** | **Exposure Rank** | **Summary of Exposure** | **Summary of Sensitivity** |
| | | | | | | floods has been linked to decreased egg-to-fry survival in Washington.<br><br>Snowmelt and the resulting runoff in spring may be important for aiding the seaward migration of salmon smolts. Reduced flows during the spring have both direct and indirect effects on smolt migrations. The reduced stream velocities increase the travel time required for smolts to reach the ocean–this in turn increases the time of exposure to predators. Low flows may also make smolts more vulnerable to predators per unit of time exposed. With warming, species such as Smallmouth Bass, Walleye, and Northern Pikeminnow will almost certainly become more effective predators on salmon smolts. Spring-run Chinook are particularly vulnerable to predation because they originate higher in river networks and have longer migrations to sea. However, although fall-run Chinook have shorter seaward migrations, many populations emigrate as age-zero fry, which makes them vulnerable to broader size-spectra of predators, likely increasing their predation risk per unit time of migration.<br><br>Marine: Increases in ocean and estuarine temperature, increased stratification of the water column, and/or changes in the intensity and timing of coastal upwelling may alter primary and secondary productivity, with potential impacts on growth, productivity, survival, and migrations of salmonids. For example, cool Pacific-Decadal Oscillation (PDO) years have historically coincided with high returns of Chinook salmon, while warm PDO cycles coincided with declines in salmon numbers. In general, changes in coastal ocean habitat quality and productivity could negatively impact Chinook salmon. |
| Lower Columbia Coho ESU | Moderate-High | High | Moderate-High | Moderate-High | > Increased water temperatures (freshwater and sea surface)<br>> Lower summer | In general, coho salmon likely exhibit sensitivity to warmer water temperatures (freshwater and ocean) and lower summer flows.<br><br>Freshwater temperature and flow regimes: Central California represents the southern extent of the range for coho salmon, suggesting that they may be less sensitive to increases in water temperature than other species of Pacific salmon (i.e. pink, chum, and sockeye). However, due to their reliance on streams for freshwater rearing, coho are likely |

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| **Species** | **Overall Vulnerability** | **Overall Confidence** | **Sensitivity Rank** | **Exposure Rank** | **Summary of Exposure** | **Summary of Sensitivity** |
| | | | | | flows | sensitive to both altered flow and thermal regimes. Juveniles prefer low-velocity habitat often in off-channel areas; reduced summer flows may increase the likelihood that such off-channel habitats become inaccessible, thermally stressful, or hypoxic.<br><br>Early run timing individuals might be more sensitive to fall flood events, which are projected to increase in Washington, and may also be more sensitive to warmer water temperatures and lower flows during peak migration timing (i.e. mid-August to September). Later run timing individuals should be less sensitive because they migrate as adults during cooler periods of the year and their embryos are not yet buried in the gravel during late fall flooding. However, late run individuals may be more likely to have embryos or recently emerged fry threatened by spring flooding that is predicted to increase in severity and frequency.<br><br>In general, coho salmon populations may be less resilient to episodic mortality events caused by climate stressors, because they exhibit only moderate levels of life history diversity and do not have as much variation in age at maturity as do sockeye salmon and Chinook salmon.<br><br>Marine: Increases in ocean and estuarine temperature, increased stratification of the water column, and/or changes in the intensity and timing of coastal upwelling may alter primary and secondary productivity, with potential impacts on growth, productivity, survival, and migrations of salmonids. For example, cool Pacific-Decadal Oscillation (PDO) years have historically coincided with high returns of coho salmon, while warm PDO cycles coincided with declines in salmon numbers. Cooler SSTs during the winter prior to and after smolt migration have also been linked to higher coho survival. In general, changes in coastal ocean habitat quality and productivity could negatively impact coho salmon. |
| Lower Columbia Steelhead DPS | Moderate-High | High | Moderate-High | Moderate-High | > Altered spring runoff timing and amount/mag | The survival of steelhead embryos or recently emerged fry may be sensitive to the timing and magnitude of spring runoff rather than the fall and winter aspects of flow regimes. For example, high winter flows that threaten the egg-to-fry survival of fall-spawning salmonids are not |

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| **Species** | **Overall Vulnerability** | **Overall Confidence** | **Sensitivity Rank** | **Exposure Rank** | **Summary of Exposure** | **Summary of Sensitivity** |
| | | | | | nitude<br>> Increased water temperatures<br>> Lower summer flows | predicted to negatively affect steelhead.<br><br>Steelhead may also exhibit some sensitivity to warming water temperatures. Direct measures of Oncorhynchus mykiss thermal physiology suggest many parameters do not differ significantly from those of other salmonids (except in locally adapted populations of Redband Rainbow Trout in desert streams). In addition, contemporary temperature regimes in the Columbia River cause steelhead and Chinook salmon to use the same thermal refuges during spawning migrations. Similar to Chinook salmon, steelhead are vulnerable to high angling pressure when seeking refuge in cold refugia such as tributary junctions; thus warmer temperatures can have indirect effects on mortality. However, the geographic distribution of steelhead suggests they may be less sensitive to warm temperatures than other anadromous salmonids—steelhead occur in Southern California, farther south than any Pacific salmon. Further, the resident life history form of steelhead can persist in desert streams that often exceed 68˚F through what appears to be local adaptation. Whether steelhead populations from warmer streams exhibit higher thermal tolerance is poorly understood, as is the potential rate of evolution in attributes of thermal physiology.<br><br>Similar to Chinook salmon, steelhead exhibit alternative life histories in regards to run-timing, which confer different sensitivities to climate. Summer-run steelhead migrate higher in river networks, entering freshwater between late spring and fall, and overwinter before spawning the following spring. In contrast, winter-run steelhead migrate during winter or early spring and spawn immediately. Because they spend more time in freshwater, summer-run populations of steelhead may be more sensitive to changes in flow and temperature regimes across river networks. For example, higher temperatures will increase the metabolic costs accrued by summer-run steelhead during the several months that they hold in streams prior to spawning.<br><br>The existence of a resident life history form likely buffers steelhead from |

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| **Species** | **Overall Vulnerability** | **Overall Confidence** | **Sensitivity Rank** | **Exposure Rank** | **Summary of Exposure** | **Summary of Sensitivity** |
| | | | | | | environmental stochasticity and may make populations less vulnerable to extirpation. For example, anadromous individuals can survive ephemeral periods of unsuitability in their natal streams while they are away at the ocean, whereas residents can survive in years where conditions are poor along migratory routes. |
| Margined Sculpin | Moderate | Low | Low-Moderate | Moderate-High | > Increased water temperatures | Little information is available regarding the sensitivity of Margined Sculpin to climate change. Margined Sculpin likely prefer aquatic habitat with water temperatures below 68°F; they can withstand short exposure to 77°F water temperatures, but experience mortality at and above 80°F. Margined Sculpin are largely associated with pools and deeper habitats, although more recent studies indicate they may exhibit broader habitat usage than previously thought. However, a limited distribution (they are found in only a few drainages in Washington) likely limits their ability to move in response to climate change and human land use impacts (e.g. sedimentation, channelization, and water pollution related to logging, agriculture, development, and grazing). |
| Middle Columbia Steelhead DPS | Moderate-High | High | Moderate-High | Moderate | > Altered spring runoff timing and amount/magnitude<br>> Increased water temperatures<br>> Lower summer flows | The survival of steelhead embryos or recently emerged fry may be sensitive to the timing and magnitude of spring runoff rather than the fall and winter aspects of flow regimes. For example, high winter flows that threaten the egg-to-fry survival of fall-spawning salmonids are not predicted to negatively affect steelhead.<br><br>Steelhead may also exhibit some sensitivity to warming water temperatures. Direct measures of *steelhead* thermal physiology suggest many parameters do not differ significantly from those of other salmonids (except in locally adapted populations of redband rainbow trout in desert streams). In addition, contemporary temperature regimes in the Columbia River cause steelhead and Chinook salmon to use the same thermal refuges during spawning migrations. Similar to Chinook salmon, steelhead are vulnerable to high angling pressure when seeking refuge in cold refugia such as tributary junctions; thus warmer temperatures can have indirect effects on mortality. However, the geographic distribution of steelhead suggests they may be less sensitive to warm temperatures than other anadromous salmonids—steelhead occur in Southern California, farther south than any Pacific salmon. |

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| **Species** | **Overall Vulnerability** | **Overall Confidence** | **Sensitivity Rank** | **Exposure Rank** | **Summary of Exposure** | **Summary of Sensitivity** |
| | | | | | | Further, the resident life history form of steelhead can persist in desert streams that often exceed 68˚F through what appears to be local adaptation. Whether steelhead populations from warmer streams exhibit higher thermal tolerance is poorly understood, as is the potential rate of evolution in attributes of thermal physiology.<br><br>Similar to Chinook salmon, steelhead exhibit alternative life histories in regards to run-timing, which confer different sensitivities to climate. Summer-run steelhead migrate higher in river networks, entering freshwater between late spring and fall, and overwinter before spawning the following spring. In contrast, winter-run steelhead migrate during winter or early spring and spawn immediately. Because they spend more time in freshwater, summer-run populations of steelhead may be more sensitive to changes in flow and temperature regimes across river networks. For example, higher temperatures will increase the metabolic costs accrued by summer-run steelhead during the several months that they hold in streams prior to spawning.<br><br>The existence of a resident life history form likely buffers steelhead from environmental stochasticity and may make populations less vulnerable to extirpation. For example, anadromous individuals can survive ephemeral periods of unsuitability in their natal streams while they are away at the ocean, whereas residents can survive in years where conditions are poor along migratory routes. |
| Mountain Sucker | Low-Moderate | Low | Low-Moderate | Moderate | > Increased water temperatures<br>> Altered flow regimes | Little information is available regarding the sensitivity of Mountain Sucker to climate change. Spawning typically occurs during mid- to late-summer during stable low flows and in water temperatures between 52-66°F. Warming water temperatures may affect spawning timing and other physiological and life history components of Mountain Sucker, including length of egg incubation. Floods, droughts, and altered streamflow volume likely impact egg and juvenile survival, availability of spawning habitat, and/or food availability (i.e. algae). Wildfires and resultant effects on stream temperatures, turbidity, and flow volumes may affect the quality and availability of mountain sucker habitat, but further information is needed. |

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| **Species** | **Overall Vulnerability** | **Overall Confidence** | **Sensitivity Rank** | **Exposure Rank** | **Summary of Exposure** | **Summary of Sensitivity** |
| Olympic Mudminnow | Moderate | Low | Moderate | Moderate | > Increased high flood events | Olympic Mudminnows occupy slow-moving streams, ponds, and freshwater wetlands at lower elevations with minimal water flow and ample aquatic vegetation. This species appears to be fairly tolerant of temperature and oxygen fluctuations, but has been documented to seek out cooler water temperatures and shaded areas during summer temperature peaks. Relative intolerance of swift water limits Olympic Mudminnow distribution to lowland areas, and in combination with salinity intolerance, may make them vulnerable to sea level rise and saltwater intrusion in current wetland habitat, although no studies examining this risk have been conducted. This species is likely to be sensitive to any hydrological shifts (e.g. low flows, flood timing and magnitude, altered sediment delivery) that affect freshwater wetland availability, function, and composition. |
| Ozette Sockeye ESU | Moderate | Low | Moderate | Moderate | > Increased water temperatures (freshwater and sea surface)<br>> Increased winter/spring flood events | In general, sockeye salmon likely exhibit sensitivity to warmer water temperatures (freshwater and sea surface) and increased severity or frequency of winter/spring flood events. Washington is near the southern extent of the range for sockeye salmon, suggesting that they will be sensitive to increases in water temperature (freshwater and ocean). For example, even at the northern extent of their range in Alaska, sockeye salmon in shallow, non-stratified lakes may be thermally stressed in the summer. In Washington, sockeye generally rear in deep, thermally stratified lakes and can move below the thermocline if surface waters become thermally unsuitable. This suggests that sockeye may be less sensitive to temperature during the freshwater phase of their life history, as they are able to behaviorally thermoregulate. Additionally, sockeye may be somewhat more buffered from metabolic stresses associated with warmer water temperatures because lake food webs are generally more productive than that of streams. In general, Pacific salmon survival is positively related to sea surface temperatures (SST) at the northern extent of their distribution, and negatively related at the southern extent. Indeed, recent research suggests that survival rates of sockeye salmon are strongly affected by variations in regional SST during early ocean life, with lower survival rates during years with warm SST anomalies (however, the mechanisms driving this trend may be upwelling and marine productivity rather than temperature per se). |

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| **Species** | **Overall Vulnerability** | **Overall Confidence** | **Sensitivity Rank** | **Exposure Rank** | **Summary of Exposure** | **Summary of Sensitivity** |
| | | | | | | Increases in ocean and estuarine temperature, increased stratification of the water column, and/or changes in the intensity and timing of coastal upwelling may alter primary and secondary productivity, with potential impacts on growth, productivity, survival, and migrations of salmonids. Sockeye salmon are also likely sensitive to winter flood events that can scour substrates or move gravel and silts to bury embryos. Increased severity of winter floods has been linked to decreased egg-to-fry survival in fall-spawning Pacific salmon of Washington. |
| Pacific Cod (Salish Sea population) | High | High | High | Moderate-High | > Increased ocean temperatures | Though limited information is available regarding the sensitivity of the Salish Sea population of Pacific Cod to climate change, their main sensitivity will be due to potential increases in sea surface temperature. Pacific cod spawning and recruitment are strongly linked to temperature, with colder water supporting larger hatch size and maximizing growth performance. Cooler waters also support higher abundance of zooplankton prey (e.g. copepods), which is thought to be linked to increased recruitment. Temperature over 45°F appear to be associated with poor spawning success and limited recruitment. For Atlantic Cod, declines in recruitment with increasing temperature were particularly high for cod at the limits of their distribution. Pacific Cod in Washington are already at the upper end of their thermal preference, which is likely to increase their sensitivity to any increases in temperature and could lead to northward population shifts. |
| Pacific Hake (Georgia Basin DPS) | Low-Moderate | Moderate | Low-Moderate | Moderate | > Increased ocean temperatures<br>> Altered upwelling patterns | Pacific Hake are unlikely to experience direct physiological sensitivity to climate change. However, increases in sea surface temperature, changes in upwelling patterns, and the associated changes that these trigger in zooplankton abundance will increase their sensitivity. Pacific Hake have already been documented as moving northward into Canadian waters; this shift is thought to be linked to higher food abundance in more northerly waters. Pacific Hake primarily target euphausiids, which often decline in abundance with warmer water conditions. Potential increases in water temperature could lead to decreases in euphausiid prey, declines in recruitment, and further northward shifts of Pacific Hake. |
| Pacific Herring (Georgia Basin | Moderate-High | High | Moderate | Moderate-High | > Increased ocean | A main way in which Pacific Herring will be sensitive to climate change is through change in their prey availability and the distribution of |

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| **Species** | **Overall Vulnerability** | **Overall Confidence** | **Sensitivity Rank** | **Exposure Rank** | **Summary of Exposure** | **Summary of Sensitivity** |
| DPS) | | | | | temperatures<br>> Altered upwelling patterns<br>> Changes in salinity<br>> Saltwater intrusion in estuarine habitat | appropriate spawning habitat. Primary and secondary productivity are strongly linked to juvenile abundance, as juveniles tend to prey on zooplankton (e.g. copepods). Predicted increases in sea surface temperature and changes in upwelling, such as delayed and shorter upwelling seasons, could affect the timing and abundance of available prey for juveniles, though the magnitude of these effects is uncertain. In Washington, Pacific Herring populations have already shown northward movement for spawning and smaller juvenile cohorts, and these patterns could increase with predicted increases in sea surface temperature. Increased temperatures could also lead to northward shifts and increased abundance of Pacific Hake, which prey upon Pacific Herring and could thus lead to population declines through increased predation. Pacific Herring will also be sensitive to potential changes in nearshore and estuarine spawning habitat, such as increased salinity due to sea level rise and saltwater intrusion in estuaries, which could create suboptimal conditions for spawning and larval growth. Additionally, the suite of vegetative species used by this species as spawning substrate could change with long-term variation in water temperature and acidity. The prevalence and composition of this algal mat could result in degradation of spawning habitat to a degree that ultimately reduces incubation success. |
| Pacific Lamprey | Moderate-High | Moderate | Moderate-High | Moderate-High | > Increased water temperatures<br>> Lower summer/fall flows<br>> Increased winter flood events<br>> Altered fire regimes | Pacific Lamprey exhibit physiological sensitivity to warming water temperatures. Egg and ammocoete survival is lowest and larval deformations most common at 72°F relative to lower water temperatures. Warmer summer water temperatures (>68°F) have also been found to compound adult body size reductions and accelerate sexual maturation and post-spawning death the following spring. All life stages of Pacific Lamprey are likely vulnerable to shifting flow regimes due to reduced snowpack, earlier snowmelt, and shifting precipitation regimes. Warmer water temperatures and low summer and fall flows can affect adult spawning migration timing (i.e. migration occurs earlier in warmer, lower flow years) and/or inhibit adult migrations upriver by constricting channels or causing thermal barriers. Reduced streamflows can also limit or degrade floodplain habitat for spawning and rearing by elevating water temperatures and/or contributing to juvenile and nest |

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| **Species** | **Overall Vulnerability** | **Overall Confidence** | **Sensitivity Rank** | **Exposure Rank** | **Summary of Exposure** | **Summary of Sensitivity** |
| | | | | | | stranding and desiccation. Juvenile Pacific Lamprey, which occupy low velocity stream margins, and Pacific Lamprey nests, which are found in low gradient stream reaches, may also be vulnerable to scouring via winter flood events. Wildfire may also affect survival and rearing by reducing stream shading; high shade is correlated with higher Pacific Lamprey ammocoete abundance. Climate-driven changes in the marine environment may also affect Pacific Lamprey, but little is known about this part of their life stage. |
| Pacific Sand Lance | Moderate-High | Moderate | Moderate | Moderate-High | > Increased air and ocean temperatures<br>> Decreased oxygen<br>> Sea level rise<br>> Increased coastal erosion | Though there is limited information regarding the sensitivity of Pacific Sand Lance to climate change, their sensitivity is likely to stem from climate-induced changes in their intertidal spawning habitat and changes in prey distribution and abundance. Increasing air and sea surface temperatures could lead to suboptimal sediment temperature and lower oxygen conditions in sediments where Pacific Sand Lance prefer to burrow, forcing them to emerge from the sediment and making them more susceptible to predation. Pacific Sand Lance tend to return to the same burrowing sediment habitat interannual, so changes in nearshore habitat (e.g. due to rising sea level or coastal erosion from increased storms) could limit burrowing and spawning habitat availability. Increasing sea surface temperature could also lead to declines and changes in distribution in zooplankton, limited prey availability for sand lance, and decreased recruitment. |
| Puget Sound Chinook Salmon ESU | Moderate-High | High | Moderate-High | Moderate-High | > Increased freshwater temperatures<br>> Lower summer flows<br>> Increased winter/spring flood events | In general, Chinook salmon appear sensitive to warmer water temperatures, low flows, and high flows. Warmer water temperatures can affect physiological performance and energy budgets, as well as developmental rates and the timing of key lifecycle transitions (i.e. phenology). Lower stream flows have been linked to mass mortality events of Chinook salmon. Extreme high flows can reduce the likelihood of egg survival during incubation, and both low and high flows can affect adult migration.<br><br>Temperature: Chinook salmon appear sensitive to elevated freshwater temperatures both as juveniles rearing in tributary streams and as adults migrating up river networks to spawn. Water temperatures positively affect metabolic costs, so warming reduces the amount of |

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| **Species** | **Overall Vulnerability** | **Overall Confidence** | **Sensitivity Rank** | **Exposure Rank** | **Summary of Exposure** | **Summary of Sensitivity** |
| | | | | | | time a spawning adult can persist in freshwater and decreases the total distance a fish can migrate on a given level of energy stores. Indeed, Chinook salmon that migrate slower, and accrue more energy loss, have higher mortality rates in the Columbia River. In addition to energetic effects, temperatures in excess of ~63˚F (the approximate temperature at which the maximum rate of physiological processes is observed for Chinook salmon) begin to thermally stress individuals, making them more vulnerable to pathogens and other health issues. Episodes of high water temperature have led to large mortality events in several river systems within or adjacent to the Columbia River Basin. Puget Sound Chinook salmon may be more sensitive to warmer summer temperatures and lower flows, as their spawning migration encounters the warmest part of the watershed (the downstream portion) during the warmer part of the year (later summer and early fall). Cool tributaries may provide refuge from heat stress for migratory Chinook salmon, and may reduce the sensitivity of this species to warming temperatures.<br><br>Warming temperatures in the streams where Chinook salmon rear can have negative effects even when temperatures are not near the thermal maxima of the species. For example, the strength of density dependence in fish growth was positively related to water temperature, which corroborates the mechanistic predictions of bioenergetics models. This suggests warming temperatures decrease the carrying capacity of streams for rearing juvenile salmonids. Because Puget Sound Chinook salmon rear in streams for up to 1 year, they may be vulnerable to heat stress during low flow periods of late summer and fall. However, the life history diversity of this species (particularly the diversity in age at maturity) likely enhances resilience to mortality events such as extreme flows or temperatures.<br><br>Flow regimes: Low flows during the summer and fall may be stressful for migrating adults. Mass mortality events in both fall and spring-run Chinook salmon have been linked to high temperatures due to low flows. Some salmon populations may also depend on high flows to allow passage to upstream spawning areas. For example, spring-run (stream- |

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| **Species** | **Overall Vulnerability** | **Overall Confidence** | **Sensitivity Rank** | **Exposure Rank** | **Summary of Exposure** | **Summary of Sensitivity** |
| | | | | | | type) Chinook often migrate to spawning grounds during the high flows that occur from late-winter through early-summer. However, high flow events during the fall and winter can scour the gravels where embryos incubate, reducing egg-to-fry survival. Increased severity of winter floods has been linked to decreased egg-to-fry survival in Washington. Snowmelt and the resulting runoff in spring may be important for aiding the seaward migration of salmon smolts. Reduced flows during the spring have both direct and indirect effects on smolt migrations.<br><br>Marine: Increases in ocean and estuarine temperature, increased stratification of the water column, and/or changes in the intensity and timing of coastal upwelling may alter primary and secondary productivity, with potential impacts on growth, productivity, survival, and migrations of salmonids. For example, cool Pacific-Decadal Oscillation (PDO) years have historically coincided with high returns of Chinook salmon, while warm PDO cycles coincided with declines in salmon numbers. In general, changes in coastal ocean habitat quality and productivity could negatively impact Chinook salmon. |
| Puget Sound Steelhead DPS | Moderate-High | High | Moderate-High | Moderate-High | > Altered spring runoff timing and amount/magnitude<br>> Increased water temperatures<br>> Increased flood events and associated sedimentation and/or scour<br>> Lower summer | In general, steelhead appear sensitive to warmer water temperatures, low flows, and high flows. Warmer water temperatures can affect physiological performance and energy budgets, as well as developmental rates and the timing of key lifecycle transitions (i.e. phenology). Lower stream flows (particularly summer and early fall) can reduce the probability of survival in rearing juveniles. Extreme high flows can reduce the likelihood of egg survival during incubation, and both low and high flows can affect adult migration. Steelhead may be able to shift the timing of a life stage transition to reduce the probability of exposure to changes in temperature or flow through phenotypic plasticity.<br><br>Similar to Chinook salmon, steelhead exhibit alternative life histories in regards to run-timing, which confer different sensitivities to climate. Summer-run steelhead migrate higher in river networks, entering freshwater between late spring and fall, and overwinter before spawning the following spring. In contrast, winter-run steelhead migrate |

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| **Species** | **Overall Vulnerability** | **Overall Confidence** | **Sensitivity Rank** | **Exposure Rank** | **Summary of Exposure** | **Summary of Sensitivity** |
| | | | | | flows | during winter or early spring and spawn immediately. Because they spend more time in freshwater, summer-run populations of steelhead may be more sensitive to changes in flow and temperature regimes across river networks. For example, higher temperatures will increase the metabolic costs accrued by summer-run steelhead during the several months that they hold in streams prior to spawning.<br><br>The existence of a resident life history form likely buffers steelhead from environmental stochasticity and may make populations less vulnerable to extirpation. For example, anadromous individuals can survive ephemeral periods of unsuitability in their natal streams while they are away at the ocean, whereas residents can survive in years where conditions are poor along migratory routes.<br><br>Temperature: Steelhead may exhibit some sensitivity to warming water temperatures. Direct measures of steelhead thermal physiology suggest many parameters do not differ significantly from those of other salmonids (except in locally adapted populations of redband rainbow trout in desert streams). In addition, contemporary temperature regimes in the Columbia River cause steelhead and Chinook salmon to use the same thermal refuges during spawning migrations. Similar to Chinook salmon, steelhead are vulnerable to high angling pressure when seeking refuge in cold refugia such as tributary junctions; thus warmer temperatures can have indirect effects on mortality. However, the geographic distribution of steelhead suggests they may be less sensitive to warm temperatures than other anadromous salmonids—steelhead occur in Southern California, farther south than any Pacific salmon. Further, the resident life history form of *steelhead* can persist in desert streams that often exceed 68˚C through what appears to be local adaptation. Whether steelhead populations from warmer streams exhibit higher thermal tolerance is poorly understood, as is the potential rate of evolution in attributes of thermal physiology.<br><br>Flow regimes: The survival of steelhead embryos or recently emerged fry may be sensitive to the timing and magnitude of spring runoff rather |

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| | | | | | | than the fall and winter aspects of flow regimes. For example, high winter flows that threaten the egg-to-fry survival of fall-spawning salmonids are not predicted to negatively affect steelhead.<br><br>Marine: Increases in ocean and estuarine temperature, increased stratification of the water column, and/or changes in the intensity and timing of coastal upwelling may alter primary and secondary productivity, with potential impacts on growth, productivity, survival, and migrations of salmonids. |
| Pygmy Whitefish | Low-Moderate | Low | Low-Moderate | Moderate | > Increased water temperatures<br>> Altered fire regimes | Pygmy Whitefish occupy cool lakes and streams with temperatures below 50°F, and are likely adapted to cold and low-productivity environments (i.e. small size, early maturation), making them sensitive to increasing water temperatures. Warmer water temperatures may have direct physiological effects, allow upstream expansion of some populations (provided no barriers exist) and/or affect ecological interactions by expanding the range of potential predators or competitors. Wildfires that remove stream- or lakeside vegetation may exacerbate temperature increases and/or contribute to sedimentation, which can affect spawning habitat. |
| Quillback Rockfish | Moderate-High | Moderate | Moderate | Moderate-High | > Increased ocean temperatures<br>> Sea level rise<br>> Declines in pH<br>> Decreased oxygen | The main sensitivity of Quillback Rockfish to climate change is likely to stem from changes to their prey base. Warmer ocean conditions could lead to decreases in prey (e.g. copepods for juveniles, larger crustaceans, small fish, and cephalopods for adults) for both juveniles and adults, prompting decreases in adult fecundity and juvenile survival. Additionally, nearshore habitat loss due to sea level rise could impact juvenile survival, as juveniles tend to use nearshore habitat as nursery and foraging area. Deepwater coral habitat, which many adult rockfish use, may also decrease due to acidification, further reducing available habitat. Decreased oxygen levels may have direct physiological effects on Quillback Rockfish, leading to higher levels of mortality across various life stages. Due to their long life cycles and generation times, adults may be able to persist through short term pulses of negative ocean conditions (e.g. years with warmer sea surface temperature), though conversely, their low productivity could make it difficult for populations to recover from climate-related declines. |

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| Redstripe Rockfish | Moderate-High | Moderate | Moderate | Moderate-High | > Increased ocean temperatures<br>> Sea level rise<br>> Declines in pH<br>> Decreased oxygen | The main sensitivity of Redstripe Rockfish to climate change is likely to stem from changes to their prey base. Warmer ocean conditions could lead to decreases in prey (e.g. copepods for juveniles, larger crustaceans, small fish, and cephalopods for adults) for both juveniles and adults, prompting decreases in adult fecundity and juvenile survival. Additionally, nearshore habitat loss due to sea level rise could impact juvenile survival, as juveniles tend to use nearshore habitat as nursery and foraging area. Deepwater coral habitat, which many adult rockfish use, may also decrease due to acidification, further reducing available habitat. Decreased oxygen levels may have direct physiological effects on Redstripe Rockfish, leading to higher levels of mortality across various life stages. Due to their long life cycles and generation times, adults may be able to persist through short term pulses of negative ocean conditions (e.g. years with warmer sea surface temperature), though conversely, their low productivity could make it difficult for populations to recover from climate-related declines. |
| River Lamprey | Moderate-High | Low | Moderate-High | Moderate | > Increased water temperatures (fresh and ocean)<br>> Lower summer/fall flows<br>> Increased winter flood events | Little is known about River Lamprey vulnerability to climate change (particularly in Washington), but they likely have similar vulnerability to Pacific Lamprey because they exhibit similar life history stages (spawning, rearing, and migration), although they typically occupy larger rivers at lower elevations. Rearing individuals may be vulnerable to shifts in flow regimes (e.g. desiccation or stranding due to low flows, enhanced scouring from high flows) and water quality (e.g. temperature increases), and adult River Lamprey may also be vulnerable to temperature and migration barriers resulting from reduced streamflows. Changes in the marine and estuarine environment that affect River Lamprey hosts (e.g. Pacific Herring, Surf Smelt) will likely affect the marine survival of this species. |
| Salish Sucker | Moderate-High | Moderate | Moderate | Moderate-High | > Lower summer flows<br>> Increased high flood events (frequency | Salish Suckers occupy lakes and pools of headwater streams, spawn in riffles, and prefer long/deep pools with slower water velocities that are adjacent to shallow habitat with abundant vegetation (i.e. in-stream and over-stream cover). They are likely sensitive to climate-driven changes in habitat availability and quality. Declining summer and spring streamflows may affect pool length and depth, availability of spawning areas, and/or habitat connectivity. Altered riparian cover due to wildfire |

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| **Species** | **Overall Vulnerability** | **Overall Confidence** | **Sensitivity Rank** | **Exposure Rank** | **Summary of Exposure** | **Summary of Sensitivity** |
| | | | | | and magnitude)<br>> Decreased oxygen | and land use changes can affect rearing habitat availability and quality and exacerbate increasing water temperatures. Altered flood frequencies or magnitudes may also affect this species, particularly if off-channel refugia is not available. Salish Suckers appear to be fairly tolerant of various water temperatures; spawning typically begins around 45-46°F, but has been documented in water temperatures up to 68°F. However, sublethal effects of warmer water temperatures are unknown (e.g. impacts on growth, fecundity, disease incidence). Hypoxic conditions are increasingly threatening this species, and are exacerbated by warmer water temperatures and streamflow reductions. |
| Snake River Spring/Summer Chinook Salmon ESU | Moderate-High | High | Moderate-High | Moderate-High | > Increased freshwater temperatures<br>> Lower summer flows<br>> Increased winter/spring flood events | In general, Chinook salmon appear sensitive to warmer water temperatures, low flows, and high flows. Warmer water temperatures can affect physiological performance and energy budgets, as well as developmental rates and the timing of key lifecycle transitions (i.e. phenology). Lower stream flows have been linked to mass mortality events of Chinook salmon. Extreme high flows can reduce the likelihood of egg survival during incubation, and both low and high flows can affect adult migration.<br><br>Temperature: Chinook salmon appear sensitive to elevated freshwater temperatures both as juveniles rearing in tributary streams and as adults migrating up river networks to spawn. Water temperatures positively affect metabolic costs, so warming reduces the amount of time a spawning adult can persist in freshwater and decreases the total distance a fish can migrate on a given level of energy stores. Indeed, Chinook salmon that migrate slower, and accrue more energy loss, have higher mortality rates in the Columbia River. In addition to energetic effects, temperatures in excess of ~63˚F (the approximate temperature at which the maximum rate of physiological processes is observed for Chinook salmon) begin to thermally stress individuals, making them more vulnerable to pathogens and other health issues. Episodes of high water temperature have led to large mortality events in several river systems within or adjacent to the Columbia River Basin. In the Columbia River, cool tributaries provide refuge from heat stress for migratory Chinook salmon, and may reduce the sensitivity of this species to |

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| **Species** | **Overall Vulnerability** | **Overall Confidence** | **Sensitivity Rank** | **Exposure Rank** | **Summary of Exposure** | **Summary of Sensitivity** |
| | | | | | | warming temperatures. However, time spent in thermal refugia can come at a price, such as increased exposure to angling pressure, later arrival at spawning grounds, and other factors.<br><br>Warming temperatures in the streams where Chinook salmon rear can have negative effects even when temperatures are not near the thermal maxima of the species. For example, the strength of density dependence in fish growth was positively related to water temperature, which corroborates the mechanistic predictions of bioenergetics models. This suggests warming temperatures decrease the carrying capacity of streams for rearing juvenile salmonids. Because Chinook salmon rear in streams for up to 3 years, they are vulnerable to heat stress during low flow periods of late summer and fall. However, the life history diversity of this species (particularly the diversity in age at maturity) likely enhances resilience to mortality events such as extreme flows or temperatures.<br><br>The variation in sensitivity among Chinook salmon populations and life histories is difficult to predict. Upriver populations are potentially more sensitive to water temperature and/or low flows because of their increased cumulative exposure to thermal stress and the higher metabolic demands of a longer migration. However, these populations are likely better adapted to deal with thermal and energetic stress compared to lower Columbia River populations. For example, lower river populations (particularly ocean-type/fall run stocks) have lower energy stores and may be just as vulnerable to temperature-induced increases in metabolic costs as are upriver populations. In terms of run timing, stream- and ocean-type life histories (i.e. spring and fall runs, respectively) each have their own unique sensitivities to temperature. Stream-type fish rear longer in freshwater, and thus have greater cumulative exposure to potential water temperature-related stressors in tributary streams. However, ocean-type individuals migrate to sea at a smaller size (typically age-zero fry) and may be more vulnerable to any energetic impacts of warmer temperatures in lower rivers and estuaries. As adults, stream-type individuals migrate during the cooler months of |

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| | | | | | | the year in spring and then reside upriver before spawning in the fall; whereas ocean-type fish migrate during the warmest part of the year in late summer and fall, but spawn immediately afterward and therefore spend much less time running negative energy budgets in freshwater. Thus stream-type adults are relatively more vulnerable to heat stress and energy demands during summer residence, whereas ocean-type adults are more vulnerable to stress during migration itself. Assessing how each life history has responded to contemporary variation in climate is challenging because of confounding factors: stream-type populations are located higher in river systems and have been heavily affected by their increased cumulative exposure to dams<br><br>Flow regimes: Low flows during the summer and fall may be stressful for migrating adults. Mass mortality events in both fall and spring-run Chinook salmon have been linked to high temperatures due to low flows. Some salmon populations may also depend on high flows to allow passage to upstream spawning areas. For example, spring-run (stream-type) Chinook often migrate to spawning grounds during the high flows that occur from late-winter through early-summer. However, high flow events during the fall and winter can scour the gravels where embryos incubate, reducing egg-to-fry survival. Increased severity of winter floods has been linked to decreased egg-to-fry survival in Washington.<br><br>Snowmelt and the resulting runoff in spring may be important for aiding the seaward migration of salmon smolts. Reduced flows during the spring have both direct and indirect effects on smolt migrations. The reduced stream velocities increase the travel time required for smolts to reach the ocean–this in turn increases the time of exposure to predators. Low flows may also make smolts more vulnerable to predators per unit of time exposed. With warming, species such as Smallmouth Bass, Walleye, and Northern Pikeminnow will almost certainly become more effective predators on salmon smolts. Spring-run Chinook are particularly vulnerable to predation because they originate higher in river networks and have longer migrations to sea. However, although fall-run Chinook have shorter seaward migrations, many |

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| **Species** | **Overall Vulnerability** | **Overall Confidence** | **Sensitivity Rank** | **Exposure Rank** | **Summary of Exposure** | **Summary of Sensitivity** |
| | | | | | | populations emigrate as age-zero fry, which makes them vulnerable to broader size-spectra of predators, likely increasing their predation risk per unit time of migration.<br><br>Marine: Increases in ocean and estuarine temperature, increased stratification of the water column, and/or changes in the intensity and timing of coastal upwelling may alter primary and secondary productivity, with potential impacts on growth, productivity, survival, and migrations of salmonids. For example, cool Pacific-Decadal Oscillation (PDO) years have historically coincided with high returns of Chinook salmon, while warm PDO cycles coincided with declines in salmon numbers. In general, changes in coastal ocean habitat quality and productivity could negatively impact Chinook salmon. |
| Snake River Basin Steelhead DPS | Moderate-High | High | Moderate-High | Moderate-High | > Altered spring runoff timing and amount/magnitude<br>> Increased water temperatures<br>> Lower summer flows | In general, steelhead appear sensitive to warmer water temperatures, low flows, and high flows. Warmer water temperatures can affect physiological performance and energy budgets, as well as developmental rates and the timing of key lifecycle transitions (i.e. phenology). Lower stream flows (particularly summer and early fall) can reduce the probability of survival in rearing juveniles. Extreme high flows can reduce the likelihood of egg survival during incubation, and both low and high flows can affect adult migration. Steelhead may be able to shift the timing of a life stage transition to reduce the probability of exposure to changes in temperature or flow through phenotypic plasticity.<br><br>Similar to Chinook salmon, steelhead exhibit alternative life histories in regards to run-timing, which confer different sensitivities to climate. Summer-run steelhead migrate higher in river networks, entering freshwater between late spring and fall, and overwinter before spawning the following spring. In contrast, winter-run steelhead migrate during winter or early spring and spawn immediately. Because they spend more time in freshwater, summer-run populations of steelhead may be more sensitive to changes in flow and temperature regimes across river networks. For example, higher temperatures will increase the metabolic costs accrued by summer-run steelhead during the |

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| | | | | | | several months that they hold in streams prior to spawning.<br><br>The existence of a resident life history form likely buffers steelhead from environmental stochasticity and may make populations less vulnerable to extirpation. For example, anadromous individuals can survive ephemeral periods of unsuitability in their natal streams while they are away at the ocean, whereas residents can survive in years where conditions are poor along migratory routes.<br><br>Temperature: Steelhead may exhibit some sensitivity to warming water temperatures. Direct measures of steelhead thermal physiology suggest many parameters do not differ significantly from those of other salmonids (except in locally adapted populations of Redband Rainbow Trout in desert streams). In addition, contemporary temperature regimes in the Columbia River cause steelhead and Chinook salmon to use the same thermal refuges during spawning migrations. Similar to Chinook salmon, steelhead are vulnerable to high angling pressure when seeking refuge in cold refugia such as tributary junctions; thus warmer temperatures can have indirect effects on mortality. However, the geographic distribution of steelhead suggests they may be less sensitive to warm temperatures than other anadromous salmonids—steelhead occur in Southern California, farther south than any Pacific salmon. Further, the resident life history form of steelhead can persist in desert streams that often exceed 68˚F through what appears to be local adaptation. Whether steelhead populations from warmer streams exhibit higher thermal tolerance is poorly understood, as is the potential rate of evolution in attributes of thermal physiology.<br><br>Flow regimes: The survival of steelhead embryos or recently emerged fry may be sensitive to the timing and magnitude of spring runoff rather than the fall and winter aspects of flow regimes. For example, high winter flows that threaten the egg-to-fry survival of fall-spawning salmonids are not predicted to negatively affect steelhead.<br><br>Marine: Increases in ocean and estuarine temperature, increased |

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| **Species** | **Overall Vulnerability** | **Overall Confidence** | **Sensitivity Rank** | **Exposure Rank** | **Summary of Exposure** | **Summary of Sensitivity** |
| | | | | | | stratification of the water column, and/or changes in the intensity and timing of coastal upwelling may alter primary and secondary productivity, with potential impacts on growth, productivity, survival, and migrations of salmonids. |
| Snake River Fall Chinook Salmon ESU | Moderate-High | High | Moderate-High | Moderate-High | > Increased freshwater temperatures<br>> Lower summer flows<br>> Increased winter/spring flood events | In general, Chinook salmon appear sensitive to warmer water temperatures, low flows, and high flows. Warmer water temperatures can affect physiological performance and energy budgets, as well as developmental rates and the timing of key lifecycle transitions (i.e. phenology). Lower stream flows have been linked to mass mortality events of Chinook salmon. Extreme high flows can reduce the likelihood of egg survival during incubation, and both low and high flows can affect adult migration.<br><br>Temperature: Chinook salmon appear sensitive to elevated freshwater temperatures both as juveniles rearing in tributary streams and as adults migrating up river networks to spawn. Water temperatures positively affect metabolic costs, so warming reduces the amount of time a spawning adult can persist in freshwater and decreases the total distance a fish can migrate on a given level of energy stores. Indeed, Chinook salmon that migrate slower, and accrue more energy loss, have higher mortality rates in the Columbia River. In addition to energetic effects, temperatures in excess of ~63˚F (the approximate temperature at which the maximum rate of physiological processes is observed for Chinook salmon) begin to thermally stress individuals, making them more vulnerable to pathogens and other health issues. Episodes of high water temperature have led to large mortality events in several river systems within or adjacent to the Columbia River Basin. In the Columbia River, cool tributaries provide refuge from heat stress for migratory Chinook salmon, and may reduce the sensitivity of this species to warming temperatures. However, time spent in thermal refugia can come at a price, such as increased exposure to angling pressure, later arrival at spawning grounds, and other factors.<br><br>Warming temperatures in the streams where Chinook salmon rear can have negative effects even when temperatures are not near the thermal |

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| | | | | | | maxima of the species. For example, the strength of density dependence in fish growth was positively related to water temperature, which corroborates the mechanistic predictions of bioenergetics models. This suggests warming temperatures decrease the carrying capacity of streams for rearing juvenile salmonids. Because Chinook salmon rear in streams for up to 3 years, they are vulnerable to heat stress during low flow periods of late summer and fall. However, the life history diversity of this species (particularly the diversity in age at maturity) likely enhances resilience to mortality events such as extreme flows or temperatures.<br><br>The variation in sensitivity among Chinook salmon populations and life histories is difficult to predict. Upriver populations are potentially more sensitive to water temperature and/or low flows because of their increased cumulative exposure to thermal stress and the higher metabolic demands of a longer migration. However, these populations are likely better adapted to deal with thermal and energetic stress compared to lower Columbia River populations. For example, lower river populations (particularly ocean-type/fall run stocks) have lower energy stores and may be just as vulnerable to temperature-induced increases in metabolic costs as are upriver populations. In terms of run timing, stream- and ocean-type life histories (i.e. spring and fall runs, respectively) each have their own unique sensitivities to temperature. Stream-type fish rear longer in freshwater, and thus have greater cumulative exposure to potential water temperature-related stressors in tributary streams. However, ocean-type individuals migrate to sea at a smaller size (typically age-zero fry) and may be more vulnerable to any energetic impacts of warmer temperatures in lower rivers and estuaries. As adults, stream-type individuals migrate during the cooler months of the year in spring and then reside upriver before spawning in the fall; whereas ocean-type fish migrate during the warmest part of the year in late summer and fall, but spawn immediately afterward and therefore spend much less time running negative energy budgets in freshwater. Thus stream-type adults are relatively more vulnerable to heat stress and energy demands during summer residence, whereas ocean-type |

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| | | | | | | adults are more vulnerable to stress during migration itself. Assessing how each life history has responded to contemporary variation in climate is challenging because of confounding factors: stream-type populations are located higher in river systems and have been heavily affected by their increased cumulative exposure to dams<br><br>Flow regimes: Low flows during the summer and fall may be stressful for migrating adults. Mass mortality events in both fall and spring-run Chinook salmon have been linked to high temperatures due to low flows. Some salmon populations may also depend on high flows to allow passage to upstream spawning areas. For example, spring-run (stream-type) Chinook often migrate to spawning grounds during the high flows that occur from late-winter through early-summer. However, high flow events during the fall and winter can scour the gravels where embryos incubate, reducing egg-to-fry survival. Increased severity of winter floods has been linked to decreased egg-to-fry survival in Washington.<br><br>Snowmelt and the resulting runoff in spring may be important for aiding the seaward migration of salmon smolts. Reduced flows during the spring have both direct and indirect effects on smolt migrations. The reduced stream velocities increase the travel time required for smolts to reach the ocean–this in turn increases the time of exposure to predators. Low flows may also make smolts more vulnerable to predators per unit of time exposed. With warming, species such as Smallmouth Bass, Walleye, and Northern Pikeminnow will almost certainly become more effective predators on salmon smolts. Spring-run Chinook are particularly vulnerable to predation because they originate higher in river networks and have longer migrations to sea. However, although fall-run Chinook have shorter seaward migrations, many populations emigrate as age-zero fry, which makes them vulnerable to broader size-spectra of predators, likely increasing their predation risk per unit time of migration.<br><br>Marine: Increases in ocean and estuarine temperature, increased stratification of the water column, and/or changes in the intensity and |

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| | | | | | | timing of coastal upwelling may alter primary and secondary productivity, with potential impacts on growth, productivity, survival, and migrations of salmonids. For example, cool Pacific-Decadal Oscillation (PDO) years have historically coincided with high returns of Chinook salmon, while warm PDO cycles coincided with declines in salmon numbers. In general, changes in coastal ocean habitat quality and productivity could negatively impact Chinook salmon. |
| Surf Smelt | Moderate-High | High | Moderate-High | Moderate-High | > Increased air temperatures<br>> Altered upwelling patterns<br>> Sea level rise<br>> Increased storminess | The primary presumed threat to Surf Smelt as a result of climate change is a reduction in spawning habitat due to sea level rise, acting in concert with shoreline armoring – a situation known as the "coastal squeeze." Because Surf Smelt utilize intertidal beaches for spawning, and the backshores of these beaches tend to be armored with bulkheads and other structures, rising sea level will effectively eliminate these habitats. Surf Smelt may also experience some physiological sensitivity to climate change since warmer and drier beach conditions have been shown to lead to higher levels of egg mortality. Surf Smelt sensitivity will be increased by potential changes in zooplankton prey availability. Predicted delayed and shorter upwelling systems could affect the timing and abundance of prey and lead to declines in prey availability, particularly for juveniles, though the magnitude of these impacts is uncertain. Additionally, since Washington Surf Smelt tend to use a small number of beaches for spawning, changes in beach habitat due to sea level rise and stronger and increased storms could lead to declines in available spawning area. |
| Tiger Rockfish | Moderate-High | Moderate | Moderate | Moderate-High | > Increased ocean temperatures<br>> Sea level rise<br>> Declines in pH<br>> Decreased oxygen | The main sensitivity of Tiger Rockfish to climate change is likely to stem from changes to their prey base. Warmer ocean conditions could lead to decreases in prey (e.g. zooplankton) for both juveniles and adults, prompting decreases in adult fecundity and juvenile survival. Additionally, nearshore habitat loss due to sea level rise could impact juvenile survival, as juveniles tend to use nearshore habitat as nursery and foraging area. Deepwater coral habitat, which many adult rockfish use, may also decrease due to acidification, further reducing available habitat. Decreased oxygen levels may have direct physiological effects on Tiger Rockfish, leading to higher levels of mortality across various life stages. Due to their long life cycles and generation times, adults may be |

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| | | | | | | able to persist through short term pulses of negative ocean conditions (e.g. years with warmer sea surface temperature), though conversely, their low productivity could make it difficult for populations to recover from climate-related declines. |
| Tui Chub | Low-Moderate | Low | Low-Moderate | Moderate | > Increased water temperatures<br>> Altered flow regimes<br>> Altered fire regimes | Little information is available regarding the sensitivity of Tui Chub to climate change. Tui Chub inhabit lakes and slow-moving pools in riverine environments, spawning and rearing in shallow areas in spring and summer. Similar to other minnow species, they are likely sensitive to climate-driven shifts in rearing and spawning habitat near stream and lake margins (e.g. reduced habitat due to reduced spring/summer low flows or lake water levels caused by reduced snowpack, earlier snowmelt, shifting precipitation regimes and/or drought). Wildfire may also affect streamside vegetative cover and rearing habitat, as young Tui Chub are typically found close to shore in areas with heavy vegetation. Tui Chub are also likely sensitive to increasing water temperatures, as yearly spring temperature increases cue spawning timing. |
| Umatilla Dace | Moderate | Low | Low-Moderate | Moderate-High | > Lower stream flows | Little information is available regarding the sensitivity of Umatilla Dace to climate change. Umatilla Dace may benefit from increasing water temperatures, as they are currently restricted to warmer habitat areas (e.g. mainstem and downstream areas), preferring zones with slightly warmer water temperatures (64-68°F). They are also found in cooler habitats, although they may exhibit reduced mobility and retreat to interstitial spaces at cooler temperatures. Umatilla Dace is likely sensitive to reduced streamflows resulting from reduced snowpack, earlier snowmelt, and drought, particularly if streamflow declines are exacerbated by shifts in human water use. Juveniles and young-of-the-year occupy stream margins, making them vulnerable to stranding as streamflows decline. |
| Upper Columbia River Spring Chinook Salmon ESU | Moderate-High | High | Moderate-High | Moderate-High | > Increased freshwater temperatures<br>> Lower summer flows<br>> Increased | In general, Chinook salmon appear sensitive to warmer water temperatures, low flows, and high flows. Warmer water temperatures can affect physiological performance and energy budgets, as well as developmental rates and the timing of key lifecycle transitions (i.e. phenology). Lower stream flows have been linked to mass mortality events of Chinook salmon. Extreme high flows can reduce the likelihood of egg survival during incubation, and both low and high flows can affect |

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| **Species** | **Overall Vulnerability** | **Overall Confidence** | **Sensitivity Rank** | **Exposure Rank** | **Summary of Exposure** | **Summary of Sensitivity** |
| | | | | | winter/spring flood events | adult migration.<br><br>Temperature: Chinook salmon appear sensitive to elevated freshwater temperatures both as juveniles rearing in tributary streams and as adults migrating up river networks to spawn. Water temperatures positively affect metabolic costs, so warming reduces the amount of time a spawning adult can persist in freshwater and decreases the total distance a fish can migrate on a given level of energy stores. Indeed, Chinook salmon that migrate slower, and accrue more energy loss, have higher mortality rates in the Columbia River. In addition to energetic effects, temperatures in excess of ~63˚F (the approximate temperature at which the maximum rate of physiological processes is observed for Chinook salmon) begin to thermally stress individuals, making them more vulnerable to pathogens and other health issues. Episodes of high water temperature have led to large mortality events in several river systems within or adjacent to the Columbia River Basin. In the Columbia River, cool tributaries provide refuge from heat stress for migratory Chinook salmon, and may reduce the sensitivity of this species to warming temperatures. However, time spent in thermal refugia can come at a price, such as increased exposure to angling pressure, later arrival at spawning grounds, and other factors.<br><br>Warming temperatures in the streams where Chinook salmon rear can have negative effects even when temperatures are not near the thermal maxima of the species. For example, the strength of density dependence in fish growth was positively related to water temperature, which corroborates the mechanistic predictions of bioenergetics models. This suggests warming temperatures decrease the carrying capacity of streams for rearing juvenile salmonids. Because Chinook salmon rear in streams for up to 3 years, they are vulnerable to heat stress during low flow periods of late summer and fall. However, the life history diversity of this species (particularly the diversity in age at maturity) likely enhances resilience to mortality events such as extreme flows or temperatures. |

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| **Species** | **Overall Vulnerability** | **Overall Confidence** | **Sensitivity Rank** | **Exposure Rank** | **Summary of Exposure** | **Summary of Sensitivity** |
| | | | | | | The variation in sensitivity among Chinook salmon populations and life histories is difficult to predict. Upriver populations are potentially more sensitive to water temperature and/or low flows because of their increased cumulative exposure to thermal stress and the higher metabolic demands of a longer migration. However, these populations are likely better adapted to deal with thermal and energetic stress compared to lower Columbia River populations. For example, lower river populations (particularly ocean-type/fall run stocks) have lower energy stores and may be just as vulnerable to temperature-induced increases in metabolic costs as are upriver populations. In terms of run timing, stream- and ocean-type life histories (i.e. spring and fall runs, respectively) each have their own unique sensitivities to temperature. Stream-type fish rear longer in freshwater, and thus have greater cumulative exposure to potential water temperature-related stressors in tributary streams. However, ocean-type individuals migrate to sea at a smaller size (typically age-zero fry) and may be more vulnerable to any energetic impacts of warmer temperatures in lower rivers and estuaries. As adults, stream-type individuals migrate during the cooler months of the year in spring and then reside upriver before spawning in the fall; whereas ocean-type fish migrate during the warmest part of the year in late summer and fall, but spawn immediately afterward and therefore spend much less time running negative energy budgets in freshwater. Thus stream-type adults are relatively more vulnerable to heat stress and energy demands during summer residence, whereas ocean-type adults are more vulnerable to stress during migration itself. Assessing how each life history has responded to contemporary variation in climate is challenging because of confounding factors: stream-type populations are located higher in river systems and have been heavily affected by their increased cumulative exposure to dams<br><br>Flow regimes: Low flows during the summer and fall may be stressful for migrating adults. Mass mortality events in both fall and spring-run Chinook salmon have been linked to high temperatures due to low flows. Some salmon populations may also depend on high flows to allow passage to upstream spawning areas. For example, spring-run (stream- |

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| **Species** | **Overall Vulnerability** | **Overall Confidence** | **Sensitivity Rank** | **Exposure Rank** | **Summary of Exposure** | **Summary of Sensitivity** |
| | | | | | | type) Chinook often migrate to spawning grounds during the high flows that occur from late-winter through early-summer. However, high flow events during the fall and winter can scour the gravels where embryos incubate, reducing egg-to-fry survival. Increased severity of winter floods has been linked to decreased egg-to-fry survival in Washington.<br><br>Snowmelt and the resulting runoff in spring may be important for aiding the seaward migration of salmon smolts. Reduced flows during the spring have both direct and indirect effects on smolt migrations. The reduced stream velocities increase the travel time required for smolts to reach the ocean–this in turn increases the time of exposure to predators. Low flows may also make smolts more vulnerable to predators per unit of time exposed. With warming, species such as Smallmouth Bass, Walleye, and Northern Pikeminnow will almost certainly become more effective predators on salmon smolts. Spring-run Chinook are particularly vulnerable to predation because they originate higher in river networks and have longer migrations to sea. However, although fall-run Chinook have shorter seaward migrations, many populations emigrate as age-zero fry, which makes them vulnerable to broader size-spectra of predators, likely increasing their predation risk per unit time of migration.<br><br>Marine: Increases in ocean and estuarine temperature, increased stratification of the water column, and/or changes in the intensity and timing of coastal upwelling may alter primary and secondary productivity, with potential impacts on growth, productivity, survival, and migrations of salmonids. For example, cool Pacific-Decadal Oscillation (PDO) years have historically coincided with high returns of Chinook salmon, while warm PDO cycles coincided with declines in salmon numbers. In general, changes in coastal ocean habitat quality and productivity could negatively impact Chinook salmon. |
| Upper Columbia Steelhead DPS | Moderate-High | High | Moderate-High | Moderate-High | > Altered spring runoff timing and amount/mag | The survival of steelhead embryos or recently emerged fry may be sensitive to the timing and magnitude of spring runoff rather than the fall and winter aspects of flow regimes. For example, high winter flows that threaten the egg-to-fry survival of fall-spawning salmonids are not |

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| **Species** | **Overall Vulnerability** | **Overall Confidence** | **Sensitivity Rank** | **Exposure Rank** | **Summary of Exposure** | **Summary of Sensitivity** |
| | | | | | nitude<br>> Increased water temperatures | predicted to negatively affect steelhead.<br><br>Steelhead may also exhibit some sensitivity to warming water temperatures. Direct measures of steelhead thermal physiology suggest many parameters do not differ significantly from those of other salmonids (except in locally adapted populations of Redband Rainbow Trout in desert streams). In addition, contemporary temperature regimes in the Columbia River cause steelhead and Chinook salmon to use the same thermal refuges during spawning migrations. Similar to Chinook salmon, steelhead are vulnerable to high angling pressure when seeking refuge in cold refugia such as tributary junctions; thus warmer temperatures can have indirect effects on mortality. However, the geographic distribution of steelhead suggests they may be less sensitive to warm temperatures than other anadromous salmonids—steelhead occur in Southern California, farther south than any Pacific salmon. Further, the resident life history form of steelhead can persist in desert streams that often exceed 68˚F through what appears to be local adaptation. Whether steelhead populations from warmer streams exhibit higher thermal tolerance is poorly understood, as is the potential rate of evolution in attributes of thermal physiology.<br><br>Similar to Chinook salmon, steelhead exhibit alternative life histories in regards to run-timing, which confer different sensitivities to climate. Summer-run steelhead migrate higher in river networks, entering freshwater between late spring and fall, and overwinter before spawning the following spring. In contrast, winter-run steelhead migrate during winter or early spring and spawn immediately. Because they spend more time in freshwater, summer-run populations of steelhead may be more sensitive to changes in flow and temperature regimes across river networks. For example, higher temperatures will increase the metabolic costs accrued by summer-run steelhead during the several months that they hold in streams prior to spawning.<br><br>The existence of a resident life history form likely buffers steelhead from environmental stochasticity and may make populations less vulnerable |

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| **Species** | **Overall Vulnerability** | **Overall Confidence** | **Sensitivity Rank** | **Exposure Rank** | **Summary of Exposure** | **Summary of Sensitivity** |
| | | | | | | to extirpation. For example, anadromous individuals can survive ephemeral periods of unsuitability in their natal streams while they are away at the ocean, whereas residents can survive in years where conditions are poor along migratory routes. |
| Walleye Pollock (South Puget Sound) | Moderate | High | Moderate | Moderate | > Increased ocean temperatures | Walleye Pollock are likely to be sensitive to increases in sea surface temperature, particularly since Puget Sound is the southern limit of their range. Cooler waters support higher levels of Walleye Pollock recruitment and larval survival because cooler waters promote increased production of primary prey species for pollock (e.g. copepods, euphausiids, other zooplankton). For Walleye Pollock in the Bering Sea, it was found that though warmer spring conditions during spawning season enhanced early survival of larvae, continued higher temperatures led to poor feeding conditions and reduced recruitment the following year. Thus, predicted warming could result in decreases in prey abundance and declines in recruitment, larval survival, and productivity and potential northward range shifts of Walleye Pollock. |
| Westslope Cutthroat Trout | Low-Moderate | Low | Low-Moderate | Moderate | > Increased spring flood events<br>> Altered runoff timing and amount<br>> Increased water temperatures<br>> Lower summer flows | Westslope Cutthroat Trout spawn in the spring and are thus sensitive to the timing and magnitude of snowmelt and the accompanying flood pulse. Winter floods do not pose a risk to Westslope Cutthroat Trout embryos, but it is possible that increased severity of fall and winter floods could negatively affect overwintering juveniles (although quality data on this topic are lacking due to the challenge of monitoring survival in flood prone systems).<br><br>Like many stream rearing salmonids, Westslope Cutthroat Trout can be vulnerable to sub-optimally warm temperatures during base flow periods in late summer and fall. During these low flow periods, terrestrial subsidies typically comprise the dominant food source for this species, and may be critical for enabling fish to offset the elevated metabolic costs caused by higher water temperatures. Factors that mediate the magnitude of terrestrial subsidies, such as land use practices in riparian areas, can in turn mediate the sensitivity of trout to altered thermal regimes.<br><br>Recruitment of Westslope Cutthroat Trout in high elevation streams |

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| **Species** | **Overall Vulnerability** | **Overall Confidence** | **Sensitivity Rank** | **Exposure Rank** | **Summary of Exposure** | **Summary of Sensitivity** |
| | | | | | | may be constrained by cold, rather than warm, summer temperatures. Warming may have some positive effects by increasing the amount of high elevation habitat capable of rearing juveniles.<br><br>The primary source of decline for Westslope Cutthroat Trout has been hybridization with Rainbow Trout. A key uncertainty is how climate conditions might facilitate hybridization. Genetically pure Westslope Cutthroat Trout often exist in cold tributary streams and show subtle signs of being better adapted to cold temperatures than Rainbow Trout when studied in the laboratory. This suggests warming temperatures could increase hybridization by allowing Rainbow Trout to invade cold headwater streams. However, in an analysis across a large watershed, environmental factors were not as important as demographic factors in determining levels of hybridization.<br><br>Westslope Cutthroat Trout are unique among the cutthroat subspecies in that they exhibit an anadromous, coastal-roaming ecotype. Populations with this life history may be less sensitive to altered flow and thermal regimes in freshwater because there is less cumulative exposure to freshwater conditions and individuals at sea can survive ephemeral climate-related disturbance such as thermal stress events or periods of low flow. |
| White Sturgeon (Columbia River) | Moderate | Low | Moderate | Moderate | > Increased water temperatures<br>> Lower summer flows | White Sturgeon likely exhibit physiological sensitivity to warmer water temperatures, and increasing temperatures may reduce spawning success and/or increase disease risk and mortality. White Sturgeon are also sensitive to declining spring and summer streamflows, which reduce spawning habitat and annual recruitment; loss of spawning habitat and reduced recruitment associated with lower streamflows is a particular concern for impounded portions of the Columbia River. Shifts in ocean conditions may also affect prey availability for young White Sturgeon in estuarine environments, and reduced prey availability has been linked with undermined White Sturgeon growth. |
| Yelloweye Rockfish (Puget | Moderate-High | Moderate | Moderate | Moderate-High | > Increased ocean temperatures | The main sensitivity of Yelloweye Rockfish to climate change is likely to stem from changes to their prey base. Warmer ocean conditions could lead to decreases in prey (e.g. small fish, crabs, gastropods) for both |

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| Species | Overall Vulnerability | Overall Confidence | Sensitivity Rank | Exposure Rank | Summary of Exposure | Summary of Sensitivity |
| Sound/Georgia Basin DPS) | | | | | > Sea level rise<br>> Declines in pH<br>> Decreased oxygen | juveniles and adults, prompting decreases in adult fecundity and growth and juvenile survival. Additionally, nearshore habitat loss due to sea level rise could impact juvenile survival, as juveniles tend to use nearshore habitat as nursery and foraging area. Deepwater coral habitat, which is particularly preferred by Yelloweye Rockfish, may also decrease due to acidification, further reducing available habitat. Decreased oxygen levels may have direct physiological effects on Yelloweye Rockfish, leading to higher levels of mortality across various life stages. Due to their long life cycles and generation times, adults may be able to persist through short term pulses of negative ocean conditions (e.g. years with warmer sea surface temperature), though conversely, their low productivity could make it difficult for populations to recover from climate-related declines. |

## Invertebrate Vulnerability Rankings

| INVERTEBRATES | | | | | | |
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| Species | Overall Vulnerability | Overall Confidence | Sensitivity Rank | Exposure Rank | Summary of Exposure | Summary of Sensitivity |
| A Caddisfly *(Allomyia acanthis)* | High | Moderate | High | Moderate-High | > Increased air and water temperatures<br>> Low summer flows<br>> Increased sedimentation and erosion | *Allomyia acanthis* is an uncommon species of caddisfly found in only a few locations in the Cascade regions of Washington and Oregon. Although little is known about this species, caddisflies in the genus *Allomyia* are restricted to high-elevation coldwater streams in the larval and pupae stages, where they build protective cases of silk and small pieces of rock. Climate sensitivity for this species is likely tied primarily to their specialized habitat, which is particularly vulnerable to warming air and water temperatures, low summer flows, sedimentation from upstream erosion, and habitat fragmentation from nearby human activity (i.e. forestry practices and road construction). Caddisflies in general are often considered an indicator of high-quality streams, suggesting that they are particularly vulnerable to changes in their habitat. |
| A Caddisfly *(Goereilla* | High | High | High | Moderate-High | > Increased air and water | *Goereilla baumanni* is a species of caddisfly found only in few sites and always in very low numbers in Washington, Idaho, and Montana. They |

| INVERTEBRATES | | | | | | |
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| **Species** | **Overall Vulnerability** | **Overall Confidence** | **Sensitivity Rank** | **Exposure Rank** | **Summary of Exposure** | **Summary of Sensitivity** |
| *baumanni)* | | | | | temperatures<br>> Drought and/or changes in precipitation<br>> Low summer flows<br>> Increased sedimentation and erosion | are restricted to headwater springs and seepage in high-elevation forested areas during their larval and pupae stages, and within this habitat are associated with the surrounding muck comprised of decomposing organic materials. Sensitivity for this species is likely tied primarily to their specialized habitat, which is particularly vulnerable to warming air and water temperatures, low summer flows, sedimentation from upstream erosion, and habitat fragmentation from nearby human activity (i.e. forestry practices and road construction). The close association of *Goereilla baumanni* to organic muck may make this species particularly sensitive to high temperatures, drought, and precipitation changes which may make these areas more likely to dry out. Caddisflies in general are often considered an indicator of high-quality streams, suggesting that they are particularly vulnerable to changes in their habitat. |
| A Caddisfly *(Limnephilus flavastellus)* | Moderate-High | Low | Moderate | Moderate-High | > Increased air and water temperatures<br>> Drought and/or changes in precipitation<br>> Increased sedimentation and erosion | Little information is available on the caddisfly species *Limnephilus flavastellus*, which can be found in mountainous areas of Washington, Oregon, and British Columbia. Their habitat can include coldwater ponds in forested areas, where they live in the water throughout their larval and pupae stages. This species is likely less sensitive than caddisflies that are restricted only to coldwater streams, as they can tolerate the slightly larger range of conditions found in ponds. Sensitivity for this species is likely tied primarily to their specialized habitat, which is vulnerable to warming air and water temperatures, drought and changing precipitation patterns, sedimentation from upstream erosion, and habitat fragmentation from nearby human activity (i.e. forestry practices and road construction). Caddisflies in general are often considered an indicator of high-quality streams, suggesting that they are may be vulnerable to changes in their habitat. |
| A Caddisfly *(Psychoglypha browni)* | Moderate-High | Moderate | Moderate-High | Moderate-High | > Increased air and water temperatures<br>> Drought and/or changes in precipitation | *Psychoglypha browni* is an uncommon species of caddisfly found only in the Cascades region of Washington and Oregon. Little is known about this species, though the genus Psychoglypha is restricted to coldwater aquatic habitats such as streams, small rivers, and ponds in high-elevation forested areas. Sensitivity for this species is likely tied primarily to their specialized habitat, which is vulnerable to warming air and water temperatures, drought and changing precipitation patterns, |

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| **Species** | **Overall Vulnerability** | **Overall Confidence** | **Sensitivity Rank** | **Exposure Rank** | **Summary of Exposure** | **Summary of Sensitivity** |
| | | | | | > Low summer flows<br>> Increased sedimentation and erosion | sedimentation from upstream erosion, and habitat fragmentation from nearby human activity (i.e. forestry practices and road construction). Caddisflies in general are often considered an indicator of high-quality streams, suggesting that they are may be vulnerable to changes in their habitat. |
| A Caddisfly *(Rhyacophila pichaca)* | Moderate | Low | Moderate | Moderate | > Changes in precipitation<br>> Drought<br>> Low summer flows | *Rhyacophila pichaca* is an uncommon species of caddisfly found in only a few locations in Washington and Oregon. Little is known about this species, but caddisflies in the genus *Rhyacophila* are fairly large and are free-living in their larval stage (i.e. they do not build cases until the pupae stage), making them particularly vulnerable to predation. All species in this genus are restricted to streams or rivers in the larval and pupae stages, though no information is available on whether this species is restricted to cold water or high-elevation areas. Given that they are dependent on running water, it is likely that drought, changes in precipitation patterns, and low summer flows contribute to this species' sensitivity. Caddisflies in general are often considered an indicator of high-quality streams, suggesting that they are may be vulnerable to changes in their habitat. |
| A Caddisfly *(Rhyacophila vetina)* | High | Moderate | High | Moderate-High | > Increased air and water temperatures<br>> Low summer flows<br>> Increased sedimentation and erosion | Little information is available on *Rhyacophila vetina*, an uncommon species of caddisfly reported in only a few high-elevation locations in the High Cascades region. Little is known about this species, but caddisflies in the genus *Rhyacophila* are fairly large and are free-living in their larval stage (i.e. they do not build cases until the pupae stage), making them particularly vulnerable to predation. All species in this genus are restricted to streams or rivers in the larval and pupae stages, and given that *Rhyacophila vetina* only occurs in high-elevation streams, it is likely tied to coldwater conditions as well. Climate sensitivity for this species is likely tied primarily to this specialized habitat, which is particularly vulnerable to warming air and water temperatures, low summer flows, sedimentation from upstream erosion, and habitat fragmentation from nearby human activity (i.e. forestry practices and road construction). Caddisflies in general are often considered an indicator of high-quality streams, suggesting that they are particularly vulnerable to changes in their habitat. |

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| **Species** | **Overall Vulnerability** | **Overall Confidence** | **Sensitivity Rank** | **Exposure Rank** | **Summary of Exposure** | **Summary of Sensitivity** |
| A Mayfly *(Cinygmula gartrelli)* | Low-Moderate | Low | Low-Moderate | Moderate | > Increased water temperatures<br>> Changes in precipitation and/or drought<br>> Low summer flows | Little is known about *Cinygmula gartrelli*, a species of mayfly which has been located in California, Oregon, Washington, Montana, and British Columbia. All mayflies require aquatic habitats for nymph survival, and this species was located in a river in at least one of the records. Sensitivity likely is tied to this requirement, and the species could be affected by drought, precipitation changes, and summer low flows. Mayflies tend to be sensitive to changes in streambed substrate, water temperature, and water quality as well. |
| A Mayfly *(Paraleptophlebia falcula)* | Low-Moderate | Low | Low-Moderate | Moderate | > Increased water temperatures<br>> Changes in precipitation and/or drought<br>> Low summer flows | Little is known about *Paraleptophlebia falcula*, a species of mayfly which has been located in rivers in Washington, Oregon, and Idaho. All mayflies require aquatic habitats for nymph survival, so sensitivity likely is tied to this requirement. This species could be affected by changes in hydrology including drought, precipitation changes, and summer low flows. Mayflies tend to be sensitive to changes in streambed substrate, water temperature, and water quality as well. |
| A Mayfly *(Paraleptophlebia jenseni)* | Low-Moderate | Low | Low-Moderate | Moderate | > Increased water temperatures<br>> Changes in precipitation and/or drought<br>> Low summer flows | Little is known about *Paraleptophlebia jenseni*, a species of mayfly which has been located in Washington and a single site in Idaho. All mayflies require aquatic habitats for nymph survival, so sensitivity likely is tied to this requirement. This species could be affected by changes in hydrology including drought, precipitation changes, and summer low flows. Mayflies tend to be sensitive to changes in streambed substrate, water temperature, and water quality as well. |
| A Mayfly *(Siphlonurus autumnalis)* | Low | Low | Low | Low-Moderate | > Increased water temperatures<br>> Changes in precipitation | *Siphlonarus autumnalis* is found along medium and large rivers in the Pacific Northwest. It usually inhabits quiet edgewaters along the rivers, particularly in rocky areas. However, it has also been found along small spring brooks, floodplain ponds, and small lakes. Although, like all mayflies, S. autumnalis requires aquatic habitats for nymph survival, the |

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| **Species** | **Overall Vulnerability** | **Overall Confidence** | **Sensitivity Rank** | **Exposure Rank** | **Summary of Exposure** | **Summary of Sensitivity** |
| | | | | | and/or drought<br>> Low summer flows | wide range of habitats in which it can survive decreases the vulnerability of this species. Sensitivity is likely tied to changes in the hydrology of these aquatic habitats, including drought, precipitation changes, and summer low flows. Mayflies tend to be sensitive to changes in streambed substrate, water temperature, and water quality as well. |
| A Noctuid Moth *(Copablepharon columbia)* | Moderate | Low | Low-Moderate | Moderate-High | > Changes in precipitation and/or drought<br>> Increased invasive species | There is limited information on the sensitivity of *Copablepharon columbia* to climate change. This species occupies open (i.e., active) Columbia Basin sand dune habitats, but has been observed at only one dune site. This species is likely sensitive to sand dune stabilization, which typically leads to a loss of native vegetation and prevents formation of new dune areas. Sand dune stabilization is enhanced by high plant cover, which is facilitated during years of high precipitation and may also occur as a result of longer growing seasons due to climate change. Invasive species can also increase rates of dune stabilization. Drought may favor higher dune activity, which could enhance habitat quality and/or increase overall habitat for this moth, but could also impact its food plants (unknown at this time). For more information on habitat sensitivity, see Inter-Mountain Basins Active and Stabilized Dune habitat assessment. |
| A Noctuid Moth *(Copablepharon mutans)* | Moderate | Low | Low-Moderate | Moderate-High | > Changes in precipitation and/or drought<br>> Increased invasive species | There is limited information on the sensitivity of *Copablepharon mutans* to climate change. Similar to *Copablepharon columbia*, it is likely sensitive to sand dune stabilization which typically leads to a loss of native vegetation and prevents formation of new dune areas. Sand dune stabilization is enhanced by high plant cover, which is facilitated during years of high precipitation and may also occur as a result of longer growing seasons due to climate change. Invasive species can also increase rates of dune stabilization. Drought may favor higher dune activity, which could enhance habitat quality and/or increase overall habitat for this moth, but could also impact its food plants (unknown at this time). For more information on habitat sensitivity, see Inter-Mountain Basins Active and Stabilized Dune habitat assessment. |
| A Noctuid Moth *(Copablepharon viridisparsa* | Moderate | Low | Low-Moderate | Moderate-High | > Changes in precipitation and/or drought | There is limited information on the sensitivity of *Copablepharon viridisparsa hopfingeri* to climate change. Similar to *Copablepharon columbia*, it is likely sensitive to sand dune stabilization which typically leads to a loss of native vegetation and prevents formation of new dune |

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| **Species** | **Overall Vulnerability** | **Overall Confidence** | **Sensitivity Rank** | **Exposure Rank** | **Summary of Exposure** | **Summary of Sensitivity** |
| *hopfingeri)* | | | | | > Increased invasive species | areas. Sand dune stabilization is enhanced by high plant cover, which is facilitated during years of high precipitation and may also occur as a result of longer growing seasons due to climate change. Invasive species can also increase rates of dune stabilization. Drought may favor higher dune activity, which could enhance habitat quality and/or increase overall habitat for this moth, but could also impact its food plants (unknown at this time). For more information on habitat sensitivity, see Inter-Mountain Basins Active and Stabilized Dune habitat assessment. |
| Ashy Pebblesnail | Moderate | Low | Low-Moderate | Moderate-High | > Altered flow regimes<br>> Reduced oxygen<br>> Increased water temperatures | There is limited information on the sensitivity of the Ashy Pebblesnail to climate change. This species displays very similar traits and habitat requirements to the Olympia Pebblesnail. The Ashy Pebblesnail's habitat range is believed to be restricted to the Columbia River Basin's rivers, streams, and creeks, although its historic range encompassed Washington, Oregon, and Idaho. The Ashy Pebblesnail requires clear, cold, highly oxygenated streams, and therefore may be sensitive to changes in flow regimes and increases in water temperature that negatively impact dissolved oxygen levels and chemical and biological processes. Changes in flow regimes that increase nutrient runoff may cause dense algae blooms that impair or prevent the Ashy Pebblesnail's access to important food resources (e.g., lithophytes). The invasive New Zealand Mudsnail (*Potamopyrgus antipodarum*) may be a direct competitor for food and habitat. |
| Barren Juga | Moderate-High | Low | Moderate-High | Moderate-High | > Altered flow regimes<br>> Reduced oxygen<br>> Increased water temperatures | There is limited information on the sensitivity of this species to climate change. The Barren Juga's habitat range includes small- to medium-sized creeks and low elevation springs in the Columbia River Gorge area. This species requires cold, highly oxygenated water, and therefore may be sensitive to changes in flow regimes and increases in water temperature that negatively impact dissolved oxygen levels and chemical and biological processes. |
| Beller's Ground Beetle | Moderate-High | ` | Moderate | Moderate-High | > Changes in precipitation (snow and rain)<br>> Increased amount | Beller's Ground Beetle inhabits sphagnum bogs or sphagnum moss in other wet areas (e.g., near springs), preferring the wettest sites available. This species' sensitivity to climate change will largely be driven by shifts in habitat availability. Reduced water availability and quality (i.e., due to precipitation shifts, reduced snowpack, earlier snowmelt) can affect bog water levels, seasonal bog duration, and rates of |

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| **Species** | **Overall Vulnerability** | **Overall Confidence** | **Sensitivity Rank** | **Exposure Rank** | **Summary of Exposure** | **Summary of Sensitivity** |
| | | | | | and/or duration of flooding<br>> Drought | succession to meadow or other adjacent vegetation, potentially reducing or degrading habitat for this beetle. This species is likely sensitive to both bog drying and prolonged inundation from flooding. Without flight capabilities, this species has limited ability to move in response to climate change (i.e., refugia would have to be contiguous and accessible by ground). Warmer temperatures may increase beetle activity; Beller's Ground Beetles have historically been found in highest numbers during hot periods. |
| Bluegray Taildropper | Low-Moderate | Low | Low-Moderate | Moderate | > Increased temperatures<br>> Reduced soil moisture and/or changes in precipitation<br>> Altered fire regimes | There is limited information regarding the sensitivity of Bluegray Taildroppers to climate change. Their main sensitivity is likely to be driven by changes in their preferred habitat – older, late successional, forests with moist ground and a mixture of hardwood and conifer trees. Increases in temperature and decreases in summer rainfall are likely to lead to increased risk of severe fires, which would destroy habitat for this species. Declines in habitat quality could also lead to fragmentation of populations, particularly since slugs are not very mobile, and eventual population declines. Additionally, decreased summer rainfall and increased droughts could lead to changes in soil moisture and availability of fungal populations that this species feeds on. |
| Brown Juga | Moderate-High | Low | Moderate-High | Moderate | > Altered flow regimes<br>> Reduced oxygen<br>> Increased water temperatures | There is limited information on the sensitivity of this species to climate change. The Brown Juga's habitat includes shallow, small streams and springs. This species requires cold, highly oxygenated water, and therefore may be sensitive to changes in flow regimes and increases in water temperature that negatively impact dissolved oxygen levels and chemical and biological processes. |
| California Floater | Moderate | Low | Low-Moderate | Moderate-High | > Increased water temperatures<br>> Altered flow regimes<br>> Drought | There is limited information regarding the sensitivity of California Floaters to climate change. This species, which has already experienced significant declines over the past few decades, is generally found in shallow pools of freshwater streams and reservoirs with good water quality and a sufficient abundance of small fish who serve as hosts for mussels during their transition from the larval to juvenile stage. Therefore, their main sensitivity is likely to stem from climate-induced changes in water quality and host fish abundance. For instance, |

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| **Species** | **Overall Vulnerability** | **Overall Confidence** | **Sensitivity Rank** | **Exposure Rank** | **Summary of Exposure** | **Summary of Sensitivity** |
| | | | | | | increased intensity of winter storms could lead to higher flow in rivers and increased nutrient runoff, both of which would degrade and reduce available mussel habitat. Additionally, increases in water temperature could lead to altered abundance of host fish for larval stage mussels, thus leading to declines in abundance. This species may also be sensitive to summer droughts, which could lead to shallower water levels in the pools that serve as mussel habitat, and potential air exposure and mortality, particularly since mussels have limited mobility and thus limited ability to respond to changes in habitat. |
| Cascades Needlefly | Moderate-High | Low | Moderate-High | Moderate | > Increased water temperatures<br>> Changes in precipitation and/or drought<br>> Altered flow regimes | The Cascades Needlefly is a rare species limited to very few sites in Washington, Oregon, Idaho, and Montana. The larvae are restricted to seeps, springs, and spring-fed streams, and the genus *Megaleuctra* is dependent on coldwater habitats that do not dry out, as well as high water quality. The sensitivity of this species is likely closely tied to their specialized habitat requirements. Changes in flow patterns due to drought or changing patterns of precipitation, changes in water temperature, and decreased water quality are all likely to increase the sensitivity of the species. Habitat fragmentation and nearby development also alter the quality and availability of suitable habitat. |
| Chelan Mountainsnail | Low-Moderate | Low | Low | Moderate-High | > Altered fire regimes | There is limited information on the sensitivity of this species to climate change. The Chelan Mountainsnail is typically found in schist talus habitat and in detritus or under shrubs with pinegrass or elk sedge understory at elevations ranging from 1197 to 2625 feet. This species may exhibit sensitivity to disturbances including wildfire, landslides, and habitat alterations that may shift the temperature and moisture regimes of preferred habitat types. |
| Chinquapin Hairstreak | Moderate-High | Low | Moderate | Moderate-High | > Increased temperatures<br>> Reduced soil moisture and/or changes in precipitation<br>> Altered fire regimes | Climate sensitivity of this species is likely driven by temperature, moisture declines, and fire. Like most insects, butterfly emergence and activity is influenced by temperature, and warmer temperatures may enhance emergence timing and/or lengthen daily flight activity. This species may be sensitive to moisture declines, as it obtains salt from moist soil and recently dried puddles. Increasing fire frequency may affect distribution of golden chinquapin, the larval host plant for this species. Golden chinquapin is shade-intolerant and regenerates quickly after fire and other disturbance, and more frequent fires could |

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| **Species** | **Overall Vulnerability** | **Overall Confidence** | **Sensitivity Rank** | **Exposure Rank** | **Summary of Exposure** | **Summary of Sensitivity** |
| | | | | | | potentially increase chinquapin establishment opportunities and overall habitat for this butterfly. However, this butterfly requires established chinquapin canopy and exists only in a few locations in Washington, making it vulnerable to extirpation if fire occurs in its current habitat distribution during key adult and larval periods (June-September), kills its current host trees, or significantly reduces available forage (nectar plants). |
| Columbia Clubtail | Moderate-High | Low | Moderate-High | Moderate-High | > Increased air and water temperatures<br>> Altered flow regimes (low summer flows and increased winter flooding) | Although very little information is available, Columbia Clubtail sensitivity is likely driven by water temperature, air temperature, and altered flow regimes (summer low flows and winter flooding). Eggs are laid in water, and after hatching, larvae burrow and overwinter in river mud. Water temperature influences emergence timing, while warmer air temperatures influence adult flight times, affecting foraging and energy demands. Reduced summer streamflow can exacerbate increasing water temperatures and effects on clubtail aquatic eggs and larvae. In addition, lower streamflows may strand eggs or larvae, causing mortality via desiccation. Increased winter flooding that enhances scour and/or that causes significant sedimentation may reduce larval survival. |
| Columbia Oregonian | Moderate-High | Low | Moderate-High | Moderate-High | > Increased temperatures<br>> Reduced soil moisture and/or drought<br>> Altered fire regimes | There is limited information on the sensitivity of the Columbia Oregonian to climate change. This species is found in low-elevation seeps and streams of the Columbia River Gorge as well as mid-elevation upland habitats (2565 to 3280 feet) in hemlock forests. In each of these locations, the species finds cover provided by herbaceous riparian vegetation in aquatic environments and large woody debris in forests. Loss of these refugia would likely alter the temperature and moisture regimes – low temperature and moderate to high humidity – upon which this species relies. |
| Columbia River Tiger Beetle | Moderate | Moderate | Moderate | Moderate | > Increased amount and/or duration of flooding | The Columbia River Tiger Beetle occupies stable river sandbars and riparian sand dunes. They are likely sensitive to flooding, soil moisture, and temperature. Soil moisture and temperature may affect larval development, as larvae grow and molt in sand/soil burrows that draw moisture from adjacent rivers/streams. Flooding or prolonged inundation can cause larval mortality by washing away larval burrows and/or causing suffocation via submersion, although they can survive up to 3 weeks of inundation. Sandbars occupied by this species are typically |

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| **Species** | **Overall Vulnerability** | **Overall Confidence** | **Sensitivity Rank** | **Exposure Rank** | **Summary of Exposure** | **Summary of Sensitivity** |
| | | | | | | large enough (extend more than 300 feet away from river) to avoid complete inundation during spring floods. Backwater flooding resulting from dam construction is thought to have extirpated all Washington populations. |
| Crowned Tightcoil | Low-Moderate | Low | Low | Moderate | > Increased temperatures<br>> Reduced soil moisture and/or drought<br>> Altered fire regimes | There is limited information on the sensitivity of the Crowned Tightcoil to climate change, and very limited information on this species' life history, although it is associated with riparian and old growth habitat. Its abundance is closely correlated with cool, moist conditions. Activities or events that alter conditions, such as moisture levels, shade, and temperature, may make this species vulnerable. |
| Dalles Hesperian | Moderate-High | Low | Moderate-High | Moderate | > Increased temperatures<br>> Reduced soil moisture and/or drought<br>> Altered fire regimes | There is limited information on the sensitivity of the Dalles Hesperian to climate change. This terrestrial species seeks refugia in locations with high humidity and relatively constant temperature (e.g., rock talus, under moist vegetation, deep in cracks in mud). Activities or events that alter conditions, such as moisture levels, shade, and temperature, may make this species vulnerable. |
| Dalles Juga | Moderate-High | Low | Moderate-High | Moderate | > Altered flow regimes<br>> Reduced oxygen<br>> Increased water temperatures | There is limited information on the sensitivity of the Dalles Juga to climate change and very limited information on this species' life history. The Dalles Juga is found at low-elevation springs and streams in cool, clean, highly oxygenated water. This species may therefore be sensitive to changes in flow regimes and water temperatures that negatively impact dissolved oxygen levels and chemical and biological processes |
| Dalles Sideband | Low-Moderate | Low | Low | Moderate | > Increased temperatures<br>> Reduced soil moisture and/or drought<br>> Altered fire | There is limited information on the sensitivity of this species to climate change. This species is frequently found in cool, moist talus habitat and upland forest areas that are near riparian corridors. Activities or events that alter conditions, such as moisture levels, shade, and temperature, may make this species vulnerable. |

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| **Species** | **Overall Vulnerability** | **Overall Confidence** | **Sensitivity Rank** | **Exposure Rank** | **Summary of Exposure** | **Summary of Sensitivity** |
| | | | | | regimes | |
| Dry Land Forestsnail | Low-Moderate | Low | Low | Moderate | > Increased temperatures<br>> Reduced soil moisture and/or drought<br>> Altered fire regimes | There is limited information on the sensitivity of this species to climate change. Its habitat includes talus and rocky riparian areas. Activities or events that alter conditions, such as moisture levels, shade, and temperature, may make this species vulnerable. |
| Giant Palouse Earthworm | Low-Moderate | Low | Low | Moderate-High | > Increased temperatures<br>> Reduced soil moisture | There is little information on the sensitivity of the Giant Palouse Earthworm (GPE) to climate change, largely due to the fact that very little is known about this species in general. The GPE likely exhibits sensitivity to temperature; it can experience mortality from high soil temperatures, and utilizes deep burrows to survive hot, dry summer periods. Increasing temperatures and increasingly xeric conditions may reinforce this behavior. The GPE may also be sensitive to precipitation shifts and fire, as these regimes affect vegetative cover and can modify microhabitat and soil conditions, but links between precipitation, disturbance, vegetation, and GPE abundance are not clear at this time. |
| Great Arctic | Low-Moderate | Low | Low-Moderate | Low-Moderate | > Altered fire regimes | There is no information regarding the sensitivity of this species to climate change, and very little known regarding its life history. As an occupant of forest openings and meadow edges, it may benefit from more frequent fire which contributes to the creation of these habitat characteristics. However, larvae are thought to develop on grasses, and could be killed by fire. Small population sizes and limited distribution in Washington make it vulnerable to extirpation. |
| Hatch's Click Beetle | Moderate-High | Low | Moderate | Moderate-High | > Changes in precipitation (snow and rain)<br>> Increased amount and/or duration of flooding | Hatch's Click Beetle occupies low elevation sphagnum bogs, and its climate sensitivity is likely driven by changes in habitat availability. Reduced water availability and quality (i.e., due to precipitation shifts, reduced snowpack, earlier snowmelt) can affect bog water levels and seasonal bog duration, potentially altering habitat extent. This species is likely sensitive to both bog drying and prolonged inundation from flooding. Adults feed primarily on flowering shrubs, although they may also prey upon invertebrates. Shifts in abundance and flower timing (i.e., phenology) of flowering shrubs in response to climate change may |

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| **Species** | **Overall Vulnerability** | **Overall Confidence** | **Sensitivity Rank** | **Exposure Rank** | **Summary of Exposure** | **Summary of Sensitivity** |
| | | | | | > Drought<br>> Increased temperatures | affect Hatch's Click Beetle foraging and fitness, particularly since adult beetles are only active for short periods in the early spring. Warmer temperatures may increase beetle activity; Hatch's Click Beetles have historically been most active on hot days. |
| Hoary Elfin | Low-Moderate | Low | Low-Moderate | Low-Moderate | > Altered fire regimes | There is no information regarding the physiological sensitivity of this species to climate change, but it may be limited by temperature, as it currently appears only in lower elevation areas of Washington, even though its host plant exists at higher elevations. Hoary Elfin is likely sensitive to climate-driven changes in its larval host plant, kinnikinnick. Kinnikinnick is resilient to dry conditions. Fire maintains the open, high sunlight environments preferred by kinnikinnick and occupied by the Hoary Elfin (e.g., prairies, forest opening balds), but kinnikinnick may be sensitive to increasing fire frequencies and severities, as it appears to be adapted to low severity fire and to exhibit moderate survival and recovery post-fire. |
| Hoder's Mountainsnail | Low-Moderate | Low | Low | Moderate-High | > Increased temperatures<br>> Reduced soil moisture and/or drought<br>> Altered fire regimes | There is limited information on the sensitivity of this species to climate change. It is known to occur in grasslands and along timber edges including *Eriogonum* sp. and *Balsamorrhiza sagitta*. Activities or events that alter conditions, such as moisture levels, shade, and temperature, may make this species vulnerable. |
| Hoko Vertigo | Low-Moderate | Low | Low | Moderate | > Increased disease outbreaks<br>> Altered fire regimes | There is limited information on the sensitivity of the Hoko Vertigo to climate change. This species is only found at two sites on the Hoko River in the northwestern Olympic Mountains, although its range may extend into British Columbia. These two known locations are low elevation, old growth riparian areas. Because this species is so rare, it may be acutely vulnerable to fire, disease, or other events causing mass mortality as they may not be able to quickly rebuild populations. |
| Idaho Vertigo | Low-Moderate | Low | Low | Moderate | > Increased temperatures<br>> Reduced soil moisture | There is limited information on the sensitivity of this species to climate change. It is found in a mid-elevation grass and sedge meadow with springs, seeps, bogs and fens. Activities or events that alter conditions, such as moisture levels and temperature, may make this species |

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| **Species** | **Overall Vulnerability** | **Overall Confidence** | **Sensitivity Rank** | **Exposure Rank** | **Summary of Exposure** | **Summary of Sensitivity** |
| | | | | | and/or drought<br>> Altered fire regimes | vulnerable. |
| Island Marble | Moderate-High | Low | Moderate-High | Moderate | > Increased temperatures<br>> Changes in precipitation<br>> Sea level rise and storm surges<br>> Altered fire regimes | Island Marble sensitivity is likely driven by temperature, precipitation, sea level rise, storm surges, and fire. Cool, wet spring conditions appear to limit Island Marble flight periods and fecundity, and recovery during warm, dry years is not guaranteed due to other habitat stressors. Shifts in temperature and precipitation may also affect larval foraging and survival by causing a mismatch between host plant phenology and larval emergence. Sea level rise paired with storm surges and windy conditions can inundate or cause significant sediment alteration in coastal habitats of Island Marble (e.g., among dunes and backing lagoons). Storm events and sea level rise can cause larval and pupal mortality and contribute to temporary or permanent habitat loss due to inundation, burial of host and forage plants, and loss of anchoring substrate and woody debris required for vegetation establishment. Island Marble is associated with a variety of grassland species (e.g., native and non-native mustards) that excel at colonizing disturbed sites, so population recovery post-storm is possible if host plants are able to re-establish. Due to its association with disturbance-adapted host plants, increasing fire frequencies may expand habitat for island marble and/or help maintain existing habitat by preventing grassland succession to shrub or forest types. However, large, high intensity fires occurring in current habitat areas could extirpate local island marble populations. |
| Johnson's Hairstreak | Moderate-High | Low | Moderate-High | Moderate | > Changes in precipitation<br>> Altered fire regimes | Johnson's Hairstreak likely exhibits some physiological sensitivity to temperature and precipitation, with inclement weather delaying emergence and reducing diurnal activity. This butterfly may also be sensitive to moisture declines, as it has been documented drinking from puddles. This species is also likely sensitive to climate-driven changes in its larval host plant, dwarf mistletoe, which is a parasitic plant in conifer forests (e.g., western larch), particularly old growth. Increasing fire frequency, intensity, and severity may reduce dwarf mistletoe abundance in the short term, reducing habitat availability for Johnson's |

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| **Species** | **Overall Vulnerability** | **Overall Confidence** | **Sensitivity Rank** | **Exposure Rank** | **Summary of Exposure** | **Summary of Sensitivity** |
| | | | | | | Hairstreak. |
| Juniper Hairstreak | Moderate | Low | Moderate | Moderate | > Altered fire regimes | Temperature and precipitation likely affect larval forage periods. The sensitivity of Juniper Hairstreak is likely largely driven by climate-driven shifts in its larval host plant, western juniper. Western juniper is shade-intolerant, and fire helps prevent succession to conifer forest types in juniper stands. However, western juniper is also fire-intolerant, typically experiencing high fire mortality but still able to recolonize post-fire. Increasing fire frequency and severity may help maintain Juniper Hairstreak habitat by preventing succession, but can also lead to short-term habitat loss if fire burns in current habitat areas. Warmer and more xeric conditions may favor the expansion of western juniper woodland habitats, potentially benefitting Juniper Hairstreak. |
| Leschi's Millipede | N/A | N/A | N/A | N/A | N/A | This species was only classified in 2004 in Washington. There is almost no information available about its life history characteristics and no information available regarding it sensitivity to climate change. |
| Limestone Point Mountainsnail | Low-Moderate | Low | Low | Moderate | > Increased temperatures<br>> Reduced soil moisture and/or drought<br>> Altered fire regimes | There is limited information on the sensitivity of this species to climate change. It is closely associated with mid-elevations on limestone outcrops and talus. Activities or events that alter conditions, such as moisture levels and temperature, may make this species vulnerable. |
| Mad River Mountainsnail | Low-Moderate | Low | Low | Moderate-High | > Increased temperatures<br>> Reduced soil moisture and/or drought<br>> Altered fire regimes | There is limited information on the sensitivity of this species to climate change. It is found in talus under black cottonwood and bigleaf maple. Activities or events that alter conditions, such as moisture levels and temperature, may make this species vulnerable. |
| Makah Copper | Moderate-High | Low | Moderate-High | Moderate | > Changes in precipitation (snow and rain) | There is no information on the physiological sensitivity of this species to climate change. However, Makah Copper is likely sensitive to climate-driven changes in its larval host plant, bog cranberry, which occupies very wet and moist fens and bogs. Bog cranberry is not widely |

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| **Species** | **Overall Vulnerability** | **Overall Confidence** | **Sensitivity Rank** | **Exposure Rank** | **Summary of Exposure** | **Summary of Sensitivity** |
| | | | | | > Increased amount and/or duration of flooding<br>> Drought | distributed, and drier conditions paired with increased winter flooding may affect the hydrology, formation and extent of bog habitat (see habitat sensitivity summary), potentially leading to habitat reductions for both bog cranberry and Makah Copper. Although bog habitats rarely burn, bog cranberry typically benefits from fire, increasing in abundance. It is unknown how Makah Copper responds to fire, however. |
| Mann's Mollusk-eating Ground Beetle | Moderate-High | Low | Moderate | Moderate-High | > Increased temperatures<br>> Drought<br>> Increased amount and/or duration of flooding | Very limited sensitivity information is available for this species. This species is thought to occupy riparian sections of lowland river canyons, and to seek out shaded, moist areas during the daytime. Its micro- and macrohabitat preferences likely make it sensitive to flooding, increasingly xeric conditions, and temperature increases. |
| Mardon Skipper | Moderate-High | Low | High | Moderate | > Increased temperatures<br>> Changes in precipitation<br>> Altered fire regimes | Climate sensitivity of this species is likely influenced by temperature, precipitation, and fire. Population numbers vary annually in response to variable weather because Mardon Skippers exhibit physiological and indirect (i.e., habitat) sensitivity to temperature and precipitation. Temperature influences butterfly behavior (e.g., foraging time), adult life span, and larval development. Warming temperature may also affect phenological timing between Mardon Skipper and key plant species (host and nectar plants) and cause desiccation of larval forage, leading to larval and/or adult starvation. In higher elevation sites, warming temperatures leading to reduced snowpack/earlier snowmelt may also expose Mardon Skipper larvae to novel environmental conditions, which could increase mortality. Precipitation also affects adult behavior, and extreme precipitation can cause adult mortality (i.e., by preventing foraging) and/or drown larvae. Moist conditions can also contribute to fungal development. Mardon Skippers are also vulnerable to fire. Fire helps maintain open grassland habitat used by the mardon skipper by preventing conifer encroachment, but Mardon Skippers are not very mobile, and fire can cause direct mortality of all life stages. Increasing fire frequencies may expand overall habitat area available for Mardon |

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| **Species** | **Overall Vulnerability** | **Overall Confidence** | **Sensitivity Rank** | **Exposure Rank** | **Summary of Exposure** | **Summary of Sensitivity** |
| | | | | | | Skipper, but could contribute to population extirpation if fire occurs in current habitat areas. |
| Masked Duskysnail | Low-Moderate | Low | Low-Moderate | Moderate | > Altered flow regimes leading to increased nutrient runoff<br>> Reduced oxygen<br>> Increased water temperatures<br>> Increased disease outbreaks | There is limited information on the sensitivity of the Masked Duskysnail to climate change. This species displays very similar traits, habitat requirements, and global distributions to the Washington Duskysnail. The Masked Duskysnail's range is restricted to two large kettle lakes in eastern Washington – Curlew Lake in Ferry County and Fish Lake in Wenatchee National Forest. This species is considered to be a mud specialist, living on soft bottom substrates in highly oxygenated, cool lakes (preferring temperatures below 64°F); changes in water temperature and flow regimes that affect dissolved oxygen levels and stratification may therefore negatively affect the Masked Duskysnail. Changes in flow regimes that increase nutrient runoff may cause dense filamentous algae blooms that impair or prevent access to important food resources. This species occurs in low densities in isolated populations and therefore may be acutely vulnerable to diseases or other disturbance regimes causing mass mortality because they may not be able to quickly rebuild populations. |
| Meadow Fritillary | Low-Moderate | Low | Low-Moderate | Moderate | > Increased temperatures<br>> Changes in precipitation<br>> Altered fire regimes | There is almost no information regarding the sensitivity of this species to climate change, particularly in Washington. Similar to other butterflies, it is likely physiologically sensitive to changes in precipitation and temperature, which may affect larval development and adult behavior. Increasing fire frequency may help maintain and prevent succession of its meadow and forest opening habitat. Riparian habitat may be affected by increasing flood frequencies, as well as fire (see habitat summaries). |
| Mission Creek Oregonian | N/A | N/A | N/A | N/A | N/A | There is no information on the sensitivity of this species to climate change. |
| Monarch | Moderate | Moderate | Moderate | Moderate | > Increased temperatures<br>> Changes in precipitation and/or drought | Monarch climate sensitivity is likely influenced by temperature, precipitation, and drought. Monarchs breed and migrate through Washington, and warmer temperatures may accelerate monarch larval development and enhance adult reproductive activity, potentially expanding suitable breeding ranges northward where they may have historically been limited by cold temperatures. Warmer temperatures and shifts in winter precipitation at overwintering sites (e.g., California) |

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| **Species** | **Overall Vulnerability** | **Overall Confidence** | **Sensitivity Rank** | **Exposure Rank** | **Summary of Exposure** | **Summary of Sensitivity** |
| | | | | | | may also cause earlier flight times and arrival of migrants from southern overwintering grounds. Shifts in temperature and precipitation are also likely to influence milkweed abundance and distribution, which will impact Monarch distribution, migratory pathways and reproductive success. Drought reduces milkweed survival, germination, growth and seed production, and may make milkweed less palatable, affecting Monarch larval growth and survival. |
| Morrison's Bumble Bee | Moderate | Low | Moderate | Moderate | > Increased temperatures<br>> Changes in precipitation and/or soil moisture | There is almost no information regarding the sensitivity of this species to climate change, particularly in Washington. It may be sensitive to climate-driven changes in dry scrub habitat (e.g., due to increasing fire, altered precipitation and soil moisture), particularly if disturbance events affect ground nests or foraging opportunities in spring and summer.<br><br>In general, bumble bees are likely sensitive to climate-driven changes in nesting, foraging, and overwintering habitat, but detailed information is currently lacking. Shifts in temperature, precipitation, and snowpack may affect bumble bee distribution and life history, potentially forcing them into unfavorable habitats, to emerge at non-optimal times (i.e., mismatch with vegetation), and/or affecting energy demands during overwintering periods. These climate-driven changes may also affect habitat quality and availability. One of the primary concerns for bumble bee species is a shift in the abundance, distribution, and/or phenological synchrony of key forage flowering vegetation, as pollen and nectar availability influences reproduction and overwintering success of queens. |
| Nimapuna Tigersnail | N/A | N/A | N/A | N/A | N/A | There is no information on the sensitivity of this species to climate change. |
| Northern Forestfly | High | High | High | Moderate-High | > Increased water temperatures<br>> Reduced glacier size and increased | The Northern Forestfly is a species of stonefly with only one currently known location in the northern Cascades. It is associated with a high-elevation spring and stream which flows into an alpine lake, and in fact all three species in the *Lednia* genus are restricted to alpine or subalpine springs and glacial streams (the proposed name for the genus is "Meltwater Stoneflies"). This species is extremely sensitive to climate change because of its dependence on coldwater habitats, which are |

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| **Species** | **Overall Vulnerability** | **Overall Confidence** | **Sensitivity Rank** | **Exposure Rank** | **Summary of Exposure** | **Summary of Sensitivity** |
| | | | | | glacier melting | likely to warm significantly along with disappearing glaciers. |
| Olympia Oyster | High | High | High | Moderate-High | > Declines in salinity<br>> Decreased oxygen and pH | Olympia Oysters are likely to be sensitive to a number of climate factors, including declines in salinity, oxygen, and pH. Olympia Oysters are sensitive to low salinity levels, and potential increased precipitation (particularly during winter and spring) can lead to lower salinity levels and potential juvenile mortality, as juveniles have a more sensitive salinity threshold. Additionally, increases in extent and time of hypoxic conditions could limit oyster growth. Predicted declines in ocean pH in Washington are also likely to lead to decreases in growth, weight, and metamorphic success of oyster larvae, which could also trigger increased mortality at later life stages. The effects of acidification on oyster larvae could be more severe if low pH conditions are coupled with decreases in phytoplankton food availability. |
| Olympia Pebblesnail | Low-Moderate | Low | Low-Moderate | Moderate | > Altered flow regimes<br>> Reduced oxygen<br>> Increased water temperatures | There is limited information on the sensitivity of the Olympia Pebblesnail to climate change. This species displays very similar traits and habitat requirements to the Ashy Pebblesnail. The Olympia Pebblesnail's habitat range is believed to include Columbia River Basin's rivers, streams, and creeks, as well as some sites in the Olympic Mountains and San Juan Islands and the Willamette River system in Oregon. The Olympia Pebblesnail requires clear, cold, highly oxygenated streams, and therefore may be sensitive to changes in flow regimes and increases in water temperature that negatively impact dissolved oxygen levels and chemical and biological processes. Changes in flow regimes that increase nutrient runoff may cause dense algae blooms that impair or prevent the Olympia Pebblesnail's access to important food resources (e.g., lithophytes). The invasive New Zealand Mudsnail (*Potamopyrgus antipodarum*) may be a direct competitor for food and habitat. |
| One-band Juga | Moderate-High | Low | Moderate-High | Moderate | > Altered flow regimes<br>> Reduced oxygen<br>> Increased water | There is limited information on the sensitivity of this species to climate change. Its habitat includes low- to mid-elevation streams and springs with cold, highly oxygenated water, and therefore may be sensitive to changes in flow regimes and increases in water temperature that negatively impact dissolved oxygen levels and chemical and biological processes. |

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| **Species** | **Overall Vulnerability** | **Overall Confidence** | **Sensitivity Rank** | **Exposure Rank** | **Summary of Exposure** | **Summary of Sensitivity** |
| | | | | | temperatures | |
| Oregon Branded Skipper | Moderate | Low | Moderate | Moderate | > Increased temperatures<br>> Changes in precipitation<br>> Altered fire regimes | There is no information on the physiological sensitivity of this species to climate change, however, similar to other butterflies, larval development and adult activity are likely affected by temperature and precipitation. Climate sensitivity of Oregon Branded Skipper is also likely affected by fire. Increasing fire frequency may help maintain glacier outwash prairie habitat by preventing conifer or shrub encroachment, as well as create bare ground patches utilized by this skipper. However, more frequent fire may facilitate invasive species establishment, which could degrade Oregon Branded Skipper habitat (e.g., by occupying bare ground zones). |
| Oregon Megomphix | Low-Moderate | Low | Low | Moderate | > Altered fire regimes<br>> Increased temperatures<br>> Reduced soil moisture<br>> Increased wind disturbance | There is limited information on the sensitivity of the Oregon Megomphix to climate change. This rare species is found at low elevations (below 490 feet) on well-shaded slopes near streams in Washington. Its distribution is closely associated with the bigleaf maple—the more bigleaf canopy cover, the more likely Oregon Megomphix is present. Activities or events that disturb canopy cover and litter composition, such as wind and fire, may therefore negatively affect the temperature and moisture levels at which this species is best suited. |
| Oregon Silverspot | Moderate | Low | Moderate | Moderate | > Increased temperatures<br>> Drought | Oregon Silverspot exhibits some physiological sensitivity to temperature and precipitation, as larval development, pupation, and adult emergence timing vary each year according to weather, and adults exhibit thermoregulatory behavior during cold, windy conditions (e.g., shelter in warmer adjacent forest edges). Warmer temperatures may increase adult activity (i.e., less basking time) and/or accelerate larval development. Oregon Silverspot is also sensitive to climate-driven changes in habitat availability and quality. Increasing fire frequencies may help maintain the low stature coastal grassland this species requires and help prevent succession to forest or shrub ecotypes. Increasing fire frequency will likely also facilitate reproduction and germination of early blue violet, the larval host plant for Oregon Silverspot. Early blue violet is a shade-intolerant species that reproduces and germinates best in early successional coastal grasslands with bare soil or low, sparse grass cover. Early blue violet is also tolerant of hot, |

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| **Species** | **Overall Vulnerability** | **Overall Confidence** | **Sensitivity Rank** | **Exposure Rank** | **Summary of Exposure** | **Summary of Sensitivity** |
| | | | | | | dry periods, which will help maintain long-term Oregon Silverspot habitat areas under a warmer, drier climatic regime. However, dry years may cause early senescence of early blue violets, which can cause larval mortality. |
| Pacific Clubtail | Moderate-High | Low | Moderate-High | Moderate-High | > Increased air and water temperatures<br>> Altered flow regimes (low summer flows and increased winter flooding)<br>> Altered fire regimes | There is little information on the sensitivity of Pacific Clubtail to climate change. However, Pacific Clubtail sensitivity is likely influenced by air temperature, water temperature, and shifting flow regimes. Temperature is known to influence the phenology, development, behavior and other characteristics of dragonflies, and warming temperatures (both air and water) will likely impact this species during various life stages. Hydrological changes (e.g., reduced stream flows) and drought may degrade or reduce aquatic habitat available for this species and/or compound increases in water temperature. Pacific Clubtail is also likely sensitive to disturbance events (e.g., fire, floods) that reduce riparian vegetation, which eliminates stream shade and foraging and roosting sites for adults, and/or that increase siltation, which can kill larvae. |
| Pacific Needlefly | Moderate-High | Low | Moderate-High | Moderate | > Increased water temperatures<br>> Changes in precipitation and/or drought<br>> Altered flow regimes | The Pacific Needlefly is an uncommon species found only in mountainous regions of Oregon, Washington, and northern California. Little is known about this species, whose larvae are found only in seeps, springs, and small spring-fed streams. The genus *Megaleuctra* is dependent on coldwater habitats that do not dry out, as well as high water quality. The sensitivity of this species is likely closely tied to their specialized habitat requirements. Changes in flow patterns due to drought or changing patterns of precipitation, changes in water temperature, and decreased water quality are all likely to increase the sensitivity of the species. Habitat fragmentation and nearby development also alter the quality and availability of suitable habitat. |
| Pacific Vertigo | Low-Moderate | Low | Low | Moderate | > Increased disease outbreaks<br>> Altered fire regimes | There is limited information on the sensitivity of the Pacific Vertigo to climate change. Typical Vertigo habitat includes moist riparian zones as well as dry forests; the Pacific Vertigo is closely associated with primarily deciduous and occasionally coniferous trees and bushes. This species is believed to be very rare in the region. Because this species is so rare, it may be acutely vulnerable to fire, disease, or other events causing mass mortality as they may not be able to quickly rebuild populations. |

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| **Species** | **Overall Vulnerability** | **Overall Confidence** | **Sensitivity Rank** | **Exposure Rank** | **Summary of Exposure** | **Summary of Sensitivity** |
| Pinto Abalone | Moderate-High | Moderate | Moderate-high | Moderate-High | > Decreased pH<br>> Increased ocean temperatures | The main sensitivity of Pinto Abalone to climate change is likely to be from direct physiological responses to predicted decreases in pH. In laboratory experiments, elevated carbon dioxide levels led to decreased larval survival and increased shell abnormalities in Pinto Abalone. In other abalone species, simulated ocean acidification conditions have also resulted in decreased hatching rates and reduced larvae survival. Potential climate-related changes in preferred habitat of kelp beds with coralline algae could increase the sensitivity of this species, as these habitats may be sensitive to increasing sea surface temperature and could experience declines, thus limiting potential abalone habitat. Increases in sea surface temperature could also lead to decreased abalone reproduction and increased mortality. Given the current low population densities and recruitment levels of Pinto Abalone, any future threats from lower pH or increasing temperature could have an even greater impact on this species. |
| Poplar Oregonian | Low | Low | Low | N/A | N/A | There is limited information on the sensitivity of the Poplar Oregonian to climate change, and very limited information on this species' life history. Populations are found in moderately dry and cool, low elevation talus habitats in river basins. This species appears to be well adapted to drier habitats than other terrestrial snails, and therefore may be less susceptible to changes in moisture levels. |
| Propertius' Duskywing | Moderate | Low | Moderate | Moderate | > Increased temperatures | Propertius' Duskywing sensitivity is likely driven by temperature. This species exhibits some physiological sensitivity to warming temperatures, as well as indirect sensitivity to temperature via habitat changes. A study of Canadian populations found that adult flight phenology varied according to daily temperature, although larval development did not vary with temperature directly. A separate study found that warmer winter temperatures (+40°F higher than average) enhanced energetic drain on overwintering larvae and caused sublethal effects, and that increasing winter temperatures are likely to enhance desiccation stress for this species. Warming temperatures are also likely to affect the timing and distribution of key larval and adult food resources. As a specialist on certain oak species, phenology mismatches with host plants could affect adult and larval survival, but an extended growing season could enhance larval growth prior to overwintering. Further, a |

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| **Species** | **Overall Vulnerability** | **Overall Confidence** | **Sensitivity Rank** | **Exposure Rank** | **Summary of Exposure** | **Summary of Sensitivity** |
| | | | | | | lag between Propertius' Duskywing and oak polar migration in response to warming temperatures is predicted, which will likely limit this species' dispersal potential in response to climate change. |
| Puget (Blackmore's) Blue | Alpine populations - High<br>Low elevation populations - Low-Moderate | Moderate | Alpine population s - High<br>Low elevation population s - Moderate | Olympics: Moderate-High<br>South Puget Sound: Low-Moderate | > Increased temperatures<br>> Reduced snowpack<br>> Altered fire regimes | Sensitivity of this species is mainly driven by habitat. Populations associated with alpine meadows in the Olympic Mountains are likely very sensitive to climate-driven changes in habitat availability, as alpine habitats are projected to decline in extent due to warming temperatures, reduced snowpack, drought, and other drivers. Populations associated with lower elevation prairies are likely sensitive to fire. Lupine, the larval host plant of the Puget Blue as well as an adult nectar source, appears to thrive post-fire, and fire also helps prevent prairie succession to forest or shrub habitats. However, fire can also lead to direct mortality of Puget Blue adults and larvae, and/or facilitate the expansion of Scot's broom and other invasive plants, which can displace lupine. In addition, it is unknown how shifting fire regimes (e.g., seasonality, intensity) will impact this species and its host plant. |
| Puget Oregonian | Low-Moderate | Low | Low | Moderate | > Increased temperatures<br>> Reduced soil moisture and/or drought<br>> Altered fire regimes | There is limited information on the Puget Oregonian to climate change. This species is found in cool, moist conifer forests at low to moderate elevations, especially under large woody debris and leaf litter. This shade provides refugia from moderate fluctuations in temperature and moisture; changes in canopy cover may therefore negatively impact this species. |
| Puget Sound Fritillary | Low-Moderate | Low | Low-Moderate | Moderate | > Altered fire regimes | There is limited information on the sensitivity of the Puget Sound Fritillary to climate change. Similar to other butterflies that occupy prairie and forest glade habitats, the Puget Sound Fritillary is likely sensitive to fire, which can help prevent grassland succession to shrub or forest habitat, but can likely cause direct butterfly mortality and/or facilitate invasion and spread of invasive species. |
| Rainier Roachfly | Moderate-High | High | Moderate-High | Moderate-High | > Increased water temperatures<br>> Reduced glacier size | The Rainier Roachfly has only been documented within Mt. Rainier National Park (mostly on the west side). It is found in seeps, springs, and small spring-fed streams. Climate sensitivity for this species is tied to melting glaciers and an associated rise in stream temperatures. Relatively little is known about this species, but stoneflies as a whole are |

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| **Species** | **Overall Vulnerability** | **Overall Confidence** | **Sensitivity Rank** | **Exposure Rank** | **Summary of Exposure** | **Summary of Sensitivity** |
| | | | | | and increased glacier melting<br>> Changes in precipitation and/or drought<br>> Altered flow regimes | sensitive to drought or precipitation changes that may affect seep moisture, springs, and stream flow. Decreased water quality, habitat fragmentation and nearby development also alter the quality and availability of suitable habitat. |
| Ranne's Mountainsnail | Low | Low | Low | N/A | N/A | There is limited information on the sensitivity of this species to climate change. It is known to occur on only one site in Chelan County in grassland including *Eriogonum* sp. and *Balsamorrhiza sagitta*. |
| Salmon River Pebblesnail | N/A | N/A | N/A | N/A | N/A | There is no information on the sensitivity of this species to climate change. |
| Sand Verbena Moth | Moderate-High | Moderate | Moderate-High | Moderate | > Increased invasive species<br>> Sea level rise<br>> Increased coastal erosion<br>> Drought | The Sand Verbena Moth is primarily threatened by the loss of its host plant and open sandy coastal habitat as a result of encroaching vegetation, including invasive species. However, it may also exhibit sensitivity to a variety of climate and climate-driven changes, including enhanced coastal erosion, sea level rise and drought. Disturbance is the primary driver in maintaining open sandy habitat preferred by the Sand Verbena Moth's host plant, yellow sand verbena. Enhanced coastal erosion could create more open sandy habitat (i.e., through increased deposition of eroded cliff material) or decrease current moth habitat through loss of established host plants, which occur close to the shoreline. Substantial sea level rise could inundate Sand Verbena Moth habitat, but projected rates of rise through mid-century will likely not be enough to inundate current habitat areas. Drought could lead to early senescence of yellow sand verbena, which would decrease food availability for both adults and larvae and affect annual population numbers. Yellow sand verbena is adapted to dry conditions, however, and can likely survive drought periods, so overall habitat area is not likely to decrease in response to drought. |
| Sasquatch Snowfly | Moderate | Low | Moderate | Moderate | > Increased water | The Sasquatch Snowfly has been found in British Columbia and Washington, and is associated with high elevation creeks and small to |

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| **Species** | **Overall Vulnerability** | **Overall Confidence** | **Sensitivity Rank** | **Exposure Rank** | **Summary of Exposure** | **Summary of Sensitivity** |
| | | | | | temperatures > Changes in precipitation and/or drought > Altered flow regimes | medium rivers. Little else is known about this species, which was recently separated from the nearly identical *Bolshecapnia missiona*. Sensitivity for this species likely tied to habitat requirements. Like all other stoneflies, changes in flow patterns due to drought or changing patterns of precipitation, changes in water temperature, and decreased water quality are all likely to increase the sensitivity of the species. Habitat fragmentation and nearby development also alter the quality and availability of suitable habitat. |
| Shortface Lanx | Moderate | Low | Low-Moderate | Moderate-High | > Altered flow regimes > Reduced oxygen > Increased water temperatures > Increased disease outbreaks | There is limited information on the sensitivity of this species to climate change. This species is found in cold, perennial, highly oxygenated rivers and streams, and may therefore be sensitive to changes in flow regimes and water temperatures that negatively impact dissolved oxygen levels and chemical and biological processes. This species occurs in low densities in isolated populations and therefore may be acutely vulnerable to diseases or other regimes causing mass mortality because they may not be able to quickly rebuild populations. |
| Silver-bordered Fritillary | Moderate-High | Moderate | Moderate-High | Moderate-High | > Increased temperatures > Reduced snowpack > Altered flow regimes > Altered fire regimes | Climate sensitivity of Silver-bordered Fritillary is likely driven by habitat changes resulting from drying, altered hydrology, and fire. Warmer temperatures and precipitation shifts that drive reduced snowpack and altered flow regimes can lead to drying of bog, marsh and riparian habitats used by this species. Forest succession can also degrade habitat by reducing abundance of violet, its larval host plant. Increasing fire frequency and increasing winter flood risk may help maintain early successional habitat and the high violet abundance required by the Silver-bordered Fritillary. However, fire may cause adult and/or larval mortality. |
| Siuslaw Sand Tiger Beetle | Moderate-High | Low | Moderate | Moderate-High | > Reduced stream flow > Drought and/or reduced soil moisture | Siuslaw Sand Tiger Beetle occupies sandy beaches at the interface of river mouths and the Pacific Ocean. This species is likely sensitive to drought, reduced streamflow, and increasingly xeric conditions, as larvae have narrow moisture requirements and burrows are located adjacent to surface water or in areas with persistent soil moisture. |
| Sonora | Low- | Low | Low- | Low- | > Altered fire | There is limited information on the sensitivity of the Sonora Skipper to |

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| **Species** | **Overall Vulnerability** | **Overall Confidence** | **Sensitivity Rank** | **Exposure Rank** | **Summary of Exposure** | **Summary of Sensitivity** |
| Skipper | Moderate | | Moderate | Moderate | regimes | climate change. As an occupant of forest edges, prairies, meadows and other open sites, this species may exhibit sensitivity to fire, which can help maintain open habitat conditions. However, similar to other prairie butterflies, fire may cause adult and/or larval mortality. It likely exhibits some physiological sensitivity to climate conditions, as population numbers fluctuate yearly, but more information is needed. |
| Spotted Taildropper | Low-Moderate | Low | Low-Moderate | Moderate | > Increased temperatures<br>> Reduced soil moisture and/or changes in precipitation<br>> Altered fire regimes | There is very limited information regarding the sensitivity of Spotted Taildropper to climate change and limited information available regarding its life history characteristics. Their main sensitivity is likely to be driven by changes in their preferred habitat – mature conifer forests with moist ground. Increases in temperature and decreases in summer rainfall are likely to lead to increased risk of severe fires, which would destroy habitat for this species. Declines in habitat quality could also lead to fragmentation of populations and eventual population declines, particularly because documented populations of this species are already very small. |
| Straits Acmon Blue | Moderate-High | Moderate | N/A | Moderate-High | > Sea level rise<br>> Increased storm frequency and intensity | There is no information on the sensitivity of the Straits Acmon Blue to climate change. As an occupant of sand spits and beaches, it may be vulnerable to climate-driven shifts in habitat and host plant availability caused by sea level rise, increased storm frequency and intensity, and erosion, but no information is available. (See scrub and herb coastal vegetation habitat assessments for more information on potential habitat sensitivity to climate change.) |
| Subarctic Bluet | Moderate-High | Low | High | Moderate | > Altered flow regimes<br>> Drought<br>> Increased air and water temperatures<br>> Reduced snowpack and/or changes in precipitation | The Subarctic Bluet is likely sensitive to drought, increasingly dry conditions (e.g., reduced snowpack, shifts from snow to rain), and altered hydrology (e.g., reduced flows and larger floods) that can lead to drying, habitat contraction and/or altered water quality in its fen and bog habitat. Subarctic Bluet larvae are aquatic and depend on aquatic vegetation for foraging, making them sensitive to climate-driven habitat drying that may facilitate shifts toward more xeric vegetation. There are only a few populations of this species in Washington, representing the southern end of this species' range, so any significant alteration in bog habitat as a result of climate change could lead to loss of this species in the state. Similar to other Odonates, Subarctic Bluet is likely also sensitive to increasing temperatures (air and water) in a variety of ways: |

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| **Species** | **Overall Vulnerability** | **Overall Confidence** | **Sensitivity Rank** | **Exposure Rank** | **Summary of Exposure** | **Summary of Sensitivity** |
| | | | | | | warmer temperatures may affect development, phenology, behavior, and other characteristics of this species. |
| Suckley Cuckoo Bumble Bee | Moderate | Low | Moderate | Moderate | > Increased temperatures<br>> Changes in precipitation and/or soil moisture | There is no information regarding the sensitivity of this species to climate change. In general, bumble bees are likely sensitive to climate-driven changes in nesting, foraging, and overwintering habitat, but detailed information is currently lacking. Shifts in temperature, precipitation, and snowpack may affect bumble bee distribution and life history, potentially forcing them into unfavorable habitats, to emerge at non-optimal times (i.e., mismatch with vegetation), and/or affecting energy demands during overwintering periods. These climate-driven changes may also affect habitat quality and availability. One of the primary concerns for bumble bee species is a shift in the abundance, distribution, and/or phenological synchrony of key forage flowering vegetation, as pollen and nectar availability influences reproduction and overwintering success of queens. |
| Talol Springfly | Moderate | Low | Moderate | Moderate | > Increased water temperatures<br>> Changes in precipitation and/or drought<br>> Altered flow regimes | The Talol Snowfly was described in 2004 from a single collection taken from Mt. Rainier National Park. The sample was found in a medium-sized river, but nothing else is known about the ecology of this species. Like all other stoneflies, it is likely dependent on flowing water for nymph survival, making it sensitive to changes in flow patterns due to drought or changing patterns of precipitation. Stoneflies are also typically sensitive to changes in water temperature and water quality, as well as habitat fragmentation and nearby development which may alter the quality and availability of suitable habitat. |
| Taylor's Checkerspot | Moderate-High | Moderate | Moderate-High | Moderate-High | > Increased temperatures<br>> Drought<br>> Extreme precipitation events<br>> Altered fire regimes<br>> Increased invasive weeds | Taylor's Checkerspot sensitivity is likely driven by temperature, precipitation, and fire. Warming temperatures may accelerate larval development, affect larval feeding period duration, increase activity periods by reducing basking requirements, and increase total habitat use at the microsite level. However, increasingly xeric conditions may reduce the palatability of grassland larval host plants and/or cause earlier host plant senescence, contributing to larval starvation and mortality. Increasing drought frequency and severity may also require Taylor's Checkerspot to obtain moisture from puddles during spring, creating previously unneeded microhabitat requirements. Taylor's Checkerspot is also sensitive to rain, and extreme downpours could |

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| **Species** | **Overall Vulnerability** | **Overall Confidence** | **Sensitivity Rank** | **Exposure Rank** | **Summary of Exposure** | **Summary of Sensitivity** |
| | | | | | | cause severe population declines by washing away eggs and larvae and limiting adult flight. Low severity fire helps maintain the native vegetation used by Taylor's Checkerspot, but fire can also kill all butterfly age stages, potentially extirpate local populations if fires are large enough. Thus, increasing fire frequencies and severities may affect butterfly survival and habitat availability for Taylor's Checkerspot. |
| Three-band Juga | Moderate-High | Low | Moderate-High | Moderate | > Increased water temperatures<br>> Reduced soil moisture and/or drought<br>> Altered fire regimes | There is limited information on the sensitivity of this species to climate change. This species is found in shallow, slow-flowing springs and seeps and is sometimes associated with talus. Activities or events that alter conditions, such as moisture levels and temperature, may make this species vulnerable. |
| Unnamed Oregonian (*Cryptomastix mullani hemphilli*) | N/A | N/A | N/A | N/A | N/A | There is no information on the sensitivity of this species to climate change. |
| Valley Silverspot | Low-Moderate | Low | Low-Moderate | Low-Moderate | > Altered fire regimes | There is limited information on Valley Silverspot sensitivity to climate change, but it is likely sensitive to fire. Valley Silverspot prefers open grassland habitat, and its host plant, early blue violet, thrives in early successional landscapes; fire likely helps maintain open grassland habitat by preventing forest succession. However, increasing fire frequency may facilitate the expansion of Scot's broom and other invasive plants, which can outcompete violets, reducing host plant availability. |
| Washington Duskysnail | Low-Moderate | Low | Low-Moderate | Moderate | > Altered flow regimes<br>> Reduced oxygen<br>> Increased water temperatures | There is limited information on the sensitivity of the Washington Duskysnail to climate change. This species displays very similar traits, habitat requirements, and global distributions to the Masked Duskysnail. The Washington Duskysnail occurs in Washington and Montana; in Washington, their habitat includes two large kettle lakes in eastern Washington – Curlew Lake in Ferry County and Fish Lake in Wenatchee National Forest. This species is considered to be a mud |

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| **Species** | **Overall Vulnerability** | **Overall Confidence** | **Sensitivity Rank** | **Exposure Rank** | **Summary of Exposure** | **Summary of Sensitivity** |
| | | | | | > Increased disease outbreaks | specialist, living on soft bottom substrates in highly oxygenated lakes; changes in water temperature and flow regimes that affect dissolved oxygen levels and stratification may therefore negatively affect the Washington Duskysnail. Changes in flow regimes that increase nutrient runoff may cause dense filamentous algae blooms that impair or prevent access to important food resources. This species occurs in low densities in isolated populations and therefore may be acutely vulnerable to diseases or other regimes causing mass mortality because they may not be able to quickly rebuild populations. |
| Wenatchee Forestfly | Moderate-High | Low | Moderate | Moderate-High | > Increased water temperatures<br>> Changes in precipitation and/or drought<br>> Altered flow regimes | The Wenatchee Forestfly is a type of stonefly which has been found only in springs which flow into Lake Wenatchee, Washington. Little else is known about this species, but sensitivity probably is tied to specialized habitat requirements. Like all other stoneflies, changes in flow patterns due to drought or changing patterns of precipitation, changes in water temperature, and decreased water quality are all likely to increase the sensitivity of the species. Habitat fragmentation and nearby development also alter the quality and availability of suitable habitat. |
| Western Bumble Bee | Moderate-High | Low | Moderate-High | Moderate-High | > Increased temperatures<br>> Reduced snowpack<br>> Earlier snowmelt<br>> Altered fire regimes | Climate sensitivity of the Western Bumble Bee is likely driven by temperature increases, reduced snowpack and earlier snowmelt, and fire. In Washington, this species occupies primarily higher elevations; temperature increases, reduced snowpack, and earlier snowmelt may be contributing to phenological mismatches between this species and key forage plants. Temperatures may also affect the distribution of this species, as it appears to prefer cooler environments. Increasing fire frequencies may help maintain bumble bee foraging habitat by preventing conifer encroachment on meadows with abundant flowers.<br><br>In general, bumble bees are likely sensitive to climate-driven changes in nesting, foraging, and overwintering habitat, but detailed information is currently lacking. Shifts in temperature, precipitation, and snowpack may affect bumble bee distribution and life history, potentially forcing them into unfavorable habitats, to emerge at non-optimal times (i.e., mismatch with vegetation), and/or affecting energy demands during overwintering periods. These climate-driven changes may also affect |

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| **Species** | **Overall Vulnerability** | **Overall Confidence** | **Sensitivity Rank** | **Exposure Rank** | **Summary of Exposure** | **Summary of Sensitivity** |
| | | | | | | habitat quality and availability. One of the primary concerns for bumble bee species is a shift in the abundance, distribution, and/or phenological synchrony of key forage flowering vegetation, as pollen and nectar availability influences reproduction and overwintering success of queens. |
| Western Pearlshell | Moderate | Low | Moderate | Moderate | > Increased water temperatures<br>> Altered flow regimes | Western Pearlshell is a very long-lived species with a lifespan of up to 100 years and it has experienced significant declines over the past few decades. This species is generally found in shallow pools of freshwater streams and reservoirs with good water quality and a sufficient abundance of small fish who serve as hosts for Western Pearlshell during its transition from the larval to juvenile stage. Therefore, main sensitivity is likely to stem from climate-induced changes in water quality and host fish abundance. For instance, increased intensity of winter storms could lead to higher flow in rivers and increased nutrient runoff, both of which would degrade and reduce available habitat. For this species, high levels of river discharge have been found to result in decreased recruitment, and higher nutrient levels have been associated with decreased juvenile growth and increased mortality. Additionally, increases in water temperature and nutrient runoff could lead to altered abundance of host fish (e.g., juvenile salmon) for the larval stage, thus leading to declines in abundance. The long generation times of this species is likely to make response and recovery to adverse climate conditions more difficult. |
| Western Ridged Mussel | Moderate | Low | Low-Moderate | Moderate-High | > Increased water temperatures<br>> Altered flow regimes | There is limited information regarding the sensitivity of the Western Ridged Mussel to climate change. This species is generally found in shallow pools of freshwater creeks and streams and with good water quality and a sufficient abundance of small fish (e.g., sculpin and perch) who serve as hosts for Western Ridged Mussel during their transition from the larval to juvenile stage. Therefore, their main sensitivity is likely to stem from climate-induced changes in water quality and host fish abundance. For instance, increased intensity of winter storms could lead to higher flow in rivers and increased nutrient runoff, both of which would degrade and reduce available habitat. Additionally, increases in water temperature could lead to altered abundance of host fish for the larval stage, thus triggering declines in abundance, particularly since this |

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| **Species** | **Overall Vulnerability** | **Overall Confidence** | **Sensitivity Rank** | **Exposure Rank** | **Summary of Exposure** | **Summary of Sensitivity** |
| | | | | | | species appears to be a specialist in terms of preferred host fish species. Western Ridged Mussels may also be sensitive to increasing water temperature in streams and creeks; increased temperatures could lead to decreased recruitment and increased mortality of the larval stage. |
| White-belted Ringtail | Moderate-High | Low | Moderate-High | Moderate | > Increased air and water temperatures<br>> Altered flow regimes (low summer flows and increased winter flooding)<br>> Altered fire regimes | There is little information on the sensitivity of this species to climate change, but similar to the Pacific Clubtail, it is likely influenced by air temperature, water temperature, and shifting flow regimes. Temperature is known to influence the phenology, development, behavior and other characteristics of dragonflies, and warming temperatures (both air and water) will likely impact this species during various life stages. Hydrological changes (e.g., reduced stream flows) and drought may degrade or reduce aquatic habitat available for this species and/or compound increases in water temperature. White-belted Ringtail is also likely sensitive to disturbance events (e.g., fire, floods) that reduce riparian vegetation, which eliminates stream shade and foraging and roosting sites for adults, and/or that increase siltation, which can kill larvae. |
| Winged Floater | Moderate | Low | Low-Moderate | Moderate-High | > Increased water temperatures<br>> Altered flow regimes | There is limited information regarding the sensitivity of Winged Floater to climate change. This species is generally found in lakes, reservoirs, and slow-moving streams with good water quality and a sufficient abundance of small fish (e.g., sculpin, perch, hardhead) who serve as hosts for the species during its transition from the larval to juvenile stage. Therefore, their main sensitivity is likely to stem from climate-induced changes in water quality and host fish abundance. For instance, increased intensity of winter storms could lead to higher flow in rivers and increased nutrient runoff, both of which would degrade and reduce available habitat. Additionally, increases in water temperature could lead to altered abundance of host fish for larval stage, thus leading to declines in abundance. Winged Floater may also be sensitive to increasing water temperature in streams and lakes; increased temperatures could lead to decreased recruitment and increased mortality of the larval stage. |
| Yosemite Springfly | High | Low | High | Moderate-High | > Increased water temperatures | The Yosemite Springfly is rare, found only in high elevation glacier-fed streams within Washington, Oregon, and California. Little else is known about this species, but sensitivity probably is tied to specialized habitat |

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| **Species** | **Overall Vulnerability** | **Overall Confidence** | **Sensitivity Rank** | **Exposure Rank** | **Summary of Exposure** | **Summary of Sensitivity** |
| | | | | | > Reduced glacier size and increased glacier melting<br>> Changes in precipitation and/or drought<br>> Altered flow regimes | requirements, which will be affected by melting glaciers and an associated rise in stream temperatures. Like all other stoneflies, changes in flow patterns due to drought or changing patterns of precipitation and decreased water quality are also likely to increase the sensitivity of the species, as well as habitat fragmentation and nearby development which may alter the quality and availability of suitable habitat. |
| Yuma Skipper | Moderate | Moderate | Moderate | Moderate | > Altered flow regimes<br>> Prolonged drought | Yuma Skipper occupies reed beds around freshwater marshes, wetlands, streams, and other wet areas, and is likely sensitive to increasingly dry conditions that may affect the distribution and persistence of its larval host plant, the common reed. However common reed is fairly resilient, as it is able to persist for several years in dried-out wetlands; therefore, habitat for Yuma Skipper may be resilient to short-term drought, but could be vulnerable to long-term drought and/or significant shifts in surface water delivery to wetland areas. Further, the extremely limited distribution of Yuma Skipper in Washington makes it vulnerable to local extirpation. |

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*The information in the climate impacts overview was compiled from various synthesis reports on climate change projections and impacts for the Pacific Northwest region. Specific citations for information not derived from these reports can be found in-text. Otherwise, primary literature sources can be found within the following synthesis reports:*


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# Appendix D

# Stakeholder Engagement and Outreach

## Table of Contents

# Appendix D
# Stakeholder Engagement and Outreach

## Introduction and Overview

The development process of the original CWCS included significant outreach to the public and WDFW's stakeholders, all of which is detailed in the 2005 plan, available on the SWAP website – http://wdfw.wa.gov/conservation/cwcs/. The following chapter summarizes our approach to engage stakeholders in the review and revision of the CWCS and the development of the State Wildlife Plan (SWAP) Revision. In general, we aimed for a strategic and leveraged approach to engaging external partners. One of the guiding principles adopted early in the SWAP Revision process encouraged us to "be efficient – conduct the SWAP revision in a manner that matches the available resources for planning and implementation." With limited resources available for this revision, we focused on how to get the best value from stakeholder and public outreach efforts. An Outreach Plan, located near the end of this appendix, was developed to guide our efforts, and specific components of that plan are discussed in the next section.

Our overall approach was to provide several opportunities for feedback from our stakeholders and conservation partners throughout the SWAP Revision process, recognizing that input early in the process would be more effective at shaping the scope and content. We worked with the Wildlife Diversity Advisory Council (WDAC), a standing committee convened by WDFW and representing a range of interests as our primary stakeholder committee. During this period, the WDAC consisted of 18 members from across the state. We provided periodic updates to WDAC on the process for the SWAP Update and worked with a subcommittee early in the process for feedback on our content and focus areas, including feedback on the SGCN list and approach to identifying habitats of concern. Each member of the WDAC was encouraged to reach out to the people and organizations they interact with outside of WDFW to provide input during the revision.

Using the tools described below, we cast a wide net beyond the WDAC to identify and invite other individuals and organizations who might be interested in being involved in the development process, and then focused in on working with those who indicated interest. We made use of the WDFW website, email announcements, in person workshops, webinars and presentations and briefings to small groups to announce the SWAP Update project and invite comments during the development process.

## Development and Implementation of an Outreach Plan

We worked with members of the WDFW Cross Program Advisory Team[1] to develop an Outreach Plan which addressed both outreach to interested parties external to WDFW and also in-reach, activities to engage the expertise of staff within the agency. The Outreach Plan was then reviewed by members of the Wildlife Diversity Advisory Council, and after discussion, the plan was adopted (see References Section for the goals and objectives of the plan).

A few of the key activities outlined in the plan are discussed below.

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[1] The Cross Program Advisory Team included managers from across the agency and met monthly beginning in July 2013 to provide guidance and input on the development of the State Wildlife Action Plan Update.

## 1. Use of the WDFW website for outreach

In early 2014, we updated the WDFW website to announce that the 2005 CWCS was being reviewed and revised as a State Wildlife Action Plan Update. We provided basic information about the update process and timeline and encouraged interested parties to contact the SWAP Coordinator for more information and to be on a list for future updates.

**March 2015: SGCN list and supporting information**

In early March we published our draft SGCN list on the website and provided information about the list, the criteria used, differences from 2005 and the implications of being included on the SGCN list. We also published fact sheets for each of the SGCN, including information on conservation status, conservation concern, distribution, population trends, habitat needs, key stressors and actions. Any visitor to the website was encouraged to review and submit comments on these documents, or the list itself.

**July 2015: Full draft (content review only)**

The full draft SWAP was posted on the website in late July for a general public review period. This draft was intended for content review only.

## 2. Developing an interested persons list

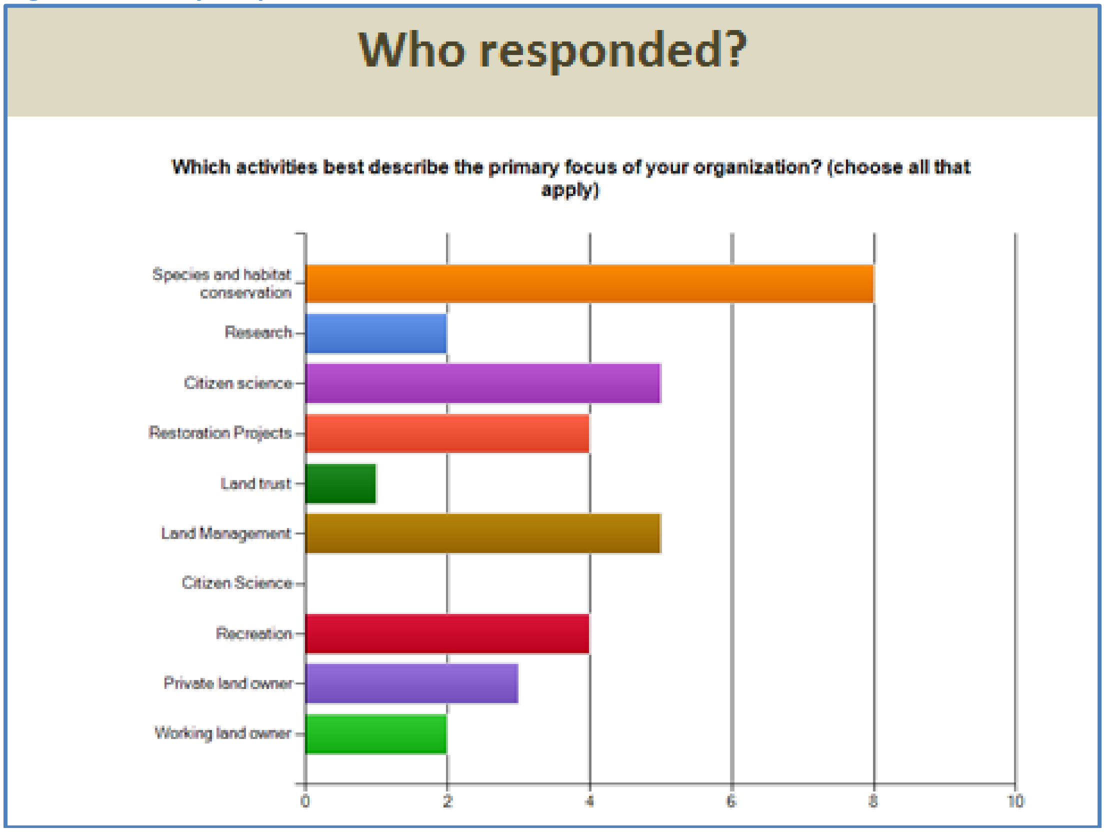
Early in the process we reviewed existing lists from within WDFW to identify individuals, tribes and organizations potentially interested in conservation issues or having specialized expertise or knowledge to contribute. An introductory email was sent to approximately 250 individuals and organizations, announcing the SWAP Update and our goal of developing a list of people interested in being involved in or kept informed of the process for updating the plan. We provided a brief overview of the purpose and intent of the SWAP Revision.

## 3. Survey to determine how the SWAP could add value to conservation actions of other organizations

We developed a survey, located near the end of this appendix, to find out generally how the State Wildlife Action Plan could add value to other organizations, and identify specific opportunities to contribute to shared conservation goals or strategies. The survey asked respondents to identify the top priority initiatives or objectives related to habitat or species conservation in a 3 to 5 year timeline, so that WDFW could assess how the agency, and specifically the SWAP, could contribute towards those objectives. We also provided a list of options for respondents to indicate how WDFW could assist in furthering shared goals related to species and habitat conservation. Finally, we included an open ended question specifically asking for ideas on how the SWAP itself could add value to their respective conservation efforts.

While the number of those responded was relatively low (approximately 20), respondents represented a diverse group of interests and organizations, and the results were informative from that perspective. The following figures summarize the diversity of those who responded.

**Figure 1: Survey Respondents**




**Sample responses to "How the SWAP could add value to your work"**

- Promote on the ground actions to conserve habitat, and access to habitat, especially given threat of climate change.
- Incentive for private landowners; facilitate private incentives for species recovery.
- Serve as a road map for private landowners to help them coordinate incentive based habitat plans with appropriate agencies and tribes.
- Be responsive to needs of agricultural community.
- Provide grant opportunities for land protection and public education projects.
- Promote citizen science at every age level (databases and field experts).
- Communicate to the public about species conservation and climate change
- Integrated/collaborative planning.
- Provide predictability about natural resources management issues; identify management actions that could become Army conservation projects.
- Incorporate priorities set by Pacific Coast Joint Venture Scientists.
- Help to set priorities for partners, and inform updates of national bird plans.

While the resources available for the SWAP Update and the focus of our revision did not allow us to address all the comments, the exercise provided good feedback to the agency and emphasized the importance of using a full conservation toolbox when considering appropriate actions to improve status of SGCN or Ecological Systems of Concern (ESOC), including technical assistance, transparent and clear communication, incentives for private landowners, increased education and others. These conservation tools can be as important in some cases as research or survey and monitoring activities.

The feedback from the survey as well as other comments received through the website and at SWAP presentations encouraged us to post information on SGCN early in our review to ensure that to the extent possible, experts had ample opportunity to add any appropriate information. In identifying stressors and actions (in SGCN and ESOC fact sheets), we also identified potential partners and included a full range of conservation tools.

### 4. Presentations and briefings to key conservation partners

Throughout the SWAP Revision process, the SWAP Coordinator provided briefings and updates to both small and large groups. The purpose was generally to outline the Update process, share products as they were available, and gather feedback. We held briefings with each of the following list of organizations:

- WDNR Natural Heritage Program staff
- Pacific Coast Joint Ventures quarterly meeting
- USFWS staff from Region 1
- Audubon Washington & Black Hills Audubon
- USFWS Surrogate species program lead - identifying possible synergies
- USFS Region 6 TRACs program (purpose to identify possible synergies)
- Cascadia Partner Forum
- North Pacific Landscape Conservation Program staff
- Northwest Climate Science Center

### 5. In-person workshops and webinars

We scheduled three in-person workshops around the state and one webinar, and advertised these on our website and by email to interested persons. We timed the workshops to coincide with the release of the draft SGCN list on our website, and the availability of fact sheets for most of the species. The one to two-page fact sheets describe habitat, conservation status and need, stressors and actions (see Appendix A for updated versions of these fact sheets). The focus of the workshops was both to provide an overview of all the elements of the Update, but to focus particularly on the availability of the SGCN information on the web and encourage review and comment of these draft products.

### 6. Targeted Outreach

After the draft SWAP was released for public review, we targeted outreach to key stakeholders we wanted to be sure had an opportunity to provide comment. We offered webinars and in person briefings to introduce the SWAP and key components, tools that might be of use and opportunities for implementation. Working landowner associations, tribes and Department of Defense facilities in Washington are three groups we planned to reach out to specifically during August and September of 2015.

## References Section

1. **Wildlife Diversity Advisory Council**

   Wildlife Diversity is a term commonly used to describe wildlife species that are not traditionally managed for harvest. Also known as "nongame", these species make up the majority of wildlife. The Wildlife Diversity Advisory Council (WDAC) was created to advise the Department on both keeping common species common and recovering listed wildlife species. The council also recommends approaches on how to develop and maintain the social, political, and resource support necessary to achieve conservation of wildlife diversity species in Washington.

   *Mission Statement*

   The purpose of the Wildlife Diversity Advisory Council (WDAC) is to advise the Department of Fish and Wildlife on matters pertaining to Wildlife Diversity (nongame species and habitat). At the Department's request, WDAC may focus on present or emerging issues as they relate to wildlife diversity.

2. **Goals and Objectives of the SWAP Outreach Plan (adopted in August, 2014)**

**GOAL**

The purpose of this plan is to outline a set of meaningful and cost-effective outreach activities regarding WDFW's efforts to revise the State Wildlife Action Plan. Our goal is to design and conduct these activities in such a way as to provide sufficient opportunities for interested parties to contribute to the content of the plan and/or provide substantive comments on specific elements before submission to the USFWS in September, 2015.

**SPECIFIC OBJECTIVES (benchmarks)**

1. Identify appropriate audience
   - Develop address and contact lists.
2. Develop outreach materials as necessary, to include a web page, fact sheet, PowerPoint presentations, email alerts to interested parties and materials to support interactive workshops.
3. Conduct outreach activities necessary to accomplish goal, to include at least two in person workshops and one webinar during development of the plan, and at least two webinars to introduce the final draft plan.
   - In person one-on-one meetings and calls, and presentations at appropriate events and workshops will be conducted as resources allow.
4. Ensure that the SWAP Revision timeline allows ample time for interested parties to participate in the process.
   - Schedule outreach activities to gather meaningful feedback and input.
   - Provide appropriate time for public review and comment on draft SWAP.

**TARGET DELIVERABLES**

1. Outreach materials: webpage, one-pager
2. Targeted audience presentations: 2-4
3. Public workshops/webinars : 3-5

3. **Survey Monkey** (used to collect feedback on how the SWAP could add value to conservation work by WDFW conservation partners and others)

STATE WILDLIFE ACTION PLAN

The purpose of this survey is to assess how the State Wildlife Action Plan could most effectively contribute to regional conservation needs and align with the priorities of organizations working on behalf of species and habitat conservation in Washington. We will use responses to help shape and prioritize key elements of the Plan. The SWAP is updated every 10 years and designed to be a blueprint to inform conservation planning within WDFW and also the broader conservation community in the State. Click this link (http://wdfw.wa.gov/conservation/cwcs/) for a one page overview.

Thank you in advance for taking the time to respond to this survey.

**1. What is the name of your organization?**

**2. Your name and your position title?**

**3. What description best fits your organization?**

- ☐ What description best fits your organization? Indian Tribe
- ☐ Non-governmental organization
- ☐ Coalition
- ☐ Public-private partnership
- ☐ State agency
- ☐ Local agency
- ☐ Federal agency

Other (please specify)

**4. Which activities best describe the primary focus of your organization? (choose all that apply)**

- ☐ Research
- ☐ Citizen science
- ☐ Restoration Projects

- [ ] Land trust
- [ ] Land Management
- [ ] Citizen Science
- [ ] Recreation
- [ ] Private land owner
- [ ] Working land owner

Other (please specify)

**5. Please describe how the State Wildlife Action Plan could be value added to your organization. What would it need to do to support or enhance the work of your organization in a positive way?**

**6. Please indicate one to three priority intiatives or objectives of your organization (related to species or habitat conservation) in the next 3-5 year timeframe. Please be brief but specific enough so that we can assess how WDFW and the State Wildlife Action Plan might contribute to those objectives.**

**7. Please indicate which of the following are ways your organization either works with WDFW currently, or might in the future. Click all that apply.**

- ☐ Please indicate which of the following are ways your organization either works with WDFW currently, or might in the future. Click all that apply. Share information on priorities for species and habitat conservation
- ☐ Use information in the State Wildlife Action Plan to develop joint projects on common priorities
- ☐ Collaborate on citizen science projects
- ☐ Collaborate on preparing outreach and education materials
- ☐ Provide public testimony or other support for State Wildlife Grants Program (e.g., attend the annual Teaming with Wildlife Fly-in Days)
- ☐ Contribute to landscape or regional conservation efforts (e.g. the Arid Lands Initiative)
- ☐ Provide specific expertise as needed to advance conservation objectives
- ☐ Other

**8. What is your preferred way to comment or contribute to the development of the SWAP?**

Track developments via web and comment when needed

- ☐ Periodic email updates
- ☐ 2-3 hour workshops to engage with staff and explore SWAP content
- ☐ Webinars to introduce elements of the SWAP and address questions
- ☐ WDFW presentations at events or meetings of my organizations

Other (please specify)

**9. Is there anything else you'd like to tell us?**

Thank you for taking our survey! Next

# Appendix E

# Prioritization Matrix

## Description of the WDFW Prioritization Tool

The prioritization tool uses 34 different criteria to rank an action for the purpose of informing planning discussions and decisions. This tool first attempts to identify actions that are either an Absolute Priority (the expectation is that it be done and justification is required if it will not occur), or Non-Priority (meaning there are sufficient reasons to not take an action and if an action is taken it should be justified). All actions can also be scored using both weighted and standard criteria that, if applicable to the action, add value to its relative priority. Finally, the status of the species or ecosystem (the Resource Score) may also be added to the equation to allow that value to influence the priority ranking.

### Step by step instructions

The italicized instructions below are found on the "Instructions" tab on the Prioritization Tool and describe how to complete the Priority Scoring spreadsheet found on the "Scoring Tool" tab. Figures 1-5 provide screen shots of the various tabs for illustration purposes only.

*The tool is intended to prioritize all types of actions (even those that are not similar; e.g. a planning activity vs. a habitat improvement project); however, it may be more useful when evaluating similar actions (e.g. one type of species survey vs. another species survey).*

*Scoring:*

| | |
|---|---|
| *Step 1* | *Describe an Activity in Column A.* |
| *Step 2* | *Assign a Resource Score by determining Taxa or Ecological System Priority value (see Figure 5). If more than one applies, choose the highest ranking (lowest #).* |
| *Step 3* | *Record the value derived from Step 2 in Column AO of the ScoringTool tab* |
| *Step 4* | *Examine the ABSOLUTE PRIORITY, NON-PRIORITY, WEIGHTED PRIORITY, and STANDARD PRIORITY Columns in the ScoringTool tab; insert a "1" in all that apply. (See figures 1-4)* |

*Interpreting the Results:*

| | |
|---|---|
| *Step 1* | *Consider the overall Total Absolute Priority Score (Column H).* |
| *Step 2* | *Any action with a positive value in the Total Absolute Priority column should be treated as a high priority and justification should be developed if the activity will not be conducted or completed.* |
| *Step 3* | *Consider the Total Non-Priority Score (Column N).* |
| *Step 4* | *Any action with a positive value in the Total Non-Priority column should be treated as a very low priority and justification should be developed if the activity is to be conducted.* |
| *Step 5* | *Examine the Total Priority Score (AN) and the Combined Priority Score (AO).* |
| *Step 6* | *The Combined Priority Score is the Actions final priority score and should be compared to scores from other activities being evaluated.* |
| *Step 7* | *When making decisions, it may be useful to also compare just the Total Priority Scores to understand how the Resource Score embedded into the Combined Priority Score affected that score.* |

## Classifying actions and activities

This prioritization tool provides one means by which actions and activities that WDFW undertakes may be prioritized by scoring actions using the criteria described in the categories below.

### Absolute Priority

If an action is linked to one or more absolute priority values, the action is assumed to be of highest priority and is required to be accomplished or justification provided for why it will not be.

- Statutory Requirement.
- Legal Mandate (e.g. court order).
- Financial or Contract obligations (including match commitments for grants).
- Governor Priorities and Requests (e.g. Results Washington).
- Fish and Wildlife Commission Requests.
- WDFW Director or Assistant Director Priorities and Requests (e.g. Conservation Initiative).

Figure 1 Illustration of the Absolute Priority Scoring Tool

| ABSOLUTE PRIORITY | | | | | | TOTAL ABSOLUTE SCORE |
|---|---|---|---|---|---|---|
| Statutory Requirement | Legal mandate (e.g. court order) | Financial, or Contract Obligations (including Match commitments) | Governor Priorities and Requests (Results WA) | FWC Priorities and Requests | Director or Assistant Director Priorities and Requests (e.g. Conservation Initiative) | |
| | | | | | | |

### Non-priority

If an action or activity triggers one or more of these items it qualifies as a Non-priority. In general, WDFW should not implement actions determined to be a Non-priority, without justification.

- Other entities will lead or are likely to conduct the actions with or without WDFW.
- The cost of the project makes the action infeasible, including consideration of short- and long-term resource commitments.
- The likelihood of success is so low that investing in the effort is not justifiable.
- The action will result in significant risk to WDFW authorities or funding streams.
  Action will result in higher priority conservation action not occurring.

Figure 2 Illustration of the Non-Priority Scoring Tool

| NON-PRIORITY | | | | | TOTAL NON-PRIORITY SCORE |
|---|---|---|---|---|---|
| Other entities (USFWS, NOAA, Federal Land Managers, non-profits, land trusts, Partnerships, Citizen Science)will lead or are likely to perform the conservation actions with or without WDFW | The cost of the project makes the action infeasible, including consideration of short- and long-term resource commitments | The likelihood of success is so low that investing in the effort is not justifiable | Action will result in significant risk to WDFW authorities or funding streams | Action will result in higher priority conservation action not occurring | |
| | | | | | |

All actions, but in particular those that have not been found to be either an Absolute or a Non-priority, may then be scored to determine their relative priority by evaluating them against several weighted and standard criteria.

**Weighted Priority.** These are criteria that are considered to be particularly important when determining an actions priority. (See Figure 3)

- Achieves conservation outcome that contributes to species recovery.
- Achieves conservation outcome that maintains or restores ecological integrity.
- External interests could impact WDFWs regulatory authorities or funding if WDFW does not engage in the action.
- Action is a state, regional, national or international priority that WDFW has committed to support (NABCI/AFWA/WAFWA priorities).
- Achieves conservation necessary to preclude the need for listing or support down-listing or de-listing action at the Federal level, or mitigates the impacts of a listing (e.g. CCAA, SHA).
- Achieves conservation necessary to preclude the need for listing or support down-listing or de-listing action at the state level.
- WDFW participation is essential to address an urgent conservation need (imminent threat) that will result in unacceptable harm or loss to the species or habitat.
- Action or project is likely to maintain or develop a funding source or mechanism for diversity species conservation.
- WDFW participation would foster partnerships or help maintain project and/or social/political support for WDFW.
- Action can be shown to have long-term values when evaluated in climate change projections.

Figure 3 Illustration of the Weighted Priority Scoring Tool

| **WEIGHTED PRIORITY (INSERT "1" IN EACH APPLICABLE CELL; IT WILL BE MULTIPLED BY THE VALUE IN COLUMN Y)** | | | | | | | | | | **TOTAL WEIGHTED PRIORITY SCORE** |
|---|---|---|---|---|---|---|---|---|---|---|
| **Achieves conservation outcome that contributes to species recovery** | **Achieves conservation outcome that maintains or restores ecological integrity** | **External interests could damage WDFWs regulatory authorities or funding if WDFW does not engage** | **State, regional, national or international priority that WDFW has committed to support (NABCI/AFWA/WAFWA priorities)** | **Achieves conservation necessary to preclude the need for Federal listing or likely to result in the species being listed (or downlisted) as threatened, or delisted; or mitigate the impacts of a listing (e.g. CCAA, SHA)** | **Achieves conservation necessary to preclude the need for State listing or likely to result in the species being listed (or downlisted) as sensitive, threatened, or delisted** | **WDFW participation is essential to address a pressing conservation need (imminent threat) that will result in unacceptable harm or loss to the species or habitat** | **Action or project likely to maintain or develop a long-term funding source or mechanism for diversity species conservation** | **Failure to participate would erode or prevent important partnerships or cause the collapse of a multi-partner or ongoing project and/or social/political support for WDFW** | **Action can be shown to have long-term values when evaluated in climate change projections** | 3 |
| | | | | | | | | | | 0 |

**Standard Priority**

Criteria that contribute to an action's priority but have not been weighted (see figure 4).

- Fills an immediate or near-term critical information need.
- Provides ecosystem, landscape level, or multiple SGCN species benefits.
- Action will preclude the need for Critical Habitat designation on WDFW lands Action addresses a need in a Federal recovery plan.
- Action addresses address a need in a species-specific State management plan
- Action addresses a need in the SWAP.
- Action maintains or develops a partnership or citizen science effort that will implement conservation actions and reduce future WDFW work load.
- Yields expanded conservation capacity and/or significant reduction in conservation work load
- Action is likely to significantly inform the public on important species conservation and other diversity issues.
- Facilitates special conservation agreements involving landowners (private or public).
- Contributes to conservation assessment and/or status review with a longer-term need
- Action will also meet other WDFW goals and objectives (e.g. recreation such as hunting, fishing, watchable wildlife; customer service; maintain workforce).

Figure 4 Illustration of the Standard Priority Scoring Tool

| STANDARD PRIORITY - (ENTER "1" IN EACH APPLICABLE CELL; IT WILL BE MULTIPLIED BY THE VALUE IN COLUMN AM) | | | | | | | | | | TOTAL STANDARD PRIORITY SCORE |
|---|---|---|---|---|---|---|---|---|---|---|
| Fills an immediate or near-term critical information need | Provides ecosystem, landscape level, or multiple SGCN species benefits | Action will preclude the need for Critical Habitat designation on WDFW lands (may not be needed due to HCP) | Action addresses a need in a Federal recovery plan | Action addresses address a need in a species-specific State management plan (e.g. recovery, 2-year action) | Action addresses a need in the SWAP | Action maintains or develops a partnership or citizen science effort that will implement conservation actions and reduce future WDFW work load | Action is likely to significantly inform the public on important species conservation and other diversity issues | Contributes to conservation assessment and/or status review with a longer-term need or use horizon | Action will also meet other WDFW goals and objectives (e.g. recreation such as hunting, fishing, watchable wildlife; customer service; maintain workforce) | 1 |
| | | | | | | | | | | 0 |

## Scoring Totals

All actions are evaluated against all Weighted and Standard criteria, which generates a combined priority score (figure 6). Each score may be further refined by including the Resource Score in the analysis. Resource Scores are determined by comparing the NatureServe State and Global Ranks for species or ecosystem (See figure 5).

Figure 5 Assigning Resource Scores

**Resource Priority value relative to NatureServe Status Rank Category**

**Taxa Priority Assignment = red digits** (see **TaxaRankValues** tab for S and G values)

| ↑ | NatureServe Global Rank | | | | |
|---|---|---|---|---|---|
| **NatureServe State Rank** | **G1** | **G2** | **G3** | **G4** | **G5** |
| S1 | 1 | 1 | 1 | 2 | 2 |
| S2 | x | 2 | 2 | 3 | 3 |
| S3 | | x | 4 | 5 | 5 |
| S4 | | | x | 6 | 6 |
| S5 & SNA | | | | x | 7 |

If a taxon is a vagrant, limited occurrence, peripheral to Washington due to geographic/political boundaries, or otherwise irregular in contributing to WA biodiversity, it is Priority = 8

**Habitat (Ecol. System) Priority = red digits**

| | Global Category | | | | |
|---|---|---|---|---|---|
| **State Category** | **1** | **2** | **3** | **4** | **5** |
| 1 | 1 | 1 | 1 | 2 | 2 |
| 2 | x | 2 | 2 | 3 | 3 |
| 3 | | x | 4 | 5 | 5 |
| 4 | | | x | 6 | 6 |
| 5 | | | | x | 7 |

1 = critically imperiled (at highest risk of extinction)
2 = imperiled
3 = vulnerable
4 = apparently secure
5 = secure

Figure 6 Combined Priority Score

| TOTAL STANDARD PRIORITY SCORE | TOTAL PRIORITY SCORE | RESOURCE SCORE | = | COMBINED PRIORITY SCORE |
|---|---|---|---|---|
| 1 | | | | |
| **Subtotal** | **Subtotal** | Subtotal | = | TOTAL |

# APPENDIX F

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Key to Abbreviations:

Ch-2 = Chapter 2
Ch-4 = Chapter 4
Ch-5 = Chapter 5

A-1 = Appendix A-1
A-2 = Appendix A-2
A-3 = Appendix A-3
A-4 = Appendix A-4
A-5 = Appendix A-5

App-C = Appendix C

CC-Mammals =: Climate Change Vulnerability – Mammals
CC-Birds = Climate Change Vulnerability – Birds
CC-Herps = Climate Change Vulnerability – Amphibians and Reptiles
CC-Fish = Climate Change Vulnerability – Fish
CC-Invertebrates = Climate Change Vulnerability – Invertebrates