Fish and Wildlife of the Region

CHAPTER 5

Invertebrates

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Invertebrates eclipse all other forms of life on Earth, not only in sheer numbers, diversity, and biomass, but also in their importance to functioning ecosystems. Invertebrates are found in every habitat type and perform vital services such as pollination, seed dispersal, and nutrient recycling.

Detailed surveys are lacking, but it is likely that many thousands of invertebrate species can be found in the greater Portland-Vancouver region. These organisms can be divided into to basic groups: terrestrial and aquatic. The terrestrial group includes the insect orders Hymenoptera (bee, wasps and ants), Lepidoptera (butterflies and moths), and Hemiptera (true bugs), as well as non-insect taxa such as Arachnida (spiders, mites, and their relatives), Diplopoda (millipedes), and Chilopoda (centipedes). The aquatic group includes Plecoptera (stoneflies), Ephemeroptera (mayflies) and Trichoptera (caddisflies), as well as freshwater mussels (in the class Bivalvia). Some species inhabit both terrestrial and aquatic environments; examples include Coleoptera (beetles), Diptera (flies), Odonata (dragonflies and damselflies), and Gastropoda (snails and slugs). Table 5-1 lists examples of native terrestrial invertebrates in the greater Portland-Vancouver region (see also Appendix G for a list of the region's butterflies).

There is a growing consensus that invertebrates are underrepresented when it comes to conservation attention and research. This lack of knowledge may limit conservation funding and prevent the funds that are available from conserving the majority of at-risk species. Anecdotal evidence suggests severe decline for some species. For instance, the western bumble bee (Bombus occidentalis) was once commonly found in the Portland-Vancouver region but is now thought to be extirpated. Freshwater mussels are in decline throughout the West, but species such as the western pearlshell (*Margaritifera falcata*) recently have been found in Portland-area creeks. Fender's blue butterfly (*Icaricia icarioides fenderi*), a federally endangered butterfly, was thought to be extirpated from the greater Portland-Vancouver region, but a small population was recently discovered at Hagg Lake. The zerene fritillary

(*Speyeria zerene*) and field crescent (*Phyciodes tharos*) butterflies may also be extirpated from the region.

Invertebrates are found in every habitat type in the greater Portland-Vancouver region, from the soil to the tops of trees, and in every body of water, including streams, rivers and wetlands. The sheer number and mass of invertebrates reflect their enormous ecological influence. Although some invertebrates have a negative impact on humans (either directly as disease agents or by attacking food crops), the adverse effects pale in comparison to invertebrates' essential beneficial actions. Invertebrates are a critical part of nearly every food chain; they serve both as food for other animals and or as agents in the endless recycling of nutrients in the soil. Food webs often depend on critical species performing essential services such as pollination or seed dispersal (see "Pollinators and Pollinator Conservation" in Chapter 6).

Conservation Issues and Threats

Insects are threatened by the same destructive forces that affect many other animals. According to the International Union for Conservation of Nature, the leading causes of decline are habitat destruction, displacement by introduced plant and animal species, alteration of habitat by chemical pollutants (such as pesticides), hybridization with other species, and overharvesting.

CONSERVATION ISSUES AND THREATS IN TERRESTRIAL HABITATS

Habitat Loss, Degradation, and Fragmentation

Habitat loss and fragmentation are often cited as the most significant factors in decline of invertebrate species. Factors causing habitat loss and fragmentation include increasing urbanization, expansion of intensive agriculture, invasive plants, and climate change.

Introduced Plant and Animal Species

There are few studies of the direct effects of non-native plants on native insects. Introduced, non-native plants compete with native plants for resources, alter habitat composition, and cause significant reductions in the abundance and diversity of pollinators and other herbivorous insects (see Table 5-2). There is also evidence that native pollinator insects prefer native plants, even though many native insects will feed on non-native plants when few natives are available.

The Oregon Department of Agriculture estimates that there are about 1,000 species of exotic terrestrial invertebrates in Oregon. Because Port of Portland facilities have been the primary point of entry for exotic terrestrial invertebrates in Oregon, most of these 1,000 exotic species are found in the greater Portland-Vancouver region. Unlike with habitat alteration or loss, once an exotic animal or plant species is established its presence is usually permanent unless aggressive efforts are made to eradicate it. These efforts may harm native invertebrates and cost a lot of time and money.

TABLE 5-1

Examples of Native Terrestrial Macroinvertebrates of the Greater Portland-Vancouver Region

Species or Group	Population Status	Causes or Comments
Native Slugs and Snails	Declining	Habitat loss or alteration, competition with exotic slugs and snails, exotic predators and parasites
Native Earthworms (e.g., Oregon giant earthworm, *Driloleirus macelfreshi*)	Declining or extinct	Habitat loss or alteration, competition with exotic earthworms, exotic earthworms, exotic predators and parasites
Clown Millipede, *Harpaphe haydeniana*	Uncertain or declining	Habitat loss or alteration; possible keystone species of detritus nutrient cycling
Pacific Black-legged Tick, *Ixodes pacificus*	Increasing	Increased urban/forest interface, more deer; vector of Lyme disease
Wahkeena Falls Flightless Stonefly, *Zapada wahkeena*	Unknown	Known only from Wahkeena Falls, western Columbia River Gorge
Grasshoppers (several species)	Increasing	Disturbance specialists; conversion of woodlands to pasture or agriculture
Giant Silkmoths (e.g., Polyphemus moth, *Antheraea polyphemus*)		Unknown, some species may be declining Habitat/host destruction, invasive plants, non-target biocontrol agent effects, exotic bird predators
Some Predatory Carabid Beetles (e.g., *Pterostichus algidus, Scaphintous marginatus*)	Increasing	Habitat generalists
Carabid Beetle, *Promecognathus crassus*	Unknown	Specialist predator of clown millipede
Carabid Beetle, *Acupalpus punctulatus*	Unknown or declining	Wetland specialist; until recently only known from Forest Grove in 1941
Carabid Beetles, *Pterostichus johnsoni* and *P. smetani*	Unknown	Waterfall plunge pool splash zones in western Columbia River Gorge; P. smetani known only from that area
Trout Stream Beetles *(e.g., Amphizoa striata)*	Unknown or declining	Require fast, clear, clean water; specialist predators of stonefly larvae
Ectoparasitic Mammal Beetles (e.g., *Leptinullus aplodontiae* and *Platypsyllus castoris*)	Unknown	L. aplodontiae on mountain beaver; P. castoris on true beaver; abundance depends on host abundance
Metallic Wood-boring Beetle, *Buprestis gibbsii*	Declining?	Specialist on large, fallen oak branches or trunks
Native Ladybird Beetles	Some declining	Competition and predation by exotic ladybird beetles (e.g., Coccinella septempunctata and Harmonia axyridis)
Mountain Beaver Flea, *Dolichopsylla stylosus*	Unknown	Only host is mountain beaver; abundance depends on host abundance; world's largest flea
Native Ants (e.g., species of *Formica*)	Increasing	Disturbance specialists; anthropogenic habitats favor many ant species
Native Bumblebees (e.g., *Bombus occidentalis*)	Declining	Habitat alteration or loss, exotic pathogens and parasites, competition with exotic bumblebees
Native Butterflies (e.g., *Icaricia icarioides fenderi ; Erynnis propertius; Pyrgus communis; Atalopedes campestris; Parnassius clodius*)	Declining	Habitat loss and alteration

TABLE 5-2

Examples of Exotic Terrestrial Macroinvertebrates of the Greater Portland-Vancouver Region

Species or Group	Effects
Exotic Crop Pests	Economic loss; increased pesticide use; introduction of exotic, generalist biocontrol agents
Terrestrial Flatworm, *Bipalium* sp.; Predator slug, *Testacella haliotidea*	Predators of native and exotic slugs, snails, and earthworms
Exotic Slugs and Snails	Crop and ornamental damage, increased pesticide use, competitors of native slugs and snails, vetors of novel pathogens and parasites (affecting vertebrates and humans as well)
Exotic Earthworms	Change soil structure favoring exotic weeds and detrimental to native earthworms; competitors of native earthworms; vectors of novel pathogens and parasites of native earthworms; support high populations of exotic and native predators that also eat native earthworms
Chinese Mantid, *Tenodera aridifolia sinensis*	Generalist predator of native insects, including beneficials and pollinators
Bedbug, *Cimex lectularius*	Major nuisance, increased pesticide use
Brown Marmorated Stink Bug, *Halyomorpha halys*	Major nuisance pest, is becoming a major crop and ornamental plant pest, increased pesticide use
Seed Bugs (e.g., *Metapoplax ditomoides* and *Raglius alboacuminatus*)	Significant nuisance pests, increased pesticide use
European Gazelle Beetle, *Nebria brevicollis*	Competitor of native carabid beetles, possible novel predator of non-adult stages of threatened and endangered butterflies
Bark and Ambrosia Beetles (e.g., *Anisandrus dispar*, *Scolytus multistriatus*, & *Scolytus rugulosus*)	Damage, stress, or kill crop, ornamental, and forest shrubs and trees; increased pesticide use
Cabbage White Butterfly, *Pieris rapae*	Pest of cabbage, lettuce, etc.; increased pesticide use
Cherry Bark Tortrix, *Enarmonia formosana*	Kills orchard and ornamental cherries, plums, etc.; increased pesticide use; costs associated with biocontrol implementation
European Crane Flies (*Tipula oleracea & T. paludosa*)	Crop, ornamental, and turf damage; increased pesticide use
Mosquito, *Ochlerotatus japonicus*	Disease vector, nuisance, increased pesticide use
Housefly, *Musca domestica*	Disease vector, nuisance, increased pesticide use
Spotted Wing Drosophila, *Drosophila suzukii*	Crop pest increased pesticide use
Exotic Ants (e.g., Odorous House Ant, *Tapinoma sessile*, and Pavement Ant, *Tetramorium caespitum*)	Nuisance, crop damage by protecting sap-sucking insects from predators and parasites, competitors of native ants, predators of native soil terrestrial invertebrates, increased pesticide use

Pesticides

Pesticides, which include insecticides and herbicides, harm invertebrates. Insecticides not only kill insects outright, but sublethal doses can affect their foraging and nesting behaviors. Pesticides intended for a specific target often harm a host of other species.

Herbicides can kill plants on which insects depend, thus reducing the amount of foraging or egg-laying resources. The broadcast application of a non-selective herbicide can indiscriminately reduce flowers, caterpillar host plants, or nesting habitat, causing a decline in pollinators and other invertebrates.

Insecticides are widely used in urban areas throughout the United States to control both native and non-native species. These chemicals are designed to kill insects and their allies, and there is little doubt that they have led to significant decline of both terrestrial and aquatic insects. Their use should be avoided wherever possible.

CONSERVATION ISSUES AND THREATS IN AQUATIC HABITATS

Portland's urban drainages are characterized by storm-driven runoff patterns, soil erosion and sedimentation, chemical pollutants from lawn fertilizers and pesticides, channelization, and, in some areas, steep eroding banks and general channel instability. These influences harm invertebrates through toxicity, reduced oxygen in the water, habitat loss, habitat simplification, and habitat alteration. (For more information, see Chapter 7, "Threats and Challenges").

Channelization

The process of channelization destroys pools and riffles, cuts off meanders, reduces stream length, deepens channels, and destroys riparian vegetation. Loss of pools and riffles reduces habitat diversity for aquatic organisms. Loss of riparian vegetation can increase water temperature, destabilize banks (thus causing erosion), and affect aquatic invertebrate food resources.

Dewatering

Dewatering activities influence rivers and streams by altering the channel, flow, water temperature, and water chemistry, all of which in turn affect aquatic organisms. Freshwater mussels, which can live for decades, have been documented in several urban streams. Dewatering can eliminate entire populations of this long-lived invertebrate, even if the dewatering is for a short period of time for restoration purposes.

Siltation

Development reduces water quality for invertebrates in two primary ways: by increasing sedimentation loads during construction and by increasing flow after storms. Sedimentation can affect aquatic insect respiration, rendering the habitat unsuitable for many organisms.

Fertilizers and Pesticides

The application of fertilizers and pesticides and their subsequent runoff in the greater Portland-Vancouver region is highly destructive to invertebrate life. Chemically polluted streams are generally characterized by high densities of midges and worms and a lack of sensitive species such as stoneflies, mayflies, and caddisflies. In many cases the volume of pesticides and fertilizers used per acre on urban lawns and gardens is greater than that used on agricultural crops.

Conservation Strategies: Habitat Needs of Invertebrates

Although the status of most of the region's invertebrates is unknown, residents can still take action to maintain and increase the diversity of invertebrates in both terrestrial and aquatic environments. A variety of native habitats will meet the needs of many species. Planting native plants in yards and parks and along streams, leaving areas "unmanaged," and limiting the use of pesticides all can have a positive impact. Managing for healthy invertebrate populations can be done by anyone—homeowners with only a small yard, business and industry, roadside managers, and people who care for parks and natural areas.

RECOGNIZE HABITAT

Invertebrate habitat can be found anywhere, and even small patches can contribute to supporting regionwide invertebrate populations. For example, warm, sunny habitat areas attract a good variety of invertebrates. Conserving the following features will benefit many invertebrates:

- **Natural or semi-natural grassland.** Grassland can support a diverse native flora.
- **Hedgerows or small patches of shrub.** These can provide both habitat and connectivity to larger habitat areas.

- **Roadsides.** Carefully managed roadsides can provide good herbaceous and shrub habitat for invertebrates.
- **Urban gardens and parks.** These areas provide important habitat in a fragmented landscape. If managed properly, they can serve as biodiversity reservoirs.
- **Stream, ditches, wetlands, and ponds.** All of these can be important in harboring invertebrates. Freshwater mussels inhabit many urban waterways. Although they are hard to see, they are important in helping to keep these waterways clean.

PROTECT EXISTING HABITAT

Protecting existing habitat and managing natural areas with invertebrates in mind are primary conservation activities. The *Regional Conservation Strategy* will help identify some key biodiversity habitats, but there is more information about woody habitats than grassland and prairie, which are critical to a large group of invertebrates. It will be important to identify, conserve and restore grassland and prairie in future conservation work to protect butterflies and other species.

Aquatic systems are vitally important to invertebrates. Maintaining all existing wetlands and ephemeral, intermittent, and permanent streams and streamside areas is vital to the maintenance of a healthy aquatic invertebrate community. Enforcement of newer construction requirements designed to protect waterways from harmful sedimentation, maintain more natural hydrology, and protect riparian habitat can help prevent further harm.

RESTORE HABITAT

Restoration in urban areas should include establishing native flowering herbaceous plants, providing nesting materials for bees, and reducing pesticide use, to encourage bees and other insects to colonize parks, gardens, and other urban areas. Pavement, buildings, and turf eliminate habitat for ground-nesting insects and reduce the area available for plants. If gardens and other potential habitat are too fragmented and widely spaced, they may not be able to support species whose flight range is limited. The Backyard Habitat Certification program (a partnership between Columbia Land Trust and the Audubon Society of Portland) encourages homeowners to help biodiversity; identifying gaps in connectivity for invertebrates and other animals can help focus programs such as these where they will be most effective. The following are some restoration principles to consider for invertebrate conservation:

- Control and remove invasive weeds.
- Use native forbs and grasses to enhance the diversity of grasslands.
- Use flowering native shrubs to create hedgerows, and lengthen the flowering period by using a variety of species.
- In urban parks and gardens, create flower borders, ecolawns, and ornamental plantings that feature native plants.
- Consider a green roof (i.e., an ecoroof) roof on buildings and structures.
- Relocate mussels found during aquatic restoration using a standard relocation protocol (http://www.xerces.org/wp-content/uploads/2009/10/mussel-relocation-position-statement.pdf).

MANAGE HABITAT

The following techniques for managing habitats are of particular relevance to urban areas:

- Reduce pesticide use, consider less toxic alternatives, and implement an integrated pest management (IPM) plan.
- Pesticides that are not allowed on blooming crops to protect beneficial insects may still be allowed on roadsides, gardens, and parks. Targeted education can reduce these uses.
- A chemical sampling protocol can be designed for urban streams to determine what types and amounts of chemicals are entering the system. Once these chemical inputs have been determined, steps can be taken to limit them in the system. This approach can be expensive but can help in developing targeted strategies.

Mowing is a common practice in urban areas, usually to maintain the height of grasses in parks and lawns. Mowing should be avoided in areas that offer insect habitat, such as those where bees are actively foraging or nesting. Alternately, mowing can be conducted in the evening, when insects are less active. Other mowing techniques that help avoid harm to insect populations include mowing only one part of the area per year, leaving unmanaged areas for pollinators, avoiding mowing during major bloom periods, and allowing habitat to grow back between mowings.

Questions, Unresolved Issues, and Data Gaps

More systematic surveys of the greater Portland-Vancouver region are needed to better understand the region's fauna. One very useful exercise would be to pull all of the information that is already available into one place. Metro has implemented butterfly surveys at several of its natural areas. Surveys of the snail fauna of Forest Park have been implemented. The Xerces Society and local watershed groups are conducting mussel surveys across the Portland-Vancouver region. Unfortunately this information is not in any one place and is hard to access. A clearinghouse where all of this type of data can be house and easily accessed would be ideal.

FOR MORE INFORMATION:

Kaufman Field Guide to Insects of North America
Eric Eaton and Ken Kaufman. 2007. Houghton Mifflin Harcourt, New York.

Field Guide to Insects and Spiders of North America
Arthur V. Evans. 2007. Sterling Publishing Co., Inc., New York.

Insects of the Pacific Northwest
Peter Haggard and Judy Haggard. 2006. Timber Press, Portland.

The Butterflies of Cascadia: A Field Guide to all the Species of Washington, Oregon and Surrounding Territories
Robert Michael Pyle. 2002. Seattle Audubon Society, Seattle.

Life Histories of Cascadia Butterflies
David G. James and David Nannallee. 2011. Oregon State University Press, Corvallis.

Dragonflies and Damselflies of the West
Dennis Paulson. 2009. Princeton University Press, Princeton.

Freshwater Mussels of the Pacific Northwest (2nd edition)
E. Neadeau, A.K. Smith, J. Stone, and S. Jepsen
www.xerces.org/wp-content/uploads/2009/06/pnw_mussel_guide_2nd_edition.pdf

Western Freshwater Mussels
www.xerces.org/western-freshwater-mussels/

Information on aquatic macroinvertebrate and water quality monitoring in streams and wetlands
www.xerces.org/aquatic-invertebrates/

www.deq.state.or.us/lab/techrpts/docs/DEQ03LAB0036SOP.pdf
www.oweb.state.or.us/OWEB/docs/pubs/wq_mon_guide.pdf

Pollinator conservation and other invertebrate information
http://www.xerces.org

Fish

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At least 72 species of fish spend some or all of their life history within the greater Portland-Vancouver region (see Appendix E). Of these, 47 are native species and 24 are non-native. One native species, the Oregon chub, is extirpated in the region. Many of the region's fish species spend their entire life within a specific home range that can vary in size from feet to several miles. The region also hosts anadromous species such as salmon, steelhead, sturgeon, Pacific eulachon (smelt) and Pacific lamprey that spend a portion of their life history within the region, as rearing juveniles and spawning adults, but live the bulk of their lives in the ocean.[1] All native fish species in the region are highly dependent on habitat and water quality conditions at every stage of life in order to maintain viability or prevent declines or potential extirpation. Connectivity and access within and among various habitat types within the region is critical in maintaining viable populations. Development and the associated stream barriers and road crossings create challenges for many fish species in the region.

Conservation Issues and Key Threats to Fish

Fish occupy the following major habitat types within the region:

- Estuary (i.e., the Lower Willamette and Columbia River tidally influenced lowlands)
- Rivers and streams (e.g., the Willamette, Columbia, Clackamas, Lewis, and Washougal rivers; Tryon, Johnson, Butte, and Boardman creeks in Oregon; and Mason, Salmon, Gee, and Lacamas creeks in Washington)
- Lake/wetland (e.g., Smith and Bybee, Beaver, Blue, Fairview, Steigerwald, Vancouver and Columbia River Gorge lakes and wetlands)
- Pond (e.g. Salish and Laurelhurst in Oregon; King's Pond in Washington)
- Off-channel/wetland (e.g. Oaks Bottom, the Ridgefield and Tualatin National Wildlife Refuges, and Sauvie Island Wildlife Area)

Fish occupying every habitat type in the region face challenges related to management of land and water. More than 160 years of development, particularly in the Portland-Vancouver metropolitan area, has altered once-important habitat areas in the Lower Willamette River, Columbia River estuary, and tributaries that supported fish species native to the region.

The Columbia River estuary (including the Lower Willamette below Willamette Falls) provides essential habitat for all native fish species, including juvenile salmon, steelhead, and other anadromous fish as they grow to a size and condition that increases their survival during their ocean migration. Historically, the estuary contained substantial amounts of shallow-water habitat that provided excellent conditions for growth and survival of native fish species. Human land and water management activities have modified these estuarine habitat conditions, resulting in a loss of habitat complexity and access to off-channel habitats. Combined with the effects of the hydropower/flood control system, the primary activities that have determined current estuary habitat conditions include riparian habitat loss, channel confinement (primarily via diking and seawall construction), channel manipulation (e.g., dredging and bank stabilization), floodplain development, and water withdrawal for urbanization and agriculture. With the exception of high summer water temperatures, water quality has generally improved in the lower Willamette River over past decades as a result of pollutant reductions. Yet high pollutant and thermal loads that still occur in some areas, during certain time periods, may be lethal to fish that spend even a limited amount of time in the area.

Tributary stream habitat conditions are also moderately to severely degraded within much of the region. Widespread development and land use activity affect habitat quality and complexity, water quality, and watershed processes in lower Willamette and Columbia tributaries. Stream habitat degradation is primarily due to past and current land-use practices that have affected properly functioning stream channels, riparian areas, and floodplains, as well as watershed processes. The following land management activities create threats and lead to conditions that limit survival of native fish species within the region:

- **Timber harvest and development within riparian areas.** This has reduced stream shade and the input of large woody debris, increased water temperature, and destabilized streambanks, which has led to increased input of fine sediment. Active removal of large wood contributed significantly to reductions in the amount of complex instream habitat. Removal of wood in an attempt to reduce risk and damage from floods continues to this day but is not as extensive as past efforts to completely remove all wood from the region's stream systems.

- **Agricultural development throughout the lowlands in the region.** Agricultural development has directly affected riparian areas and floodplains. Historical floodplain habitats were lost through the filling of wetlands, channelization, and construction of levees and seawalls. Runoff and erosion from agricultural lands where pesticides, herbicides, and fertilizers are applied reduce water quality, to the detriment of native fish and other aquatic species.

- **Construction of dams, culverts, and other barriers.** These structures limit access to spawning, rearing, and foraging habitats for native fish. Dams alter overall flow, reduce high and low flows, and change temperature patterns and hydrologic and geomorphic processes in ways

[1] "Anadromous" refers to fish that spend most of their adult lives at sea but return to fresh water to spawn.

that can result in erosion and reduced natural scour and coarse sediment movement in rivers where dams are located. A number of fish species—in particular several populations of anadromous salmonids—have altered their normal life history patterns to reflect changes in flow and/or temperature patterns that result from the operation of dams in the Columbia and Willamette rivers.

- **Urban and rural development throughout the region**. Development has led to the degradation of riparian and floodplain conditions and an increase in stormwater runoff from roads, ditches, and impervious surfaces. The result is dramatically altered hydrology and a decrease in water quality (because of pollutants associated with development) that can severely limit the productivity and survival of native fish species.

Many species of fish in the region—particularly the anadromous salmonids—also are affected by management activities associated with the production of hatchery fish to support sport and commercial fisheries. According to NOAA Fisheries, recent studies and scientific works have identified the following potential adverse effects of artificial propagation:

- Behavioral differences that result in diminished fitness and survival of hatchery fish compared to naturally spawned fish.

- Genetic effects that result from poor broodstock and rearing practices; these effects include inbreeding, outbreeding, and domestication selection.

- Incidence of disease.

- Increased rates of competition with and predation on naturally spawned populations.

In recent years, some hatchery programs have been designed to conserve or recover natural populations of salmon.

Habitat Needs, Threats, and Opportunities

The resident and anadromous salmonid species found within the region (i.e., Chinook, coho, and chum salmon, steelhead/rainbow trout, bull trout, and resident and coastal cutthroat trout) occupy multiple habitat types during their varied life histories. Unfortunately, because of population declines, local populations of salmon, steelhead and bull trout are listed as threatened under the federal Endangered Species Act and coastal cutthroat trout are identified as a state species of concern. Salmonids within the region require connectivity within and among various habitat types, water quality that meets current standards, and riparian areas that provide shade and the potential for woody debris to maintain habitat and viable populations.

Salmonids are found in most of the region's water bodies, with the exception of blocked and impaired stream reaches and small, isolated wetlands that do not connect to flowing water. Various trout species are found in a number of isolated, often constructed, ponds in the region; these ponds either currently are or historically have been stocked by fish and wildlife agencies or private landowners for recreational purposes but are not supported by natural production of native trout species. Anadromous salmonid species that return to the region after growing and maturing in the ocean spawn in major tributaries of the lower Willamette and Columbia rivers, such as the Clackamas, Sandy, and Lewis rivers; in numerous minor tributaries on the Oregon side of the Columbia River, including Abernethy, Tryon, Kellogg/Mt. Scott creeks and Johnson Creek/Crystal Springs; and in many tributaries in every subbasin on the Washington side.

A host of state and federal funding, research, educational, and regulatory programs are in place to support the region's native fish populations, including salmonids.

COHO SALMON

Coho salmon (*Oncorhynchus kisutch*) in the Columbia Basin have been in decline for the last 50 years. The number of wild coho returning to the Columbia River historically was at least 600,000 fish; at a recent low point in 1996, the total return of wild fish may have been as few as 400. Coinciding with this decline in total abundance has been a reduction in the number of self-sustaining wild populations. All Columbia Basin coho populations upstream of Hood River have been extirpated. Of the 24 historical populations that made up the Lower Columbia River coho evolutionary significant unit (ESU), only in the Clackamas and Sandy subbasins is there direct evidence of persistence during the adverse environmental conditions of the 1990s. Since 2000, the numbers of wild coho have increased in both the Clackamas and Sandy subbasins. During this same period, naturally reproducing coho populations have become re-established in the Scappoose and Clatskanie subbasins. In Washington, the East Fork Lewis and Lower Gorge coho populations are targeted as primary populations to be restored in order to increase the long-term viability of coho.

CHINOOK SALMON

In general, the numbers of Chinook salmon (*Oncorhynchus tshawytscha*) in the lower Columbia Basin are thought to be substantially lower than they were historically. Coinciding with this decline in total abundance has been a reduction in the number of functioning wild populations, particularly in the case of fall Chinook in Oregon. (At the ESU level, spring Chinook populations also have declined.) In addition, the significant presence of stray hatchery fish is thought to be common throughout most of the range of Lower Columbia River fall Chinook. Up to 90 percent of the naturally spawning fall Chinook in Oregon's portion of the Lower Columbia River Chinook ESU are believed to be stray hatchery fish. Of the 12 historical naturally reproducing Chinook populations in Oregon's portion of the Lower Columbia River ESU, only four can be confirmed as present: the early fall Chinook population in the Clatskanie, the late fall population in the Sandy, and the spring Chinook populations in the Sandy and Clackamas. Washington has substantial runs of fall Chinook in the Lewis, Kalama, Washougal and Wind River systems, but many of these are hatchery-origin fish, which pose a risk to naturally produced fish through interbreeding. In Washington, the Kalama, North Fork Lewis, East Fork Lewis, and Washougal populations are targeted for intensive recovery actions to increase the likelihood of long-term persistence, whereas the Lower Gorge population can potentially contribute to Chinook recovery.

STEELHEAD

Although wild steelhead (*Oncorhynchus mykiss*) in Oregon's portion of the Lower Columbia River steelhead distinct population segment (DPS) are depressed relative to historical levels, no known population extirpations have occurred. However, current extinction risk estimates for these populations are large enough that they all are classified as being at at least moderate risk of extinction; this is considered a non-viable status. Key Washington populations targeted for restoration efforts to ensure steelhead survival include the Kalama, East Fork Lewis, Washougal (for summer steelhead), and Lower Gorge (for winter steelhead).

CHUM SALMON

Chum salmon (*Oncorhynchus keta*) have been sporadically observed in several Oregon tributaries, most notably Big Creek; however, there are no data that lend themselves to a quantitative status assessment as performed for Lower Columbia River coho, Chinook, and steelhead species. Chum salmon have not been routinely observed in recent years during spawning surveys conducted for coho and Chinook in lower Columbia tributaries. This lack of chum spawners indicates that the fish are no longer present. As a result, Oregon's Columbia River chum salmon populations are considered either extremely depressed or functionally extirpated. In Washington, the East Fork Lewis, Washougal, and Lower Gorge populations are key populations targeted for recovery efforts. Chum are routinely found spawning in Washington's Grays River, in the area

upstream of the I-205 Bridge (at Woods Landing and Riverside), and in an area below Bonneville Dam (at Ives Island and Duncan, Hamilton, Horsetail, Multnomah, and Hardy creeks). The hatchery program for these populations uses local brood stock to augment the wild populations with the same genetic stock.

OTHER FISH SPECIES

The greater Portland-Vancouver region also includes important habitats for other culturally important, sensitive, and declining species such as federally listed bull trout (*Salvelinus confluentus*), Pacific lamprey (*Lampetra tridentata*), coastal cutthroat trout (*Oncorhynchus clarki clarki*), Pacific eulachon (*Thaleichthys pacificus*), North American green sturgeon (*Acipenser medirostris*), and white sturgeon (*Acipenser transmontanus*). These species have been affected by many of the same factors that have resulted in declines in salmon and steelhead, such as habitat loss and degradation, alterations in flows and sediments, declines in water quality, and loss of access to important areas. Many of the conservation and restoration actions that are being implemented for salmon and steelhead are helping to improve conditions for these and numerous other native species, although there are times when opportunities to benefit other species can be missed if they are not considered explicitly. Fortunately, efforts are under way to try to fill the gaps in our knowledge and practices for some of the less understood at-risk species in the region.

Bull Trout

Bull trout are native throughout western North America (Oregon, Washington, Idaho, Nevada, Montana, and British Columbia) and were historically found throughout the Columbia and Willamette rivers and in their tributaries. Given bull trout's long incubation time and need for very cold water, the species is more sensitive to increased water temperatures, poor water quality, and degraded stream habitat than many other salmonids. Bull trout are now rarely found in the greater Portland-Vancouver region. The U.S. Fish and Wildlife Service listed bull trout as threatened in 1998 and designated critical habitat for the species in 2005; these criteria were revised in 2010. Critical habitat in the region includes the mainstem Columbia River and portions of the Lewis River. The U.S. Fish and Wildlife Service is in the process of updating its draft bull trout recovery plan (scheduled for publication in 2012), although recovery actions are already under way. For example, in 2011, in cooperation with the Oregon Department of Fish and Wildlife and other partners, an experimental population of bull trout was reintroduced into the upper Clackamas River basin.

Eulachon (Smelt)

In 2010 NOAA Fisheries listed the Pacific eulachon (commonly called smelt, candlefish, or hooligan) as threatened in the greater Portland-Vancouver region, as part of the southern DPS. Eulachon typically spend 3 to 5 years in salt water before returning to fresh water to spawn in their natal streams. Within the Columbia Basin, the major and most consistent eulachon spawning runs occur in the mainstem of the Columbia River as far upstream as Bonneville Dam, and in the Cowlitz River. Critical habitat designated in 2011 includes the lower Columbia River up to Bonneville Dam and the lower portions of the Sandy and Lewis rivers, which provide important spawning grounds, with sandy and course gravel substrates. Most eulachon adults die after spawning. Larvae are carried downstream and are dispersed by estuarine and ocean currents shortly after hatching. Recovery planning for the species is expected to occur now that the listing process has been completed. Threats to the species include habitat loss and degradation, hydroelectric dams (which block access to historical eulachon spawning grounds and affect the quality of spawning substrates via flow management), altered delivery of coarse sediments, and siltation. Other concerns include dredging activities (which can entrain and kill fish or otherwise result in decreased spawning success), chemical pollutants, and the potential impacts of climate change, such as ocean warming trends that may alter prey, spawning, and rearing success.

Pacific Lamprey

Although the Pacific lamprey has not been listed under the Endangered Species Act, recent data indicate that the abundance and distribution of this species have been reduced in many river drainages. Historically, Pacific lampreys were thought to be distributed wherever salmon and steelhead occurred. The U.S. Fish and Wildlife Service considers Pacific lamprey to be a species of concern and has been leading a Pacific lamprey conservation initiative to improve the status of the species in collaboration with Native American tribes and other federal, state, and local agencies. In 2010 the agency released the document, Best Management Practices to Minimize Adverse Effects to Pacific Lamprey. In 2011, the U.S. Fish and Wildlife Service finalized its Pacific Lamprey Assessment and Template for Conservation Measures, which contains an overall description of the status of the species, threats affecting them, and the relative risk of population groupings within specific geographical regions throughout the range of the species in the United States. The document also describes conservation actions and research, monitoring, and evaluation efforts that are occurring and needed within each region. Lower Columbia and Willamette river Pacific lamprey populations were found to be at lower risk than populations in other parts of the Columbia Basin. Needed actions identified within this area include passage improvements, lamprey-specific surveys and identification workshops, water quality improvements, stream and floodplain restoration, and outreach and education. The next phase of the initiative will involve development of regional implementation plans. Efforts are being made to address the specific needs of lamprey in fish passage and habitat restoration projects, and to protect lamprey during and after construction projects when ammocoetes (i.e., lamprey larvae) are living in stream substrates.

Coastal Cutthroat Trout

The U.S. Fish and Wildlife Service is leading development of a similar conservation plan for coastal cutthroat trout under the multi-agency Coastal Cutthroat Trout Conservation Initiative. Although the coastal cutthroat trout has been proposed for listing under the federal Endangered Species Act in the past, as recently in 2010 the U.S. Fish and Wildlife Service has found that listing of this subspecies was not warranted. However, coastal cutthroat trout are considered to be a sensitive species because of many ongoing threats. Under the species initiative, partnering agencies and organizations will develop a range-wide coastal cutthroat trout conservation plan that will assess coastal cutthroat trout populations, identify threats and conservation needs, and be used to help coordinate conservation efforts. This initiative, with the development of the conservation plan and other tools, will result in the implementation and evaluation of important conservation measures for coastal cutthroat trout.

White Sturgeon

White sturgeon are not currently listed under the Endangered Species Act, but the species has received special conservation attention. The Lower Columbia River downstream from Bonneville Dam is the most productive in the species' range. The Oregon Department of Fish and

Wildlife released its Lower Columbia River and Oregon Coast White Sturgeon Conservation Plan in 2011 to address requirements under Oregon's Native Fish Conservation Policy. The plan covers the white sturgeon population segment within the mainstem lower Columbia River downstream of Bonneville Dam and gives consideration to fish inhabiting the lower Willamette River and Oregon's coastal rivers, bays and estuaries. The aim of the plan is "to ensure a healthy, viable and productive white sturgeon population in the lower Columbia River downstream of Bonneville Dam for use and enjoyment of present and future generations." In 2011, the Oregon and Washington departments of fish and wildlife issued the 2011 Joint Staff Report: Stock Status and Fisheries for Fall Chinook Salmon, Coho Salmon, Chum Salmon, Summer Steelhead and White Sturgeon, which describes catch limits for white sturgeon in specific watershed areas; these catch limits vary in number and size depending on various watershed zones. Numbers are being watched carefully to ensure appropriate management of this species over time.

Green Sturgeon

The southern Distinct Population Segment for North American green sturgeon, which includes fish in the Columbia River from the estuary up to Bonneville Dam, was listed as threatened by NOAA Fisheries in 2006; the agency is working to conserve green sturgeon. The species is primarily associated with oceanic waters, bays, and estuaries. Critical habitat designated in 2009 includes the Columbia River estuary from the mouth up to River Mile 74 but not the area from River Mile 74 to Bonneville Dam (which is at River Mile 146). In addition to Endangered Species Act protections, Oregon and Washington fisheries regulations that protect this species are currently in effect in the Columbia River.

Climate Change

It is likely that all of the region's fish species, both native and non-native, will be affected by the potential increase in water temperature and hydrologic changes associated with global climate change. Many non-native fish species may actually expand their range as increasing water temperature allows them to successfully forage and reproduce in rivers and streams flowing throughout the region. Most isolated lakes and ponds and the entire Columbia River estuary, which includes the Lower Willamette River, provide habitat conditions suitable for non-native, warm-water fish species to thrive. Introduced, non-native fish species often compete with native fish for food and space; many non-native fish feed on other fish species and have the potential to feed on native fish species if they co-occur in the lower Willamette and Columbia rivers and lower reaches of larger tributary streams. Conversely, it is likely that the range of cold-water fish, including salmonids and lamprey, will be reduced because of climate change-related increases in stream temperature, alterations in hydrology, and competition with non-native species.

Priority Conservation and Restoration Strategies

Coordinated recovery efforts for Oregon and Washington currently are being implemented. In Oregon, the Oregon Department of Fish and Wildlife completed the Lower Columbia River Conservation and Recovery Plan for Oregon Populations of Salmon and Steelhead in 2010 and adopted the Upper Willamette River Conservation and Recovery Plan for Chinook Salmon and Steelhead in 2011. In Washington, the Lower Columbia River Fish Board completed the Lower Columbia Salmon Recovery and Fish & Wildlife Subbasin Plan in 2004 and updated it in 2010. These documents outline threats and limiting factors for the survival and recovery of ESA-listed fish populations that spend part of their life cycle within the greater Portland-Vancouver region. The Lower Columbia Salmon Recovery and Fish & Wildlife Subbasin Plan identifies watersheds of importance to threatened and endangered salmonids in the lower Columbia River (Table 5-3). In both states' recovery plans, limiting factors and threats are divided into specific groups related to habitat, hydropower/irrigation/flood control, hatcheries, and harvest. Actions are identified

TABLE 5-3

Roles of the Region's Salmon and Steelhead Populations in the Recovery of Lower Columbia River Evolutionarily Significant Units: Summary of Designations for Each Population, According to the Preferred Recovery Scenario

P = primary = targeted for restoration to high persistence probability
C = contributing = low to medium improvements needed to reach moderate persistence probability
S = stabilizing = to be maintained at current levels (generally low persistence probability)

Watershed	Fall Chinook (Tule)	Fall Chinook (Bright)	Spring Chinook	Chum	Winter steelhead	Summer steelhead	Coho
Scappoose	P	--	--	P	n/a[1]	--	P
Kalama	C	--	C	C	P	P	C
NF Lewis	X	P*	P	X	C	S	C
EF Lewis	P	--	--	P	P	P	P
Salmon	S	--	--	S	S	--	S
Washougal	P	--	--	P	C	P	C
Sandy	C	P*	P	P	P*	--	P
Clackamas	C	--	--	C	P	--	P*
Lower Gorge	C	--	--	P*	P	--	P

[1] Not listed under U.S. Endangered Species Act.
Source: Lower Columbia Salmon Recovery and Fish & Wildlife Subbasin Plan, 2010.
X refers to subset of larger population.
Primary populations designated for a very high level of viability are denoted with *.
Dashes indicate that the species is not present.

TABLE 5-4

Strategies to Recover Lower Columbia River Salmon and Steelhead Populations and Their Relevance to General Threats Affecting Those Populations

STRATEGY	GENERAL THREAT CATEGORY ADDRESSED				
	Fish Harvest	Hatchery Mgmt.	Hydro/Flood Control	Land Use	Invasive Species
Protect and conserve natural ecological processes that support the viability of wild salmon and steelhead populations and their life history strategies throughout their life cycle.	■	■	■	■	■
Restore floodplain connectivity and function and maintain unimpaired floodplain connectivity and function.			■	■	
Restore riparian condition and LWD recruitment, and maintain unimpaired conditions.			■	■	
Restore passage and connectivity to habitats blocked or impaired by artificial barriers, and maintain unimpaired passage and connectivity.		■	■	■	
Restore and maintain hydrologic regimes that support the ecological needs of wild salmon and steelhead populations.			■	■	
Restore channel structure and complexity, and maintain unimpaired structure and complexity.			■	■	
Restore impaired food web dynamics and function, and maintain unimpaired dynamics and function (both impacts of competition for food resources and altered ecosystem function).	■	■	■	■	■
Restore degraded water quality and maintain unimpaired water quality.			■	■	
Restore degraded upland processes to minimize unnatural rates of erosion and runoff, and maintain natural upland processes.				■	
Reduce the impact of non-native plants and animals on wild salmon and steelhead populations and prevent the introduction of new non-native plants and animals					■
Reduce predation on wild salmon and steelhead that has been exacerbated by anthropogenic changes to the ecosystem.		■	■	■	■
Manage fisheries so that harvest impacts do not compromise the recovery of wild salmon and steelhead populations.	■				
Manage hatchery origin fish in ways that support the recovery of wild salmon and steelhead populations		■			
Reduce or eliminate other source anthropogenic sources of mortality (e.g. beach stranding of juveniles due to ship wakes in the estuary) and prevent them from becoming a problem in areas where they currently do not occur.	■	■	■	■	■

Source: : Lower Columbia Salmon Recover and Fish & Wildlife Subbasin Plan 2010 and ODFW 2010.

for each threat category and are prioritized based on what is determined to be the most effective measure for achieving viability and subsequent delisting of salmon and steelhead populations in the lower Columbia and Willamette rivers (Table 5-4). In general, several strategies can be implemented throughout the greater Portland-Vancouver region to improve conditions for all salmonids:

- Protect intact headwaters and existing native vegetation.
- Protect and increase riparian corridor width and shade to reduce temperatures, increase the availability of wood, and provide cover and invertebrate prey.
- Increase the amount of off-channel habitat for migrating salmonids and provide additional refugia and rearing areas for juvenile salmonids.
- Improve connectivity with floodplains.
- Restore fish passage at culverts, dams, and other barriers.
- Manage forests and urban and rural growth and development to protect and restore watershed processes.
- Reduce the amount of impervious surfaces and retrofit sites to improve stormwater management and add green infrastructure in urban areas.
- Increase channel complexity and the amount of large wood in streams.
- Monitor action effectiveness to ensure that measures produce the intended effect.

Questions, Unresolved Issues, and Data Gaps

Research, monitoring, and evaluation are needed to assess the status and trends of fish species and their habitats, track progress toward achieving recovery goals (for ESA-listed species), and provide the information needed to refine strategies and actions to recover depressed populations through the process of adaptive management. The status of most non-salmonid native fish species is largely unknown because of an inability to effectively monitor smaller populations of fish that occupy varied habitats. Populations that do not receive sufficient monitoring to track abundance and productive capability may be at increased risk of extirpation because of reduced diversity within the population and an inability to survive unsuitable habitat conditions over time.

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http://www.nmfs.noaa.gov/pr/species/fish/pacificeulachon.htm

U.S. Fish and Wildlife Service bull trout website
http://www.fws.gov/pacific/bulltrout/Index.cfm

U.S. Fish and Wildlife Service Coastal Cutthroat Trout Conservation Initiative
http://www.fws.gov/columbiariver/cctinitiative.html

U.S. Fish and Wildlife Service Pacific lamprey website http://www.fws.gov/pacific/Fisheries/sphabcon/Lamprey/index.cfm
http://www.fws.gov/oregonfwo/Species/Data/PacificLamprey/

Lower Columbia River and Oregon Coast White Sturgeon Conservation Plan
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Amphibians

Char Corkran, herpetologist and consultant, and Laura Guderyahn, City of Gresham

Of the 36 amphibian species known to occur in Oregon and Washington (34 of which are native), 18 native amphibians and one non-native live in the greater Portland-Vancouver region (see Appendixes E and G). We are now beginning to understand the important roles of frogs, toads, newts, and salamanders in energy and nutrient cycling. Their potential as indicators of environmental health is a function of both their life history and the permeability of their skin to toxins. Most amphibian species have an aquatic larval stage before they metamorphose into a terrestrial adult form, so they are closely tied to both water and land habitats. Streams surrounded by conifer forests, ponds next to upland woods or prairies, and side channels of rivers lined with riparian hardwoods are examples of adjacent habitat pairs that are important to amphibians in the region.

Conservation Issues and Key Threats to Amphibians

Amphibians are facing unprecedented threats at local, regional, and global levels. Worldwide, 200 amphibian species may now be extinct, and one-third of the remaining amphibian species are threatened. Of the 19 species found in the greater Portland-Vancouver region, 12 are considered federal species of concern and/or are state listed as sensitive species in Oregon or Washington (see Appendix E); it is likely that the Oregon spotted frog has already been extirpated from the greater Portland-Vancouver region.

Research is linking global amphibian losses to habitat destruction and fragmentation, diseases, non-native species, global climate change, pesticides and other pollutants, and poaching for the pet trade. Amphibians in the greater Portland-Vancouver region are affected by most of these factors, but the most significant conservation issue is loss and degradation of habitat. Among amphibian habitats in the region, wetlands have suffered the most drastic losses in acreage and quality.

The filling or draining of wetlands for residential or industrial development and agriculture has been a major issue for most amphibian species, but especially for western toads and Oregon spotted frogs. The introduction of non-native plants and animals into wetlands and open water also is implicated in the decline of amphibians. For example, introduced bass, other warm-water fish, and American bullfrogs all prey on native amphibian species. In addition, American bullfrogs are carriers of a fungal disease that has caused amphibian declines and extinctions throughout the world. In urban areas, stormwater runoff has the seasonal pattern of water levels in many of the remaining natural; this has been a primary driver of native plant communities and associated biota being replaced by invasive species.

In stream systems, increased water temperatures can be lethal to Cascade torrent salamanders, while siltation can prevent all stream-breeding amphibians from using sites for cover and egg laying. In some streams, introduced crayfish may threaten rare native amphibian species. In forested habitats, short harvest rotations prevent the recruitment of large logs that otherwise would provide habitat for terrestrial salamanders and winter refugia for some frogs.

Predicted climate changes include warming temperatures, erratic weather patterns, and earlier summer drying of ponds and streams. These impacts are likely to disrupt breeding cycles for many amphibians. Stream-breeding amphibians and the Cascades frog, which is limited to high-elevation wetlands, may be the most sensitive, although the temperature requirements of northern red-legged frog eggs make this species vulnerable, too. The limited mobility of amphibians also is a challenge because it makes it difficult for them to shift their range in the face of climate change.

Conservation Strategy Species: Habitat Needs, Threats, and Opportunities

The Oregon Conservation Strategy identified 17 amphibian species in Oregon that need attention, and Washington's Comprehensive Wildlife Conservation Strategy identified five amphibian species needing attention in that state. Of these, 14 salamander species and five frog species now live in at least the edges of the greater Portland-Vancouver region; one other frog species, the Oregon spotted frog, apparently has been extirpated from the area.

The 12 extant amphibian conservation strategy species in the region share habitat needs, face similar threats, and may have the same opportunities for conservation and restoration (see Appendix E). Most of the 12 species, including pond-breeding northern red-legged frogs and terrestrially breeding clouded salamanders, need mature upland forest with abundant logs and debris for at least some of their life. Four of the species, including the coastal tailed frog and the Cascade torrent salamander, require cold, silt-free

streams in forests, and four other species occur at least seasonally along such streams. The Larch Mountain salamander and three other species need talus or forests with rocky soil. The specialized habitat needs of these species and the isolation of appropriate habitat patches make localized extirpations likely.

Several amphibian species occur in the region only in its northeast corner; these include the stream species, the Cascades frog, and the Larch Mountain salamander. Other important sections of the region for amphibians designated in the Oregon and Washington conservation strategies are Forest Park and the forested buttes that are adjacent to wetlands, such as Powell, Jenne, and Grant buttes. Finally, forested stream corridors with adjacent floodplains, pocket wetlands, and stormwater ponds, such as Johnson Creek, the Tualatin River, Multnomah Channel, La Center Bottoms, Ridgefield National Wildlife Refuge Complex, Green Lake Wetlands, and Burnt Bridge Creek, are important hiding and overwintering places for amphibians in urban areas.

Priority Conservation and Restoration Strategies

- Incorporate knowledge of amphibians' needs into planning efforts in the region. The presence, habitats, movements, and seasonal activity patterns of amphibians can be addressed in planning

for trails, transportation and development projects, invasive species control, and habitat restoration on publicly owned lands and encouraged on private properties. As an example, management for amphibians in the Oregon portions of the region currently includes wetland restoration and creation efforts, with a focus on northern red-legged frogs, western painted turtles, and western pond turtles.

- Continue current management efforts to provide large woody debris and develop new stands of forest for future recruitment of large logs.

- Expand current protection of fish-bearing waters from siltation and pollutants to include headwater streams and ephemeral ponds.

Current Activities and Programs

Conservation assessments and strategies have been developed by federal and state agencies for several rare or declining amphibian species to summarize their status, biology, threats, and management (see "For More Information"). Paired with efforts on behalf of declining amphibian species in the Oregon Conservation Strategy is the goal of keeping currently common species from becoming rare.

In 1999 the Oregon Spotted Frog Recovery Team was formed as a partnership by Pacific Northwest zoos, aquariums, governmental jurisdictions, and conservation organizations throughout Oregon, Washington, and British Columbia. In 2007, the Oregon Zoo began a captive rearing program to reintroduce Oregon spotted frogs to a site in Washington. To date, there are no efforts to reintroduce the species in the greater Portland-Vancouver region.

Several citizen science programs engage volunteers in monitoring pond-breeding amphibians in the region. The cities of Portland, Gresham, and Hillsboro, Metro, the Vancouver Water Resources Education Center, and Clark, Cowlitz, and Wahkiakum counties recruit and train hundreds of volunteers each year to identify and record the numbers of egg masses and larvae of northern red-legged frog and more common species. The goal of these programs is to create a regional database that will allow assessment of regional population trends.

Questions, Unresolved Issues, and Data Gaps

The design of amphibian protection measures can be improved by filling knowledge gaps such as their range extents, habitat needs, dispersal capabilities, and movement dynamics. For example, understanding the dispersal abilities of Cope's giant salamanders and which populations are more apt to metamorphose would allow stream barriers to be prioritized for removal. Determining the extent and role of fungal and viral diseases could help protect vulnerable amphibian populations from extirpation. Basic reproductive history and habitat needs for some of the terrestrial salamanders still are not fully known. Assessing the distribution of amphibians such as the Oregon slender salamander in urban areas could guide the provision of healthy and connected habitats. More could also be done to assess water quality thresholds that may be important for sustaining viable populations of amphibians that use stormwater facilities.

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Conservation Assessment for the California Slender Salamander in Oregon (Batrachoseps attenuatus)
D.H. Olson. October 20, 2008. Version 1.0. USDA Forest Service Region 6 and USDI Bureau of Land Management. Interagency Special Status and Sensitive Species Program. Available at http://www.fs.fed.us/r6/sfpnw/issssp/species-index/fauna-amphibians.shtml

Citizen Science programs: See Chapter 10, "Species-specific Initiatives," of the *Regional Conservation Strategy for the Greater Portland-Vancouver Region.*
Special Status Amphibians and Reptiles (see Appendix H)

Metro's bird, mammal, and amphibian/reptile wildlife checklists for the Portland area http://www.oregonmetro.gov/index.cfm/go/by.web/id=15421

Washington Herp Atlas: http://www.dnr.wa.gov/nhp/refdesk/herp

Reptiles

Char Corkran, herpetologist and consultant, and Laura Guderyahn, City of Gresham

Of the 31 species of reptiles in Oregon and Washington (28 of which are native), 16 species occur in the greater Portland-Vancouver region (see Appendix E): two native and two non-native turtle species, four lizards, and eight snakes. Although most of these reptiles are characteristic of the drier habitats of the region—i.e., oak habitats, grasslands, and shrublands, which regionally are limited in extent—a few species occur in upland conifer forests. However, the turtles (including the introduced species) and two of the garter snakes are closely tied to open water and to adjacent upland habitats such as oak savanna, grassland, and riparian forest—a combination that occurs in several portions of the region.

Conservation Issues and Key Threats to Reptiles

On a global scale, the status of the vast majority of reptile species is unknown. Within the greater Portland-Vancouver region, 11 of the 14 native reptile species are considered secure in both Oregon and Washington. However, the western pond turtle is listed by the state of Washington as endangered and is considered Sensitive–Critical by the state of Oregon. The western painted turtle has the same Sensitive–Critical status in Oregon but is not considered rare in Washington because of large populations east of the Cascades. The sharptail snake is a federal species of concern and is considered Sensitive-Critical in Washington; it may not be present on the Oregon side. The racer and the gopher snake, which still are common elsewhere in the two states, may have been extirpated from the Puget Lowlands.

Worldwide threats to reptiles include habitat loss and fragmentation, excessive collection for food and the pet trade, non-native species, predation, vehicles, climate change, diseases, pollution, and mining. Habitat loss or degradation, including loss of connectivity, is the most serious issue in the greater Portland-Vancouver region, with wetland and pond habitats being the

most severely affected. The decreasing acreage of oak habitats, grasslands, and shrublands raises concern for local populations of northern alligator lizard, southern alligator lizard, racer, and ring-necked snake.

Furthermore, all of the region's reptile species are affected by collection for pets, road mortality, predation by non-native species, and disturbance that interferes with basking and nesting. Garter snakes and alligator lizards are particularly susceptible to predation by house cats, as they often live in wood piles or house foundations. Vehicles cause mortality, particularly when reptiles move between basking, breeding, and overwintering sites. Gopher snakes are mistaken for rattlesnakes and killed. Disturbance by hikers, unleashed dogs, bikers, and rock climbers can limit critically important basking time for many reptiles. The secretive behavior of the ring-necked snake and rubber boa makes it difficult to understand factors that could threaten their populations. Climate change models forecast earlier runoff of rivers, drying of ponds, and warming temperatures. Although many snake and lizard species may not be affected by these changes, the more aquatic species would be. The native turtles would lose productive summer habitat, including shallows with aquatic vegetation that are critical for hatchlings and small juveniles. If ponds dry early and strand frog tadpoles, both habitat and a major food resource for common garter snakes and western terrestrial garter snakes would be lost. Warmer temperatures may skew sex ratios in turtle populations because gender is determined by nest temperature during early stages of egg development.

Conservation Strategy Species: Habitat Needs, Threats, and Opportunities

The *Oregon Conservation Strategy* and Washington's *Comprehensive Wildlife Conservation Strategy* designate four reptiles as species of concern: western pond turtle (in both states), western painted turtle (in Oregon), and the racer and the gopher snake (in Washington, Puget Trough only) (see Appendix E). Both turtle species live in ponds, lakes, and slow-moving stream channels. Within aquatic habitats, these species need logs and other sites for basking, which is critical to thermoregulation for effective foraging and the production of eggs. However, these turtles also require nearby, sparsely vegetated upland areas for nesting, such as grasslands, oak savanna, or openings in riparian forests. In addition, the western pond turtle winters in oak or riparian woodlands. Both of the snake species occur in grassland habitats and require communal winter den sites.

Both turtle species have suffered from the filling and draining of wetlands for agriculture and development. Remaining aquatic habitats are degraded by pesticides and pollutants. Invasive reed canarygrass has choked many open-water sites, while exotic blackberry species shade nesting sites and hamper movement on land. Non-native turtles compete with native species and infect them with diseases and parasites. Non-native fish and American bullfrogs prey on turtle hatchlings and small juveniles, and unleashed dogs kill and disturb adults. Raccoons and coyotes, albeit native species, are at relatively high densities in urban areas; these animals prey on turtles and dig up nests to eat their eggs. At many western pond turtles sites there is little or no successful nesting or recruitment of juveniles into the population, so the population consists mostly of adults. When female turtles are nesting or moving to and from nesting habitats, they are particularly vulnerable to predation, disturbance, vehicle mortality, and illegal capture for pets.

Both the racer and the gopher snake have lost grassland habitats in the Portland-Vancouver region and are vulnerable to road mortality and agricultural and landscaping practices. In addition, gopher snakes and occasionally juvenile racers are killed because of their resemblance to poisonous rattlesnakes.

Priority Conservation and Restoration Strategies

- Continue to restore aquatic and upland habitats (includes enhancing water quality), especially at important areas for native turtle, i.e., Sauvie Island, the Columbia Slough, and other natural areas along all rivers in the region. High-quality, appropriate connecting corridors and wildlife crossings are important for reptiles and amphibians because these animals generally do not move very fast or very far.

- Provide key habitat features for reptiles, such as large logs for turtle basking (both now and in the future), various sizes of woody debris (i.e., logs and smaller debris), and rocky outcrops.

- Control invasive species.

- Educate the public about area closures to protect turtle nesting, controlling dogs, the need to restrict raccoon and coyote access to pet food and garbage, and the importance of leaving native turtles in the wild and pets in captivity; this latter point may need to be backed up with regulations and enforcement.

Current Activities and Programs

Conservation assessments and strategies for reptiles in the region have focused on native turtle species (see "For More Information"). Conservation assessments for the western painted turtle and western pond turtle in Oregon were completed in 2009, and the Washington Department of Fish and Wildlife wrote a state recovery plan for the western pond turtle in 1999. Seattle's Woodland Park Zoo, the Washington Department of Fish and Wildlife, the U.S. Forest Service, and the Oregon Zoo developed a program for wild-caught hatchling pond turtles to be raised in captivity and released when large enough to avoid most predation. Since 1990, more than 1,500 pond turtles have been reared in zoos and released into the wild.

The Lower Willamette Valley Turtle Working Group and the Western Pond Turtle Recovery Project are partnerships among local, county, and state jurisdictions and nonprofit groups. They have shared goals of implementing conservation assessments and recovery plans and sponsoring research into limiting factors.

Besides efforts for reptiles designated as conservation strategy species in the Oregon Conservation Strategy and Washington's Comprehensive Wildlife Conservation Strategy, a primary objective is to keep currently common species from becoming rare. Educational efforts should focus on protecting known nesting and overwintering sites, re-creating such habitats, reducing invasive species, providing rocks and logs for basking and cover, and controlling domestic cats and dogs. Another key is educating the public to leave native turtles, snakes, and lizards in the wild and refrain from releasing non-native reptiles to the wild.

Questions, Unresolved Issues, and Data Gaps

Appendix H includes a list of current research needs by species. In addition to general habitat and range information, data on the impacts of diseases spread or introduced by invasive species, impacts of predators, and population genetics for the region's native turtles and lesser known snakes and lizards would greatly increase our ability to manage local reptile populations. To accurately gauge current threats to native reptile populations, an overall focus is needed on increasing the body of knowledge of basic life history, range extents, and habitat.

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Oregon Zoo Headstart Program for the Western Pond Turtle http://www.oregonzoo.org/Conservation/westernpondturtle.htm

Conservation Assessment for the Western Painted Turtle in Oregon (Chrysemys picta bellii)
J. Gervais, D. Rosenberg, S. Barnes, Claire Puchy, and E. Stewart. September 2009. Version 1.1. Sponsored by USDI Bureau of Land Management and Fish and Wildlife Service, USDA Forest Service Region 6, Oregon Department of Fish and Wildlife, City of Portland, and Metro. Available at http://www.fs.fed.us/r6/sfpnw/issssp/documents/planning-docs/ca-hr-chrysemys-picta-bellii-2009-09.pdf

Conservation Assessment of the Western Pond Turtle in Oregon (Actinemys marmorata), Version 1.0
D. Rosenberg, J. Gervais, D. Vesely, S. Barnes, L. Holts, R. Horn, R. Swift, L. Todd, and C. Lee. 2009. Report prepared for the USDI Bureau of Land Management and Fish and Wildlife Service, USDA Forest Service Region 6, Oregon Department of Fish and Wildlife, City of Portland and Metro. Available at http://www.fs.fed.us/r6/sfpnw/issssp/documents/planning-docs/ca-hr-actinemys-marmorata-2009-11.pdf.

Native Turtle Working Group, Native Turtles of Oregon
http://www.oregonturtles.com/

Special Status Amphibians and Reptiles (see Appendix H)
Metro's bird, mammal, and amphibian/reptile wildlife checklists for the Portland area
http://www.oregonmetro.gov/index.cfm/go/by.web/id=15421

Washington Herp Atlas:
http://www1.dnr.wa.gov/nhp/refdesk/herp/index.html

Birds

Katy Weil and Lori Hennings, Metro

Birds make up the majority of the greater Portland-Vancouver region's vertebrate species. At least 219 native bird species use habitat in the region, as do eight non-native species. Two species are likely extirpated. The sheer diversity in bird species and ranges in the region creates complex management needs.

Birds provide valuable ecosystem services such as insect predation, pollination, seed dispersal, and scavenging. They also create tree cavities used by many other species and exert strong controls on invertebrate populations. For example, more than 90 percent of birds rely on an insect population to successfully raise juveniles, thereby reducing damage to plants (including trees) from insects such as tent caterpillars and bark beetles. Birds control termites and carpenter ants, thus protecting human structures. Birds also can be reliable indicators of a healthy ecosystem—the proverbial canary in the coal mine. When native birds decline in an ecosystem, it is likely that the health of that system is deteriorating.

Birds are highly mobile and use every natural habitat type and many man-made structures in the greater Portland-Vancouver region, with habitat defined as the areas that birds need for feeding, nesting, roosting, resting, protection from predators, dispersal, and migration. Because of their flight capability, birds can respond to and use non-contiguous resources and habitats. For some species, gaps in the forest serve as important habitat, so the number, size, and condition of forest gaps can influence bird populations.

Bird species can be highly specialized. Examples include the acorn woodpecker and slender-billed (white-breasted) nuthatch, which rely on stands of Oregon white oak, and the streaked horned lark, which requires sparse vegetation with little structure. Other species use a variety of forested, agricultural, shoreline or other habitats. Some species, such as pileated woodpeckers and Swainson's thrushes, require large forested areas.

Urban centers and their surrounding lands can provide important avian habitat, including migratory stopover areas, for birds and other wildlife. The Oregon Department of Fish and Wildlife and the U.S. Fish and Wildlife Service consider urban areas critical for migrating birds. In fact, because the greater Portland-Vancouver region is located along the Pacific Flyway, large concentrations of birds migrating along the flyway use key habitats within the region—including habitats in urban areas. The City of Portland signed an Urban Conservation Treaty for Migratory Birds with the U.S. Fish and Wildlife Service in 2003 to demonstrate the City's long-term commitment to the protection and conservation of migratory birds and the contributions that urban areas can make toward bird conservation.

The North American Bird Conservation Initiative's 2011 State of the Birds report notes that public lands also provide essential habitat for the survival of hundreds of bird species. Approximately 40 percent of the bird species that inhabit the United States have at least 50 percent of their distribution on public lands and waters.

Conservation Issues and Key Threats to Birds

Given the mobility and complex life history of some bird species, the threats they face are many and varied. The following threats to birds are increasingly common at the global, regional, and local scales:

- Degradation, loss, and fragmentation of habitat
- Disturbances such as roads, noise, and artificial lights
- Building strikes (particularly during migration)
- Invasive species (both avian and plant)
- Urbanization
- Predation by domestic cats and disturbance and predation by domestic dogs
- Land management and restoration practices that conflict with nest success
- Reduction in insect populations, which are important food resources

These particular threats are described in more detail in Chapters 6 and 8 of this *Biodiversity Guide* (see "Patch Size and Anchor Habitats" and "Biodiversity Corridors and Connectivity" in Chapter 6 and "Conservation in Developed Areas" in Chapter 8), along with Chapter 6 of the *Regional Conservation Strategy*

SPECIAL-STATUS SPECIES

In 2001, a presidential executive order mandated that federal agencies protect migratory birds. This order emphasized the importance of protecting "species of concern" that have been identified under the Endangered Species Act and in regional lists provided by the North American Bird Conservation Initiative and Partners in Flight, a Neotropical migratory bird conservation initiative. Within the greater Portland-Vancouver region, one species that may occur in the outskirts of the region is currently listed as federally threatened: the northern spotted owl. The bald eagle was originally federally listed as endangered in 1967, but it was downlisted to threatened in 1995 and has now recovered to the point that it was removed from the list (i.e., officially delisted) in 2007. The peregrine falcon has gone through a similar process. The California condor, a feder-

ally listed endangered species, is extirpated from the region (although the Oregon Zoo's breeding program is augmenting the world's small remaining condor population). The yellow-billed cuckoo also is likely extirpated from the region; it and the streaked horned lark are candidates for listing.

Twenty-nine bird species found in the greater Portland-Vancouver region are listed as either sensitive or priority species of concern in Oregon or Washington; this includes four species listed as threatened or endangered in Oregon and/or Washington: the northern spotted owl (Oregon), American white pelican (Washington), sandhill crane (Washington), and bald eagle (Oregon). The City of Portland has a more extensive list of 58 special-status bird species that are supported primarily by riparian and riverine habitats, grassland, oak woodland or savanna, or mature coniferous forest.

MANAGEMENT OF CONIFEROUS FORESTS

Coniferous forests in the Pacific Northwest support some of the highest densities of breeding land birds in North America, including many Neotropical migrants. A 2004 report by Environment Canada[2] indicated that songbirds respond positively not only to larger habitat patches, but to the total amount of tree cover in a given region. It is likely that part of this response is due to increased connectivity in areas with more trees. A Seattle area study suggested 42 hectares (104 acres) as a patch size at which most native forest species were present (see also "Patch Size" in Chapter 6). The unique habitats and avian diversity of Pacific Northwest forests require a detailed regional conservation effort aimed at reducing the potentially deleterious effects of multiple land-use management activities on ecosystem function and on important land bird breeding habitat.

In the greater Portland-Vancouver region thousands of publicly and privately owned acres are managed for timber harvest. These are very large forested areas with scattered clear-cuts and earlier successional shrub and forestlands. Forest age is a significant habitat limitation for birds within the region because timber rotation on most commercial forests occurs about every 40 years and the forests do not achieve mature or old-growth conditions. In addition, reforesting for timber harvest tends toward Douglas fir monoculture without tree species diversity or mature, berry-producing shrubs in the understory. However, current practices typically result in smaller clear-cuts than in the past, and timber harvesters have worked to reduce impacts on streams, leave a few trees and snags, and generally create a more heterogeneous landscape in place.

LOSS AND DEGRADATION OF OAK HABITAT

Among important avian habitats in the greater Portland-Vancouver region, aside from prairie, oak habitats have shown the most significant reduction in acreage and quality. Focal species such as the white-breasted (slender-billed) nuthatch and acorn woodpecker depend on this habitat for the majority of their life cycle. Previously it was thought that only large, contiguous sections of oak habitat were enough to sustain these species, so small patches of oak within the region were considered inconsequential. However, recent research has begun to demonstrate that even small patches of uncommon habitats may be important for regional conservation.

A shift from open to more dense or closed-canopy oak habitat (because of fire suppression) has altered wildlife communities. For example, more open oak habitat such as savanna can support higher numbers of grass-nesting birds, as well as species that use large, open-grown trees. Larger trees tend to have more nesting cavities and produce more lichens, which are a seasonally important food resource for deer and elk, and acorns, which are important to many animals. The shift from savanna to woodland has also substantially reduced associated prairie habitat. The double jeopardy of habitat loss and higher tree density in remaining oak habitats has resulted in substantial declines of oak-associated wildlife species.

LOSS OF RIPARIAN HABITATS

Riparian-associated birds, including birds that use small stream corridors, wetlands, floodplains, and bottomland hardwood forests, are declining because of habitat loss and other factors. Nearly all of the region's wildlife uses water-related habitats at some point in their lives. Only five bird species—two of them non-native—are not associated with any water-related habitat. Of the 227 bird species known to occur annually in the Portland-Vancouver region (see Appendix E), 92 of them (40 percent) rely on or are strongly associated with riparian areas and wetlands. Although the yellow-billed cuckoo has been considered extirpated in the region, a single yellow-billed cuckoo was observed in 2009 in the Sandy River Delta. This sighting is a hopeful sign and a good reason to continue restoring contiguous bottomland hardwood habitat. The yellow-billed cuckoo does an excellent job controlling tent caterpillar infestations and, unlike European cuckoos, does not rely on other species to raise its young (i.e., it is not a nest parasite).

Riparian forests are highly productive, providing leaves, dead wood, and abundant invertebrates to the nearby ground and water. A healthy riparian forest has complex vegetation structure with lots of native shrubs. Birds and other wildlife use these resources for food, cover, breeding, and—importantly—movement. The fairly linear, contiguous nature of streamside vegetation, coupled with these resources and the availability of water, make riparian forests excellent movement corridors for birds and other wildlife. In fact, riparian forests provide the majority of remaining connectivity in urban and agricultural areas. Disruptions in these corridors come in the form of roads, bridges, and development and farming practices that fail to maintain sufficient riparian vegetation.

REMOVAL OF DEAD AND DYING TREES

Approximately 30 percent of bird species use standing dead and dying trees (i.e., snags). Private and some public landowners tend to remove dead and dying trees because of perceived hazards and aesthetics. Sometimes this is justified, but cutting down dead and dying trees also removes key elements from ecosystems, thus diminishing their functional value for birds and other wildlife.

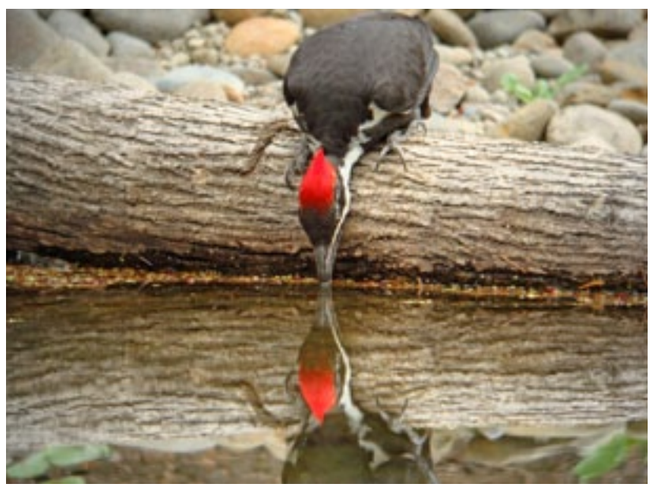
Nearly 100 wildlife species use snags in western Oregon and Washington forests, and more than half of these species depend on cavities created by birds. Primary cavity users are those that actually create cavities, such as woodpeckers. Secondary cavity users cannot create cavities; instead, they use cavities created naturally or by other species. For cavity-dependent species, absence of snags can be a primary limiting factor, and long-term breeding bird survey data document declines in many cavity-dependent birds. Local examples of cavity-dependent species include woodpeckers, western bluebirds, American kestrels, small owls, some bats, house and Bewick's wrens, nuthatches, chickadees and northern flying squirrel. Many other reptile, amphibian and small mammal species use cavities for roosting and thermal protection. Hawks, eagles, and olive-sided flycatchers use snags for perches, and snags frequently serve as nesting sites for eagles and osprey.

[2] *How Much Habitat Is Enough? A Framework for Guiding Habitat Rehabilitation in Great Lakes Areas of Concern.*

Because different species require different snag sizes and decay classes, retaining a variety of snag types will benefit more species. In general, snags that are at least15 inches diameter are most useful to wildlife, and conifer snags last longer than most hardwoods. Large live trees with dead or broken tops sometimes serve similar functions to snags.

AGRICULTURAL PRACTICES

Threats related to agricultural lands and practices include conversion from native habitats, loss of connectivity, and poor timing of mowing and other management activities. The habitat value of croplands diminishes as field size increases and there are fewer fencerows, hedges, and grassy field margins, which provided some habitat value for perching, nesting and movement. However, some grassland species such as the streaked horned lark need larger fields without woody structure. Areas of unplowed pasture represent much of the remaining prairie or prairie-like habitat in the region. Pastures and grain and grass seed fields attract wildlife and provide some value to prairie or grassland-associated birds, as well as moles, voles, and gophers. However, these habitats differ from native grasslands and prairies and are subject to management practices that harm wildlife, such as mowing or harvesting during nesting season.



CLIMATE CHANGE AND INVASIVE PLANT SPECIES

In North America, monitoring already has documented the earlier arrival of migratory birds into breeding territories because of warmer temperatures farther south. In addition, winter ranges are shifting northward; data from the National Audubon Society's nationwide annual Christmas bird count reveal a northward shift averaging 35 miles for all species over the last 40 years. Rates of bird range shifts are correlated with rates of temperature change; urban and suburban birds shifted the most, and forest birds shifted the second most. Grassland birds were the only group that shifted to the south more than to the north. This provides clues about how to focus conservation actions on the species likely to be most affected.

Climate change may also increase invasive species problems as new plants and animals move into the region without their corresponding population controls (disease, natural predators, etc.). Avian populations may decline as the vegetation with which they are associated is out-competed by new invaders. In addition, invasive species may simplify the habitat structure and reduce the plant species diversity that is critical to so many wildlife species.

OTHER ISSUES

In urban areas within the greater Portland-Vancouver region, where cats, dogs, and other small predators abound, surveys of breeding birds indicate that birds that nest close to the ground are declining compared to birds with other nesting habits. Neotropical migratory birds that breed here but overwinter south of the U.S.-Mexico border have been shown in Portland and other U.S. urban areas to be declining disproportionately compared to other species. Migratory songbirds seem to be sensitive to habitat fragmentation. They are associated with native shrub cover, require stopover habitat over long distances, and may be sensitive to human disturbance.

Current State and Local Priority Conservation and Restoration Strategies

The many programs, projects, and efforts that are currently in place to conserve birds have developed out of an urgent need to (1) monitor populations where decline has been suspected, (2) communicate that information to land managers and others, and (3) develop recommended management guidelines where necessary and possible. Within the greater Portland-Vancouver region, bird conservation efforts include the following:

- Oregon Habitat Joint Venture, which promotes protection, restoration, and enhancement of important habitats for birds and the systems on which they depend.

- Important Bird Areas program, administered by the National Audubon Society and Birdlife International.

- Monitoring Avian Productivity and Survivorship (MAPS) Program, which assesses and monitors the vital rates and population dynamics of land birds to provide critical conservation and management information. The Institute for Bird Populations established the MAPS Program in 1989. Within the greater Portland-Vancouver area, MAPS stations are located at Ridgefield National Wildlife Refuge Complex in Washington and at Oak Island (on Sauvie Island) in Oregon. Bird lists and more information are available online at http://www.birdpop.org/.

- North American Bird Conservation Initiative (NABCI), which is a coalition of 22 government agencies, private organizations, and bird initiatives in the United States. NABCI's mission is to ensure the long-term health of North America's native bird populations based on sound science and cost-effective management.

- Partners in Flight, an international cooperative effort that involves partnerships among federal, state, and local government agencies, foundations, professional organizations, conservation groups, industry, the academic community, and private individuals. Partners in Flight develops bird conservation plans that address characteristic habitats and focal species. Examples in the greater Portland-Vancouver area are shown in Table 5-5.

TABLE 5-5
Sample of Regional Habitats and Species Covered by Partner in Flight Conservation Plans

General Habitat Type	Number of Focal Species	Species
Coniferous Forest	20	Pileated woodpecker Pacific (winter) wren Red crossbill Band-tailed pigeon Orange-crowned warbler
Westside Lowlands and Valleys (includes bottomland hardwood, oak savanna, and at least four other distinct habitats)	Nearly 30	Common nighthawk House wren Purple martin Western meadowlark Swainson's thrush

At the state level, the Oregon Conservation Strategy identifies urban priorities related to new urban area planning, using multiple tools to meet conservation goals. The document incorporates habitat considerations into other conservation efforts (such as water quality/quantity), along with urban solutions such as green roofs and naturescaping; it also encourages cooperation across jurisdictional boundaries.

The U.S. Fish and Wildlife Service created the Urban Conservation Treaty for Migratory Birds program in 1999 to help municipal governments conserve birds that live, nest, overwinter, or migrate through their cities. Portland joined the program in 2003 as one of the nine participating cities committing to conserve migratory birds through education, habitat improvement, and bird conservation actions. In a February 14, 2011, letter to the U.S. Fish and Wildlife Service, the City of Portland renewed that commitment. In support of that effort, the City has developed a bird agenda. Next steps in the bird agenda have been identified, and the City is currently in the process of determining how the following major categories of action will be implemented:

- Habitat protection and improvement
- Hazard reduction
- Invasive species management
- Education and outreach

Priority Conservation and Restoration Strategies

Strategies to ensure the persistence of key bird species must begin by incorporating knowledge of the species' habitat needs into planning efforts within the greater Portland-Vancouver region. Avian habitat use, movements, and seasonal activity patterns can be addressed in planning for trails, invasive species control, and habitat restoration on publicly owned lands and encouraged on private properties.

Management actions taken within the greater Portland-Vancouver region can be effectively monitored by tracking bird use, thus adding valuable knowledge as to the efficacy of certain management practices. The following are some useful management practices for maintaining or improving bird habitat in the region:

- Selective forest thinning /oak release (i.e., removing Douglas fir that overtops and shades oak trees).

- Maintaining a variety of seral stages, including native shrub habitat, in forested landscapes.

- Creating and retaining snags and dead wood on the ground.

- Focused management of forest gap size and condition.

- For particularly sensitive or rare habitats, or small populations, use of rotational vegetation management to avoid changing a large area all at once

- Identifying and improving biodiversity corridors. Although some birds may not rely on fully connected habitat, others likely do. Connectivity for birds can be particularly important in urban areas, where habitat patches can be few and far between. Because narrow corridors can attract predators, increasing the width of movement corridors and the number of "entries and exits" of a habitat patch can help species find and safely use the corridor.

- Planning habitat thoughtfully into future urban area design.

- Identifying important conservation areas in the working landscape.

- Siting trails and other recreational facilities carefully to avoid affecting high-quality bird habitats.

Best management practices are available for various habitats within the region, including coniferous forest and lowlands and valleys. For example, see *A Landowner's Guide for Restoring and Managing Oregon White Oak Habitats* (Vesely and G. Tucker, 2004) and B. Altman's two conservation strategies for landbirds in western Oregon and Washington in "For More Information," below. Urban landscapes can be made more inviting to birds by increasing tree and native shrub cover, preserving special habitat areas such as oak savanna and native prairie, creating and improving habitat on private lands through education and outreach (such as the Audubon Society of Portland and Columbia Land Trust's Backyard Habitat Certification program), and focusing on conserving and connecting large, intact habitat areas. A helpful resource is the Audubon Society of Portland's recently released Bird Friendly Building Guidelines.

Opportunities to improve bird conservation on agricultural lands include Farm Bill funded-programs such as the Conservation Reserve Enhancement Program CREP, which is a voluntary land retirement program that helps agricultural producers protect environmentally sensitive land, decrease erosion, restore wildlife habitat, and safeguard ground and surface water. Such programs enhance habitat and food resources and provide surrogate habitat for some species, including grassland birds.

Many owners of small woodlands and lots adjacent to public greenspaces and streams in the greater Portland-Vancouver region want to improve the condition and habitat value of their forests. Continuing to implement favorable management practices on public lands and supporting private timberland owners can provide more valuable wildlife habitat within current land use patterns (see "Upland Forests" in Chapter 3 for more on changes in forest landscapes).

The City of Portland's Bureau of Environmental Services is developing guidelines for how to use "wildlife trees," downed wood, and brush piles to benefit wildlife. This may encourage landowners not to remove dead and dying trees that help maintain ecosystem functions. The City also has adopted guidelines for protecting nesting birds and developed other resources and projects as described in Portland, Oregon's Bird Agenda.

Questions, Unresolved Issues, and Data Gaps

There are knowledge gaps about the needs of bird species that use the greater Portland-Vancouver region. Examples include whether certain plant species (e.g., ocean spray) are particularly good hosts for invertebrates that serve as prey for birds, and whether certain bird species in the region have a fall moult (i.e., feather drop and replacement) that represents a distinct life history, with different habitat requirements. If so, which species are these, and what are their habitat needs? Regarding climate change, there is a need to identify bird species whose activities are tied to the timing of plant flowering or seeding, plant species or communities whose populations are likely to increase or decrease as a result of climate change, and the potential implications of these changes for birds. Another pressing question is how habitat for Neotropical migratory songbirds can be better managed in urban areas.

In some cases, existing data, such as that from the breeding bird survey and Christmas bird count, can be used to guide management recommendations, such as by identifying bird species whose ranges are shifting. In other cases, additional research, monitoring, and evaluation efforts are needed. Nest success studies are one example, particularly relating to habitat patch size (singing males do not always indicate nesting).

FOR MORE INFORMATION

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Mammals

Susan Barnes and Liz Ruther, Oregon Department of Fish and Wildlife, and Jeff Azerrad, Washington Department of Wildlife

Oregon has at least 122 mammal species and Washington has 111, not including marine mammals. At least 76 mammal species, including eight non-natives, occur within the greater Portland-Vancouver region. Mammals are extremely diverse and are present at every level of the food web as herbivores, granivores, insectivores, omnivores, and carnivores. Habitat quality and quantity are the main predictors of mammal species diversity. Mammals typically are divided into seven subgroups:

- Rodents
- Rabbits, hares, and pikas
- Bats
- Shrews and moles
- Ungulates (i.e., hoofed mammals)
- Omnivores
- Carnivores

Small and medium-sized mammals, especially those that eat grain, are the most abundant mammals in urban and suburban environments. Suburban residential areas often make excellent habitat for medium-sized omnivores, such as raccoons and skunks. In general, urban environments support fewer species of mammals than do surrounding rural and undeveloped areas. The species that occur in urbanized environments tend to be habitat generalists rather than specialists. Urbanized areas can support high populations of non-native mammal species such as the house mouse, Norway rat, Virginia opossum, and eastern fox squirrel. In less urbanized areas where larger patches of intact habitat remain, a greater variety of species is likely to be encountered.

Mammals play a variety of ecosystem roles. Predatory mammals regulate herbivores (i.e., plant-eating animals) populations; this in turn affects grazing patterns and influences the development and quality of vegetation and thus wildlife habitat. For example, cougar limit deer and elk populations, thereby reducing habitat overgrazing. Another example of mammals as regulators is the relationship between bat and insect populations. Bats in Oregon and Washington consume only insects, with an adult bat eating about 1,000 insects per hour. Bats also are a source of natural fertilizer (guano) that is important to ecosystem health. Mammals such as squirrels and chipmunks play an important role in habitat regeneration by dispersing seeds. Mammals provide stability to entire food webs and life cycles, although these functions often are disrupted by human actions.

Some mammals are considered keystone species, meaning that their role in the ecosystem has a ripple effect on every species below them, as well as on the ecosystem within which they live. Pocket gophers are an example of a keystone species. Pocket gophers live in grasslands and create extensive tunnel systems, thus aerating the soil (which promotes plant health), creating burrows for other species, and creating areas of bare earth that are used by other species, including birds, insects, and reptiles. Another keystone species is the American beaver, which often is referred to as an "ecosystem engineer" because it creates extensive wetland complexes through its dam-building activities. Beaver-created wetland habitats provide a mosaic of water/land interfaces, resulting in greater plant and animal diversity than would otherwise be present. There is increasing evidence that beavers play a critical role in overall ecosystem health and influence water quality and quantity, plant regeneration, and fish and wildlife production.

Mammals such as raccoons, coyotes, and eastern fox squirrels are habitat generalists, while others, such as the gray fox, western gray squirrel, and Douglas squirrel, are habitat specialists. Generalists are more adaptable to fragmented habitats, while specialists typically require larger, more intact habitats or specific habitat types and are less tolerant of urbanization and human presence.

Conservation Issues and Key Threats to Mammals

Conservation of mammal species diversity is a concern locally, regionally, and globally. All mammals face a variety of threats, although some threats are more obvious than others. Rare species whose distribution naturally is limited are most susceptible to environmental degradation and at greatest risk of extinction or local or regional extirpation. Small mammals are just as likely to become extinct as larger species, but ungulates (i.e., hoofed mammals) and large carnivores receive disproportionate attention with respect to conservation activity and research. Many of these smaller mammal species are classified as nongame wildlife. Nongame species generally receive less conservation attention, primarily because federal and state fish and wildlife management agencies traditionally have been structured and funded based on fish and game species.

The majority of mammal species in the greater Portland-Vancouver region receive some level of protection by federal and/or state wildlife management agencies. In Oregon, some fall into the category of non-protected nongame wildlife (OAR 635-044-0132) and therefore are not protected from take (i.e., being killed or removed from the wild). In Washington, nongame species

classified as protected may not be hunted, killed, possessed, or controlled (WAC 232-12-011). It is also illegal in Washington to use body-gripping traps to capture any mammal for recreational or commercial purposes (WAC 232-12-142). Washington's Growth Management Act requires that all cities and counties designate areas that are critical to fish and wildlife (primarily nongame species). Under the Growth Management Act, local policies and regulations must be enacted (WAC 365-196-830) to conserve and protect these areas.

Land ownership and how a mammal species interacts with its human-influenced environment can dictate species management. Oregon Department of Agriculture statutes and rules classify certain mammals as predators on private lands when they are "causing damage, are a public nuisance, or are posing a public health risk" (ORS 498.012) on those lands. This allows private landowners to take (i.e., kill) animals such as mice, voles, American beaver, mountain beaver (apolodontia), various squirrels, chipmunks, muskrat, rabbits, and coyote.

Habitat loss and fragmentation are the most significant threats to overall mammal diversity and population viability. These threats and the associated loss of special habitat elements such as large dead and dying trees and large downed wood have caused localized losses and declines of some mammals, particularly those associated with interior forest habitats (e.g., American marten). Habitat degradation from invasive plant and animal species also poses a threat to native mammals. Some mammals, such as bats, face persecution that is rooted in fear or ignorance. Large carnivorous mammals such as cougar also often face persecution, or people are simply unwilling to tolerate their presence. Even native mammals that people often view as "cute" and harmless, such as deer and tree squirrels, sometimes become nuisance wildlife and then are harassed.

Physical barriers such as roads and culverts pose a significant threat to a variety of mammal species and affect daily, seasonal, and dispersal movement patterns. Other key threats to mammals are poaching and over-harvest, pollution and chemical contaminants (including impacts on non-targeted species), disease, invasive species, predation by off-leash dogs and free-roaming cats, encroachment by humans, injury or mortality resulting from collisions with moving vehicles, artificial feeding, and other sources of injury or mortality, such as entanglement in fences, monofilament fishing line, and sticky glue strips and traps.

Lack of survey and breeding information poses another challenge to mammal species management and conservation, especially in the face of expanding urbanization and decreasing budgets at public agencies. Some mammal species are inherently difficult to study or monitor; these include species that naturally occur at low population levels, underground species such as moles and shrews, arboreal species such as the red-tree vole, secretive species, and those—such as the fisher—that have large home ranges and require large patches of remote and intact habitats.

Special-status Species: Habitat Needs

Of the 68 native mammal species found in the greater Portland-Vancouver region, 16 are either classified by Oregon or Washington as a sensitive species or have a more critical designation, and 21 are identified as state strategy species in one or both state conservation strategies. The gray wolf is listed as endangered in both Oregon and Washington, and the Columbian white-tailed deer is listed as endangered in Washington. At least 15 of the 25 mammal species that the Oregon Department of Fish and Wildlife classifies as protected nongame wildlife occur within the region. In Oregon, these species may not be hunted, trapped, pursued, killed, caught, angled for, or possessed, whether dead or alive, whole or in part (OAR 635-044-0130) (see Appendix E).

Several special-status species (e.g., American marten, fisher, red tree vole) need large patches of intact, late successional mixed conifer habitats with multi-layered canopies. These species need a high density of snags and logs for den sites and foraging and typically have low survival rates in fragmented forests. The red tree vole, which occurs only in western Oregon and northern California, has a small home range but requires tree-top connectivity for post-breeding dispersal; this species. A recent U.S. Fish and Wildlife Service decision listed the North Oregon Coast red tree vole population, whose range includes the western portion of the greater Portland-Vancouver region, as a distinct population segment; this population is a candidate for federal Endangered Species Act listing.

The Columbian white-tailed deer is a federally listed species that historically occurred throughout Columbia River bottomland hardwood forests. Now only remnant populations occur in riparian habitats on remaining islands along the lower Columbia River.

Many of the region's special-status species are bats. Although many bat species are known to use human structures such as crevices in bridges for roost sites, bats within the greater Portland-Vancouver region typically are associated with mature forests and will use large snags, hollow trees, and downed wood for roost sites.

Data Gaps

There are knowledge gaps for many of the mammal species that occur within the greater Portland-Vancouver region, particularly for nongame and special-status species. Additional information on basic species distribution, population densities and trends, dispersal patterns, seasonal movements, overwintering locations and the level of human-caused mortality would improve conservation efforts for mammals within the region and across species' ranges.

Conservation Strategies

- Prevent additional habitat fragmentation within the region, both in developed areas and toward the outer fringes of the region.
- Improve habitat connectivity within the region and with key habitat areas outside the region.
- Incorporate the needs of wildlife when implementing culvert replacement and fish passage projects, to allow animal movement.
- Develop and use measurable indicators of high-quality habitats.
- Evaluate the effectiveness of providing passage around barriers to mammal movement, to enhance species migration and habitat connectivity.
- For species that depend on habitats that already have a high degree of fragmentation or isolation, determine the patch sizes and configuration needed to maintain viable populations.
- Complete conservation assessments for special-status species that summarize status, life history, threats, and conservations strategies.
- Fill species data gaps, focusing on the highest priority special-status species first.
- Determine the impacts of introduced mammal species (i.e., nutria, eastern fox squirrel, eastern gray squirrel, eastern cottontail rabbit, Virginia opossum) on native wildlife.
- Control invasive plant species to address habitat degradation.
- Develop new cost-effective and efficient techniques for studying species that are elusive or difficult to study.
- Enact harsher penalties (e.g., fines) for wildlife crimes.

- Amend state Department of Wildlife administrative rules to eliminate the non-protected nongame wildlife category, in recognition of the inherent value of all native species of wildlife and the ecosystem services they provide.

- Amend state Department of Agriculture statutes to redefine predatory animals and the process for addressing wildlife damage.

- Implement educational and informational campaigns and policy related to the effects of dogs (on and off-leash) and free-roaming cats on wildlife.

- Enact local and/or state laws that prohibit the artificial feeding of wild mammals (with certain exceptions, such as when necessary for wildlife scientific or research purposes, or when approved by the state fish and wildlife department).

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