


the OREGON CONSERVATION STRATEGY




Chapter 6: Strategy Species

2016
Oregon Department of Fish and Wildlife

OregonConservationStrategy.org

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Contact ODFW

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Featured image: Black-necked Stilt, Keith Kohl, ODFW

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STRATEGY SPECIES

The Conservation Strategy identifies 294 Strategy Species, which are Oregon's "Species of Greatest Conservation Need". Strategy Species are defined as having small or declining populations, are at-risk, and/or are of management concern. Oregon's Strategy Species include 17 amphibians, 58 birds, 29 mammals, 5 reptiles, 60 fish, 62 invertebrates, and 63 plants and algae. Information on the Special Needs, Limiting Factors, Data Gaps, Conservation Actions, and available resources are listed for each of Oregon's Strategy Species on **profile pages** of the **OregonConservationStrategy.org** website.

Strategy Species are designated by **ecoregion**, based on conservation need and opportunities, rather than at a statewide level. The ecoregions designated for each species represent the highest priorities for implementing conservation actions for individual species. Some species occur in ecoregions other than where they are designated as a Strategy Species; conservation actions implemented in these ecoregion(s) will also contribute to the overall conservation success for the species.

Although efforts were made to standardize the conservation criteria used to determine Strategy Species, some variation exists between taxa. For more information, see **Methods for Determining Strategy Species**. For some species, not enough information was known to determine whether a species meets the conservation criteria to qualify as a Strategy Species. The Conservation Strategy identifies these species as **Data Gap Species**.

Although the focus of this section is on the requirements of Strategy Species and the actions needed to conserve them, it also takes a broader view of fish and wildlife conservation and includes information on naturally-occurring **Fish and Wildlife Diseases** and **Animal Concentrations**.

> The Strategy Species and Data Gap Species lists are available for download in **Excel table** format.

AMPHIBIANS

There are 17 amphibians identified as Strategy Species in the Oregon Conservation Strategy:

Cascade Torrent Salamander
Cascades Frog
Clouded Salamander
Coastal Tailed Frog
Columbia Spotted Frog
Columbia Torrent Salamander
Cope's Giant Salamander
Del Norte Salamander
Foothill Yellow-legged Frog
Larch Mountain Salamander
Northern Red-legged Frog
Oregon Slender Salamander
Oregon Spotted Frog
Rocky Mountain Tailed Frog
Siskiyou Mountains Salamander
Southern Torrent Salamander
Western Toad

BIRDS

There are 58 birds identified as Strategy Species in the Oregon Conservation Strategy:

Acorn Woodpecker
American Three-toed Woodpecker
American White Pelican
Black Brant
Black Oystercatcher
Black Swift
Black-backed Woodpecker
Black-necked Stilt
Bobolink
Brewer's Sparrow
Brown Pelican
Burrowing Owl
Caspian Tern
Chipping Sparrow
Columbian Sharp-tailed Grouse
Common Nighthawk
Dusky Canada Goose
Ferruginous Hawk
Flammulated Owl
Fork-tailed Storm-Petrel
Franklin's Gull
Grasshopper Sparrow
Great Gray Owl
Greater Sage-Grouse
Greater Sandhill Crane
Harlequin Duck
Juniper Titmouse
Leach's Storm-Petrel
Lewis's Woodpecker
Loggerhead Shrike
Long-billed Curlew
Marbled Murrelet
Mountain Quail
Northern Goshawk
Northern Spotted Owl
Olive-sided Flycatcher
Oregon Vesper Sparrow
Peregrine Falcon
Pileated Woodpecker
Purple Martin
Red-necked Grebe
Rock Sandpiper
Sagebrush Sparrow
Short-eared Owl

Snowy Egret
Streaked Horned Lark
Swainson's Hawk
Trumpeter Swan
Tufted Puffin
Upland Sandpiper
Western Bluebird
Western Meadowlark
Western Snowy Plover
White-breasted Nuthatch
White-headed Woodpecker
Willow Flycatcher
Yellow Rail
Yellow-breasted Chat

MAMMALS

There are 29 mammals identified as Strategy Species in the Oregon Conservation Strategy:

American Marten
American Pika
California Myotis
Columbian White-tailed Deer
Fisher
Fringed Myotis
Gray Whale
Gray Wolf
Harbor Porpoise
Hoary Bat
Killer Whale
Kit Fox
Long-legged Myotis
Northern Elephant Seal
Pacific Harbor Seal
Pallid Bat
Pygmy Rabbit
Red Tree Vole
Ringtail
Rocky Mountain Bighorn Sheep
Sierra Nevada Red Fox
Silver-haired Bat
Spotted Bat
Steller Sea Lion
Townsend's Big-eared Bat
Washington Ground Squirrel
Western Gray Squirrel
White-tailed Jackrabbit
Wolverine

REPTILES

There are 5 reptiles identified as Strategy Species in the Oregon Conservation Strategy:

California Mountain Kingsnake
Northern Sagebrush Lizard
Western Painted Turtle
Western Pond Turtle
Western Rattlesnake

FISH

There are 60 fish identified as Strategy Species in the Oregon Conservation Strategy:

Alvord Chub
Big Skate

Black Rockfish
Blue Rockfish
Borax Lake Chub
Brown Rockfish
Bull Trout
Cabezon
Canary Rockfish
China Rockfish
Chinook Salmon
Chum Salmon
Coastal Cutthroat Trout
Coho Salmon
Copper Rockfish
Deacon Rockfish
Eulachon
Foskett Spring Speckled Dace
Goose Lake Sucker
Grass Rockfish
Great Basin Redband Trout
Green Sturgeon
Hutton Spring Tui Chub
Kelp Greenling
Lahontan Cutthroat Trout
Lingcod
Longfin Smelt
Lost River Sucker
Miller Lake Lamprey
Millicoma Dace
Modoc Sucker
Northern Anchovy
Oregon Chub
Pacific Herring
Pacific Lamprey
Pacific Sand Lance
Pile Perch
Pit Sculpin
Quillback Rockfish
Redtail Surfperch
Rock Greenling
Shiner Perch
Shortnose Sucker
Spiny Dogfish
Starry Flounder
Steelhead / Rainbow / Redband Trout
Striped Perch
Surf Smelt
Tiger Rockfish
Topsmelt
Umpqua Chub
Vermilion Rockfish
Warner Sucker
Western Brook Lamprey
Western River Lamprey
Westslope Cutthroat Trout
White Sturgeon
Wolf-eel
Yelloweye Rockfish
Yellowtail Rockfish

INVERTEBRATES

There are 62 invertebrates identified as Strategy Species in the Oregon Conservation Strategy:

Archimedes Springsnail
Beller's Ground Beetle
Black Petaltail
Blue Mud Shrimp
Borax Lake Ramshorn
Bulb Juga
California Floater Freshwater Mussel
California Mussel
Columbia Clubtail
Columbia Gorge Caddisfly
Columbia Gorge Hesperian
Crater Lake Tightcoil
Dall's Ramshorn
Dalles Mountainsnail

Dungeness Crab
Fender's Blue Butterfly
Flat Abalone
Franklin's Bumble Bee
Great Basin Ramshorn
Great Spangled Fritillary
Highcap Lanx
Hoary Elfin Butterfly
Insular Blue Butterfly
Klamath Ramshorn
Leona's Little Blue Butterfly
Lined Ramshorn
Malheur Cave Amphipod
Malheur Cave Flatworm
Malheur Cave Springtail
Malheur Isopod
Malheur Pseudoscorpion
Mardon Skipper Butterfly
Monarch Butterfly
Native Littleneck Clam
Ochre Sea Star
Olympia Oyster
Oregon Shoulderband
Oregon Silverspot Butterfly
Pacific Giant Octopus
Pacific Walker
Purple Sea Urchin
Purple-lipped Juga
Razor Clam
Red Abalone
Red Sea Urchin
Robust Walker
Rock Scallop
Rotund Lanx
Scale Lanx
Scalloped Juga
Shortface Lanx
Sinitsin Ramshorn
Siskiyou Hesperian
Sisters Hesperian
Stonefly
Sunflower Star
Taylor's Checkerspot Butterfly
Turban Pebblesnail
Vernal Pool Fairy Shrimp
Western Bumble Bee
Western Ridged Mussel
Winged Floater Freshwater Mussel

PLANTS AND ALGAE

There are 63 plants and algae identified as Strategy Species in the Oregon Conservation Strategy:

Applegate's Milkvetch
Arrow-leaf Thelypody
Big-flowered Wooly Meadowfoam
Boggs Lake Hedge Hyssop
Bradshaw's Desert Parsley
Bull Kelp
Cascade Head Catchfly
Coast Range Fawn Lily
Cook's Desert Parsley
Crinite Mariposa Lily
Cronquist's Stickseed
Crosby's Buckwheat
Cusick's Lupine
Davis' Peppergrass
Dwarf Meadowfoam
Gentner's Fritillary
Golden Buckwheat
Golden Paintbrush
Greenman's Desert Parsley
Grimy Ivesia
Howell's Mariposa Lily
Howell's Microseris
Howell's Spectacular Thelypody
Howellia

Kincaid's Lupine
Large-flowered Rush Lily
Lawrence's Milkvetch
Macfarlane's Four o'Clock
Malheur Valley Fiddleneck
Malheur Wire-lettuce
McDonald's Rockcress
Mulford's Milkvetch
Native Eelgrass
Nelson's Checkermallow
Northern Wormwood
Oregon Semaphore Grass
Owyhee Clover
Packard's Mentzelia
Peacock Larkspur
Peck's Milkvetch
Pink Sandverbena
Point Reyes Bird's-beak
Pumice Grape-fern
Red-fruited Lomatium
Rough Popcornflower
Sea Palm
Sexton Mountain Mariposa Lily
Shiny-fruited Allocarya
Silvery Phacelia
Smooth Mentzelia
Snake River Goldenweed
South Fork John Day Milkvetch
Spalding's Campion
Sterile Milkvetch
Surf Grass
Tygh Valley Milkvetch
Umpqua Mariposa Lily
Wayside Aster
Western Lily
White Rock Larkspur
White-topped Aster
Willamette Daisy
Wolf's Evening Primrose

Photo Credit: Keith Kohl, ODFW

METHODS FOR DETERMINING STRATEGY SPECIES

The U.S. Fish and Wildlife Service (USFWS) requires all State Wildlife Action Plans to designate "Species of Greatest Conservation Need" as well as to provide specific information about problems that may affect those species, information needed to improve conservation, and recommended conservation actions.

The Oregon Conservation Strategy uses the term "Strategy Species" to represent "Species of Greatest Conservation Need", with the **Strategy Species** list developed to meet these requirements for Oregon. The Strategy identifies wildlife (**amphibians**, **birds**, **mammals**, and **reptiles**), **fish**, **invertebrates**, and **plants and algae** as Strategy Species, including species occurring within the nearshore.

BACKGROUND

The original list of Strategy Species was developed by regional biologists and species experts in 2006. This was done by first creating a list of all declining species in Oregon, and then using spatial models of Oregon's vegetation types to produce species-habitat associations that estimated the extent of habitat loss experienced by each species. The 2006 Strategy also identified "Data Gap Species", defined as species that may be of conservation concern, but insufficient information was available to fully assess whether they met the Strategy Species criteria.

For the 2016 revision, all 2006 Strategy Species and Data Gap Species were reviewed and updated. The Oregon Department of Fish and Wildlife (ODFW) divisions and partner organizations took the lead on reviewing and updating the various taxonomic groups. The ODFW Wildlife Division updated the Wildlife (amphibians, birds, mammals, and reptiles) Strategy Species. The ODFW Fish Division updated the Fish Strategy Species. Experts from the Oregon Department of Agriculture (ODA), Oregon Biodiversity Information Center (ORBIC), the Xerces Society for Invertebrate Conservation, and independent species experts were consulted to update the Invertebrate Strategy Species. The ODA reviewed the Plant and Algae Strategy Species, with additional information provided by the Institute for Applied Ecology. Nearshore Strategy Species were updated by the ODFW Marine Program.

Although efforts were made to standardize criteria, available information and the conservation criteria for Strategy Species do vary between taxa.

WILDLIFE STRATEGY SPECIES LIST

The ODFW's Wildlife Conservation Program staff led a comprehensive review process for the Wildlife Strategy Species list, including amphibians, birds, mammals, and reptiles. The conservation criteria used were based on the original 2006 criteria. New scientific literature and available data were reviewed to determine whether to keep, remove, or add species to the Strategy Species list dependent on whether they met the conservation criteria. All 2006 Strategy Species were reviewed. The list of 2006 Data Gap Species, and species that experienced elevated conservation status (e.g., federal Endangered Species Act status, NatureServe Global or State Rank) during the 10 years were reviewed to determine whether they met the conservation criteria to be added as a 2016 Strategy Species or Data Gap Species.

Information from literature searches, agency and partner databases, and expert review was used to update the content associated with each Strategy Species, including: special needs, limiting factors, data gaps, recommended conservation actions, and key references. The ODFW consulted with species experts throughout Oregon to review and update the Wildlife Strategy Species list and information associated with each species.

Wildlife Strategy Species Conservation Criteria:

If three or more of the criteria below apply to a species within an ecoregion, the species may be considered a Wildlife Strategy Species:

1. Life history traits render the species vulnerable to potential threats, such as: low reproductive rates, low dispersal ability, dependence on uncommon or at-risk habitats and/or structures, or the species gathers in concentrations for some part of its life cycle, including nesting, roosting, or feeding sites.
2. Population size is small or greatly reduced from its historical population size, suggesting the species could become extirpated in much or all of the ecoregion.
3. The population is at-risk because it is: (a) declining in the ecoregion, and the ecoregion is especially important for conservation, or (b) declining statewide.
4. The species is at-risk because it has a restricted distribution. This includes species that:
    - are considered an ecoregion endemic or near-endemic (e.g., a notable proportion of the species' range occurs in this ecoregion), or
    - have had a significant retraction from historical geographic range, or
    - represent a disjunct (isolated) population that is important to conservation of the species throughout its range.

5. Populations of this species are known (or strongly suspected) to be impacted by a Key Conservation Issue or major threat, including:
    - **Climate Change** (University of Washington Climate Change Vulnerability Assessment)
    - **Land Use Changes** (including renewable energy)
    - **Water Quality and Quantity**
    - **Barriers to Animal Movement**
    - **Disruption of Disturbance Regimes** (i.e., fire, flooding) or ecological processes (stream hydrology or nutrient flows)
    - **Invasive Species**
    - Other known threats to populations including: **disease**, predation, pollutants, hybridization, or parasitism

FISH STRATEGY SPECIES LIST

The ODFW Fish Conservation and Recovery Program staff led the review for the Fish Strategy Species list. The comprehensive review was based on a number of criteria, which closely match the Wildlife Strategy Species Conservation Criteria. If a fish species or Species Management Unit (SMU) is listed under the Endangered Species Act as threatened or endangered, either at the state or federal level, it was automatically designated as a Strategy Species. Additionally, the ODFW updated the ODFW Sensitive Species List to inform the Conservation Strategy Species update, and any fish species that was designated as an ODFW Sensitive Species was also designated as a Strategy Species.

A variety of resources were used to update the Sensitive Species List. Status assessments in recently approved conservation and recovery plans were used. For species and SMUs with no recent written assessment or plan, ODFW staff used information from recent research or monitoring efforts (e.g., fish distribution and abundance surveys), prior listing on the Sensitive Species List, the 2005 Oregon Native Fish Status Report, or professional knowledge and judgment to determine the status. When applicable, ODFW staff consulted with partner scientists and agencies to help inform decisions.

To account for the lack of data and multiple sources of uncertainty (e.g., taxonomic, range, abundance) surrounding many of the non-game species, the conservation risk was assessed based on a rarity model that assesses species vulnerability to drought, wildfire, climate change, or nonnative fishes. The model data were sourced from the Oregon State University Fish Collection and expert opinion, including ODFW District Fish Biologists and researchers. Two metrics were developed to assess distribution or range. For the first metric, fish distribution was defined as narrow (limited) when a species was found in four or fewer districts and broad (widespread) when a species was found in 5-16 districts. For the second metric, fish distribution was defined as narrow if only “limited distribution” or “rare” status responses were received for a species and broad if a species was “widespread” or “common” in any district. An

abundance metric was developed, where a “low” abundance score was assigned if the minimum district score for a species was 4-6 (limited, not locally abundant; rare; or unknown) and a “high” abundance score was assigned if the minimum district score for a species was 1-3 (widespread; common; or limited, but locally abundant).

A metric for habitat specificity was also developed, where fish were assigned to the “narrow” category if a species inhabited fewer than three of the five habitat types (i.e., large river, small river, creek, spring, lacustrine) and did not occupy both lowland and upland habitats, and to the “broad” category if the species inhabited three or more habitat types or occupied both lowland and upland habitats. The data for habitat types and elevation (upland, lowland, or both) were obtained from the online FishTraits.

The range/distribution, abundance, habitat specificity, and endemism (y/n) data for each species were then compiled and each fish was assigned to one of eight rarity categories (see figure below), according to Yu and Dobson (2000), based on distribution/range (high or low, assigned once for each of the two metrics), population abundance (high or low), and habitat specificity (broad or narrow).

		Distribution (range)			
		Large		Small	
	Population abundance	high	low	high	low
Habitat Specificity	broad	A (4)	C (3)	E (3)	G (2)
	narrow	B (3)	D (2)	F (2)	H (1)

Categories	Description
A	Generalist
B	Locally abundant over a large range and in specific habitat
C	Low abundance over a broad range in several habitats
D	Low abundance overa a large range and in specific habitat
E	Locally abundant in several habitats but narrow geographic range
F	Locally abundant in specific habitat but narrow geographic range
G	Low abundance, narrow geographic range, in several habitats
H	Low abundance, narrow geographic range, in specific habitat

Rarity categories, descriptions, and scores (in parentheses) from: Yu, J. and F.S. Dobson. 2000. Seven forms of rarity in mammals. Journal of Biogeography 27: 131-139.

INVERTEBRATE STRATEGY SPECIES LIST

The ODFW consulted with experts from the ODA, ORBIC, the Xerces Society for Invertebrate Conservation, and independent species experts to update the Invertebrate Strategy Species list and the

information associated with each species. To the extent possible, the Wildlife Strategy Species Conservation Criteria were used to review invertebrate species. Over the past 10 years, more information has been gathered to indicate a lack of knowledge for many species, resulting in several species moved to Data Gap Species status.

PLANT STRATEGY SPECIES LIST

The ODFW consulted with the ODA's Plant Conservation Program and with the Institute for Applied Ecology to consider new information and references for plant species. Numerous data gaps exist for plant species of conservation concern, and few surveys are conducted regularly. The list of Strategy Plants remains the same as the 2006 list; however, new information was incorporated regarding taxonomy, special needs, limiting factors, data gaps, recommended conservation actions, and key references.

NEARSHORE STRATEGY SPECIES LIST

The ODFW Marine Program led the update process for Nearshore Strategy Species. **Nearshore Strategy Species** are species occurring within the **Nearshore** that were determined to be in greatest need of management attention. Identification as a Nearshore Strategy Species does not necessarily mean the species is in trouble. Rather, those identified as Nearshore Strategy Species have some significant nearshore management and/or conservation issue connected to that species that is of interest to resource managers.

Development of the 2016 Nearshore Strategy Species list began with a review of the original list of Nearshore Strategy Species developed a decade ago, including species that utilize the nearshore but that had only been included in the Oregon Conservation Strategy. The species that were still recognized as species of concern, at-risk, important, or a priority by federal or state agencies, stakeholders, experts, non-government organizations, scientific researchers, tribes, or other conservation processes were included on the revised list. In addition, a comprehensive list of species that occur in the nearshore was evaluated for potential new additions to the Nearshore Strategy Species list. To maintain a nearshore ecosystem focus, attention was focused on both harvested and non-harvested species that predominantly occur, or are common, within Oregon's nearshore environment.

To assist with the identification of Nearshore Strategy Species, the following information was compiled from published literature, available online data, scientific databases, and personal communication from experts for each species on the list:

- taxonomic information
- distribution, including species geographic range and depth
- harvest/collection information, including sector(s) (commercial, sport, aquarium trade, and/or scientific/medical research) and whether targeted or incidental catch

- life history information, including mode of reproduction, fecundity, timing of reproduction, timing of egg/larval/juvenile stages, longevity, age at maturity, and migratory behavior or seasonal distribution
- habitat use for each life history stage
- trophic interactions, including prey, predators, and competition
- population status information, including whether a population assessment has been conducted and if the species is listed as overharvested, listed as threatened or endangered, has experienced a population decline, is rare, has small range, or is endemic, has specialized habitat requirements, or has low productivity

This information was used to help examine the conservation needs of each species with regards to four separate criteria, each weighted equally. Each species was evaluated for each of these four criteria to identify those species in greatest need of management attention:

1. Species status – examples of species status include overharvested, rare, declining population throughout its range or in Oregon.
2. Ecological importance – examples of ecological importance include habitat forming, habitat engineer, keystone species, or prey species.
3. Vulnerability to human or natural factors – examples of vulnerability include susceptible to oil spills or water pollution, life history traits render it particularly vulnerable (low productivity, specialized habitat requirements, climate change or ocean acidification effects, etc.), or there are significant data gaps or research needs on vulnerability for that species.
4. Economic/social/cultural importance – examples of importance to humans include commercially important, recreationally important, culturally important to Oregon tribes, and flagship or sentinel species.

Those species whose conservation needs were determined to best be met through existing management affecting habitats or communities of organisms were separated from the list. Through extensive examination, deliberation, and consultation with subject matter experts, 73 species were identified as Nearshore Strategy Species. These species, or distinct populations, were determined to have conservation needs in greatest need of management attention and to have the greatest potential for benefit from management actions.

The supplemental information on the special needs, limiting factors, data gaps, and conservation actions for each Nearshore Strategy Species is provided for use by managers, research and monitoring projects or programs, those producing education and outreach materials, planners, and the general public. Readers should note that management jurisdiction varies for each species. For instance, some Nearshore Strategy Species are managed by the ODFW, National Oceanic and Atmospheric

Administration, and USFWS, and many species are under shared management authority by multiple resource agencies and institutions.

Photo Credit: Peter Schroeder

SPECIES DATA GAPS

In the Oregon Conservation Strategy, information needs are identified at various scales:

- Specific 'Data Gaps' are indicated for each **Strategy Species**.
- 'Data Gap Species' are documented. These are species where not enough information is known to determine whether they meet the conservation criteria to qualify as Strategy Species.
- General research and monitoring needs are provided for Strategy Species.

DATA GAP SPECIES

The Conservation Strategy identifies 112 Data Gap Species, including 6 amphibians, 9 birds, 12 mammals, 45 fish, and 40 invertebrates. For these species, some basic information, such as distribution and range, habitat associations, and general abundance, is not known, and it is not possible to determine whether they are truly at risk, or should be designated as a Strategy Species. The Oregon Conservation Strategy Data Gap Species list documents species that require more information to determine whether they should be elevated to Strategy Species status.

> The Strategy Species and Data Gap Species lists are available for download in **Excel table** format.

Invertebrate Species Taxonomic Information

For invertebrates, few specific surveys are typically done each year, and basic information is often lacking. Before making a conservation designation for Strategy Species or Data Gap Species status, more taxonomic information is needed to determine whether a group of invertebrates actually represents a population of one species or is a distinct species. If it is determined to be a distinct species, then more data on range and habitat associations may still be needed to determine conservation status.

During the technical review for the 2016 Strategy update, these invertebrates were determined to lack sufficient taxonomic information before they can be fully designated as a Data Gap Species or a Strategy

Species: bald hesperian, basalt juga, Blue Mountains duskysnail, Blue Mountains juga, brown juga, Cascades axetail slug, Columbia duskysnail, Columbia springsnail, Crooked River juga, Deschutes mountainsnail, Deschutes sideband, diminuitive pebblesnail, disc Oregonian, Fall Creek pebblesnail, Hells Canyon mountainsnail, hotspring physa, humped coin, Keene Creek pebblesnail, Klamath taildropper, Lake Albert springsnail, Lake of the Woods pebblesnail, Malheur pebblesnail, Malheur springsnail, Modoc peaclam, Modoc Rim sideband, nerite pebblesnail, northwest hesperian, Oak Springs hesperian, Opal Springs juga, Owyhee hot springsnail, pinhead pebblesnail, purple juga, thinlip tightcoil, three-band juga, toothed pebblesnail, and Tuscan pebblesnail. The same applied to the following species complexes: duskysnails (*Colligyrus*), jugas (*Juga*), mountainsnails (*Oreohelix*), pebblesnails (*Fluminicola*), and springsnails (*Pyrgulopsis*).

Additional resources for invertebrates: **Oregon Biodiversity Information Center**, **Oregon Department of Agriculture**, **The Xerces Society for Invertebrate Conservation**

GENERAL RESEARCH AND MONITORING NEEDS FOR STRATEGY SPECIES

Species Management and Monitoring

- Determine baseline conservation status, estimated population size, and trends for Strategy Species.
- Develop and implement survey and monitoring methodology for species lacking protocols.
- Determine population goals for Strategy Species while accounting for current habitat conditions and potential for habitat restoration in Oregon.
- Develop measurable indicators of high quality habitat. For example, develop a framework for using species and habitat indicators to assess habitat status and trends.
- Determine relationships between population dynamics and habitat dynamics.
- Evaluate effectiveness of providing passage around barriers for fish and wildlife (including amphibians, reptiles, and mammals) to enhance migration or habitat connectivity.
- Improve data collection efforts and methods for all Plant Strategy Species (all plants of conservation concern).

Species Observation Data Management

An initial step to filling Strategy Species Data Gaps is taking advantage of available species observation datasets.

Species observation information collected throughout ODFW should be compiled and managed within centralized databases, and the process to incorporate data should be streamlined and automated as much as possible. This would not only allow surveys and research results to be better incorporated into

statewide analyses and programs, but also provide a structure for recording incidental observations of Strategy Species by ODFW field staff.

Incorporating species observation datasets developed and maintained by partner agencies and organizations into ODFW databases and programs is a critical component of understanding species distributions, populations, and ranges. Species observations are a common dataset, frequently collected by government agencies, private contractors, conservation organizations, and public citizens. A concerted effort is involved to communicate with these organizations to understand what is available, and then how best to incorporate the information. The ODFW works closely with the **Institute for Natural Resources, ORBIC** to access and incorporate their biodiversity database of species occurrences throughout Oregon. This database includes contributions from various state and federal agencies as well as specific monitoring projects, such as the North American Breeding Bird Survey. This database provides an ideal way to incorporate information from multiple agencies, but finding and inputting additional datasets require further effort. Carefully planned citizen science projects can provide more information on species observations with members that are trained in technique and identification protocols, while also providing a way for the public and landowners to contribute species information for use within the Conservation Strategy and other ODFW projects. For additional information, see the **Monitoring page**.

STRATEGY SPOTLIGHT: CITIZEN SCIENCE

Several conservation organizations are developing ways to use technology to engage citizens in support of science-based conservation, while also compiling valuable data on fish and wildlife species and habitats. By participating in citizen science programs, which are designed to meet specific informational needs, the public's sense of investment in public lands conservation should grow, resulting in stronger expectations and accountability for government conservation programs. These investments of personal time and resources by engaged citizens may then lead to growing public support for establishing substantial and reliable funding for science-driven conservation.

Citizen science projects result in data that can be used to fill data gaps in managing and understanding fish and wildlife species and their habitats. The Conservation Strategy recognizes **citizen science** as an extremely useful method for collecting data on Strategy Species. Data collected within citizen science projects have been incorporated into several ODFW projects, including the **ODFW Crucial Habitat Assessment** and the 2016 **Conservation Opportunity Areas** revision analysis.

Many partners recognize **eBird** as a powerful way to connect the birding community with both the conservation of species of greatest need and concern, and efforts to keep common birds common. **Avian Knowledge Northwest** has partnered with **Pacific Northwest eBird** in an effort to engage citizen scientists as a broad and supportive constituency for bird conservation, integrate monitoring into bird management and conservation practices, coordinate monitoring programs among

organizations, and maintain monitoring data in modern data management systems for more effective data delivery.

Photo Credit: Charlie Bruce

ANIMAL CONCENTRATIONS

OVERVIEW

Many animals gather together in large groups for migration, breeding, or sheltering, and these concentrations can be vulnerable to disturbance. Identifying the most important sites is the first step in conserving animal concentrations. Approaches include The Audubon Society's **Important Bird Areas** program, which recognizes the importance of migration stopovers and other areas where birds concentrate. **Conservation Opportunity Areas** include many, but not all, of the state's animal concentrations. For animal concentrations, appropriate conservation actions depend on the species and site, but will focus on maintaining or restoring important habitat features.

Klamath Lake hosts the largest concentration of wintering Bald Eagles in the continental United States, with up to a thousand individuals. At Dean Creek Wildlife Viewing Area, numerous elk congregate in marshy fields during the winter. At many of Oregon's mountain lakes and ponds, **western toad** tadpoles swarm in large masses in the summer, and begin to change into frogs and climb out onto land in large groups in the early fall. In Portland, crowds gather nightly every autumn to watch 35,000 migrating Vaux's Swifts swirl and funnel into an old chimney at Chapman School, the largest known Vaux's Swift roost in the world.

Estuaries and bays along the Oregon coast and the lakes of southeastern Oregon provide vital stop-over refuges for shorebirds migrating to and from southern wintering areas and nesting locations in Canada and Alaska. Lake Abert may support the largest number of Wilson's Phalaropes in North America; up to 70,000 birds congregate here in late July.

People have long appreciated the spectacle of thousands or millions of animals gathered in one area. Oregonians enjoy **wildlife viewing** at several popular **festivals** that celebrate seasonal animal gatherings, including wintering Bald Eagles and migrating songbirds, shorebirds, and waterfowl.

Fish and wildlife often gather in concentrations for critical activities, such as feeding, breeding, or migrating. Some species breed in colonies, perhaps due to limited, specialized breeding sites or as a strategy to deter predators. Animals congregate when their food is concentrated, and migrating animals flock to a feeding site to refuel and rest.

Animals also might gather when an important resource is naturally limited in the landscape, such as fresh water in the desert or mineral springs in mineral-poor areas. Frogs and toads that breed in seasonal ponds tend to gather together for a short burst of spring breeding because they have a limited window of opportunity for egg-laying. When Pacific tree frogs gather to breed, a springtime chorus erupts as males sing to attract mates.

When animals gather in these large groups, they can become particularly vulnerable to habitat alteration and human disturbance. Because of the large number of individuals involved, any factors that impact highly critical sites can affect a large proportion of a species or an entire suite of species. The table below summarizes important habitat types and features for some of Oregon's animal concentrations.

ANIMAL CONCENTRATIONS, HABITAT TYPES, AND FEATURES

Animal Concentration	Important Habitat Types	Important Habitat Features
Bald Eagles: wintering	Large lakes and rivers	Large trees or snags within a forest stand are used for communal roosts.
Bat roost sites (particularly hibernacula, maternal roosts, or diurnal roosts)	Depending on bat species, includes caves, mines, cliffs, bridges, and buildings	Roost sites must have suitable temperature and humidity. Lack of human disturbance is critical for **Townsend's big-eared bat** and **pallid bat**.

Animal Concentration	Important Habitat Types	Important Habitat Features
Deer and elk key winter range areas	These vary by ecoregion but usually include warmer sites, such as lower valleys and southern slopes.	Wintering areas include diverse forested landscapes with openings and a variety of age classes, perennial grasslands, and sagebrush steppe habitats. Woody vegetation for foraging (e.g., **bitterbrush**, **aspen**, alder, willow, oak), and cover for insulation and hiding are needed. Shrubs are important where snow is deep during winter.
Deer and elk herds: migration routes and transition range	These vary by ecoregion and combine features of summer and winter ranges. Travel corridors unobstructed by roads and urban areas are important.	Herds need forage and cover to provide safe passage between winter and summer ranges.
Freshwater mussel beds	Aquatic habitats	Freshwater mussels require clean water with low contamination and sedimentation and natural water flow regimes. They are important to tribal culture, filter water, are good indicators of high water quality, and are a key food source for fish, mink, otters, and raccoons.

Animal Concentration	Important Habitat Types	Important Habitat Features
Nesting colonies (rookeries): Great Blue Herons	Riparian habitats	Herons require large trees near foraging areas (open grassy and wetland habitats) and low levels of human disturbance during the nesting season. Great Blue Heron nesting colonies are declining and at risk in some areas, particularly in the Willamette Valley.
Lamprey (juveniles concentrate in high densities)	Freshwater habitats	Lamprey may prefer low-gradient floodplain habitats and lower mainstem river channels.
Pond-breeding amphibians (toads, frogs, salamanders)	Ponds and other shallow wetlands. In many areas, these ponds are created by winter and spring rains, then dry up each summer. These temporary ponds provide essential breeding habitat.	In order to support breeding amphibians, ponds and shallow wetlands must remain wet long enough for tadpoles to metamorphose, be relatively free of predators or disturbance, and provide sufficient food.
Raptors: migrating and wintering	Fields and pastures, grasslands and prairies, sagebrush steppe, and wet meadows; ridges during migration	Habitats where prey are often concentrated include open grassy areas for rodents, riparian and deciduous shrub communities for songbirds, lakes for waterfowl, and managed agricultural fields. Raptors use thermals over ridges for soaring.
Salmonid (salmon, steelhead, trout) juvenile rearing areas	Estuaries, lakes, rivers, and streams	These areas must have suitable habitat complexity, low temperatures, and low fine sediment loads.

Animal Concentration	Important Habitat Types	Important Habitat Features
Salmonid spawning and holding areas	Streams, lakes, and rivers	These areas must have suitable habitat complexity and low temperatures.
Greater Sage-Grouse leks	Big sagebrush	Cover of 15-50% is needed for nesting. Open areas are used by males for courtship. Areas rich in forbs, such as playas, meadows, and higher-elevation sagebrush steppe habitats, are important for brood-rearing.
Seabird nesting colonies	Coastal bluffs, offshore islands and rocks, and sandy islands	Depending on the species, colonies may include deep soil for burrowing (Tufted Puffin and storm-petrels), rocky ledges (Common Murres), or unvegetated sandy areas (Caspian Terns). Isolation from mammalian predators and human disturbance is critical.
Seal and sea lion haul-outs and pupping areas	Flat offshore rocks and isolated beaches	Isolation from human disturbance is important.
Shorebirds: migrating and wintering	Wet prairies, flooded fields, mudflats, alkali lakes, shorelines of wetlands and reservoirs, estuaries, and sandy ocean shore	Shorebirds need open, moist muddy or sandy areas with high invertebrate prey density.

Animal Concentration	Important Habitat Types	Important Habitat Features
Songbirds: migrating	Deciduous and mixed deciduous-conifer forests, high-elevation deciduous or mixed shrub communities, especially near water, and riparian habitat	Migrating songbirds need deciduous trees and shrubs with high invertebrate prey density and cover for insulation and hiding. Forested buttes are important in urban and agricultural landscapes.
Tadpole aggregations (for example, western toad, Oregon spotted frog)	Shallow areas in mountain lakes and ponds, slow stretches of rivers or side channels	Maintaining shallow mountain lake habitats, including native aquatic and lakeside vegetation, is important.
Waterbird nesting colonies	Lakes and marshes with both deep and shallow water	Colony characteristics vary by species but include isolated and sparsely vegetated islands (American White Pelican), trees (Snowy Egret), and emergent vegetation (Eared Grebes). Isolation from mammalian predators and human disturbance is important.
Waterfowl and other waterbirds: migrating and wintering	Wetlands, lakes, reservoirs, and estuarine bays	Waterfowl need diverse water features with high food availability (aquatic plant, invertebrate, or fish) and open water for security.
Vaux's Swift roosts	Late successional conifers, urban and suburban	Large hollow trees and snags are important for nesting and roosting. Chimneys (which 'imitate' hollow trees) may also be used.

Photo Credit: Larisa Bogardus, BLM

FISH AND WILDLIFE DISEASES

OVERVIEW

Fish and wildlife are susceptible to naturally-occurring and introduced diseases caused by a variety of pathogens, including viruses, bacteria, fungi, prions, and protozoans. Animals exposed to pathogens may exhibit illness or death or show no signs of disease if the pathogen is cleared by the animal's immune system, or they may serve as carriers or reservoirs of the pathogen. In susceptible individuals and species, disease spreads quickly when large numbers of animals are concentrated naturally during migration, when they are artificially fed, or when they congregate during breeding or due to limited habitat. Emerging and novel diseases can have devastating effects on wildlife, human health, and local economies. Climate change may increase susceptibility of fish and wildlife to disease by altering ecosystem dynamics, increasing opportunities to spread disease, and raising animals' stress response, potentially making them more susceptible to disease and illness if they become exposed. Although not a disease, ocean hypoxia and acidification may have similar effects on populations of some marine species (see the **Oregon Nearshore Strategy**).

People can help to prevent unnatural disease outbreaks by remembering not to feed wildlife, vaccinating pets, and providing and managing natural habitat. Licensed Oregon wildlife rehabilitators care for sick or injured wild animals with the goal of returning them to their natural habitat, and provide valuable educational information and outreach to the public. In addition, accredited Association of Zoos and Aquariums facilities in Oregon (e.g., Oregon Zoo, Wildlife Safari, Oregon Coast Aquarium) provide valuable public education, outreach, and conservation projects related to the health of Oregon's fish and wildlife and their native habitats.

Endemic disease is a natural part of every ecosystem. However, introduced and emerging diseases not only threaten the balance of ecosystem health but can be very difficult and costly to eradicate once established. The best action to avoid unwanted disease outbreaks is prevention. The ODFW's biologists, veterinarians, and wildlife administrators make every effort to protect the state's fish and wildlife through surveillance, monitoring, training, response plans, policy, and regulation. Listed below are the

diseases that present the greatest management concern or that present significant or recurring health risk to Oregon's fish and wildlife. This list includes diseases that occur naturally or are endemic in Oregon, as well as diseases that are introduced or emerging. The list is not inclusive of all diseases identified in Oregon fish and wildlife.

WILDLIFE DISEASES OF MANAGEMENT CONCERN

Disease or Disease-Causing Organism	Vulnerable Species	Conditions that Promote Disease Issues	Management Approaches
Ranavirus	All amphibians and reptiles	Conditions that weaken immune response (e.g., UV-B light, pesticides). Movement of infected animals.	Maintain high water quality. Investigate the natural distribution of ranavirus to determine if it is spreading to new areas. Avoid human-caused movement of amphibians and reptiles to new areas.
Chytrid skin fungus (*Batrachochytrium dendrobatidis*)	All amphibians, although some species may be more vulnerable	Conditions that weaken immune response (e.g., UV-B light, pesticides). Movement of infected animals.	Maintain high water quality. Investigate the natural distribution of chytrid fungus to determine if it is spreading to new areas. Avoid human-caused movement of amphibians to new areas.
Egg-destroying pathogen (*Saprolegnia ferax*, a watermold)	All amphibians, although some species may be more vulnerable	Conditions that weaken immune response (e.g., UV-B light, pesticides)	Maintain high water quality. Investigate the role of introduced fish in spread between water bodies.
Amphibian deformities (multiple legs and other deformities caused by a trematode, *Ribeiroia* sp.)	All amphibians, but seen most often in some frog species	High nutrient levels that increase densities of intermediate hosts (snails)	Maintain high water quality. Monitor incidence of amphibian deformities. Avoid human-caused movement of amphibians to new areas.

Disease or Disease-Causing Organism	Vulnerable Species	Conditions that Promote Disease Issues	Management Approaches
Septicemic cutaneous ulcerative disease	Aquatic native turtles	Movement of infected animals. Cause presently unknown but occurrence highest in "headstart" turtles.	Avoid human-caused movement of turtles to new areas. Continue research to identify cause and determine population impacts.
Avian cholera (caused by the bacterium *Pasturella multocida*)	Waterfowl especially, but can also impact gulls, terns, coots, and crows	Seen primarily in southern wetlands of state in winter from concentration of waterfowl during migration. Waterfowl concentrations increase when the amount of open water is reduced (e.g., during drought, freezing temperatures, or due to habitat loss). Freezing temperatures also increase vulnerability by weakening immune systems.	Maintain and restore wetland habitats important for migratory waterfowl. Manage major die-offs through carcass removal and appropriate disposal to reduce local point sources and minimize impacts to populations.
Bird feeder diseases (salmonellosis, mycoplasmal conjunctivitis, avian poxvirus, trichomoniasis)	Songbirds, primarily finch species	Concentration of birds at bird feeders. Contaminated feeder surfaces and fecal-contaminated bird food.	Conduct outreach regarding prevention methods. Implement sanitation measures at bird feeders or cessation of wild bird feeding.

Disease or Disease-Causing Organism	Vulnerable Species	Conditions that Promote Disease Issues	Management Approaches
Newcastle virus	Double-crested Cormorants, many bird species at risk	Occurs in breeding colonies along the Columbia River and Northwest coast. Appears to occur on an every other year cycle, typically in odd-numbered years (2013, 2015, etc.).	Monitor and conduct surveillance of colonies. Work with wildlife rehabilitators to avoid and manage potential disease risk in facilities.
West Nile virus	Birds in the family Corvidae and sage-grouse, other bird species, some mammals (squirrels)	Conditions conducive for mosquito production and over-winter survival	Zoonotic disease passed by mosquito vectors. Reduce mosquito breeding areas in urban environments. Follow Centers for Disease Control and Prevention recommendations. Place warning guidance at wetland management areas.

Disease or Disease-Causing Organism	Vulnerable Species	Conditions that Promote Disease Issues	Management Approaches
Avian influenza (highly pathogenic)	Many wild bird species are hosts. Waterfowl and shorebirds are the principal hosts to highly pathogenic (HPAI H5, H7) strains; harbor seals may serve as hosts in marine habitats.	Waterfowl, shorebirds, and other wild bird species serve as hosts to most of the 144 strains of the virus. Mutated or highly pathogenic strains can have devastating impacts to the poultry industry and to human health, and may cause wild bird deaths. Poor bio-security in backyard ponds, with falconry birds, rehabilitation facilities, and hunt clubs can contribute to spread of avian influenza.	Monitor and conduct surveillance of captured or translocated birds, including waterfowl (duck banding), Mountain Quail, turkeys, grouse, and farmed game birds. Increase biosecurity education to landowners, poultry owners, falconers, rehabilitators, and hunt clubs. Consider HPAI surveillance in harbor seals during capture events and unusual mortality events.
Botulism (caused by a nerve toxin produced by the bacterium *Clostridium botulinum*)	Waterfowl and shorebirds	Associated with shallow wetland habitats during warm weather. Botulism can be made worse by fluctuating water levels. It is often associated with carcasses (waterfowl, fish kills). Fly larvae can bioconcentrate this toxin.	Manage water levels, flow, flushing, and changes at important migration areas to prevent botulism. Manage major die-offs by carcass removal and proper disposal to minimize further impacts to local populations.

Disease or Disease-Causing Organism	Vulnerable Species	Conditions that Promote Disease Issues	Management Approaches
Mycoses (diseases caused by fungi, including toxins produced by mold), Aspergillosis (aflatoxins)	Many bird species. Aspergillosis is most common in waterfowl, gulls, corvids, and raptors.	Transmitted from moldy corn or acquired from soil or damp organic materials. Stressed or diseased animals may have increased susceptibility.	Aspergillosis: Monitoring and surveillance. Minimize access to source sites, such as moldy silage piles. Manage major die-offs by carcass removal to minimize impacts to local populations.
Cryptococcus gattii	*C. gattii* has been identified in harbor porpoises, Dall's porpoises, Roosevelt elk, domestic animals, and humans along the coast and Willamette Valley.	Geographic and local environmental factors are important in development of infection.	Additional research is needed to understand the location of environmental "hot spots".

Disease or Disease-Causing Organism	Vulnerable Species	Conditions that Promote Disease Issues	Management Approaches
Algal blooms (toxic)	Waterfowl and other wildlife species associated with contaminated water sources. Algal bloom toxins in marine habitat can affect shellfish safety for human consumption and cause disease in shorebirds and marine mammals.	Warmer, stagnant water bodies with high nutrient content, in particular, can cause anoxic conditions for fish and toxic algal blooms for avian and terrestrial species. Factors that influence harmful algal blooms in marine waters are not well understood.	Maintain good water quality, flushing, and flow. Reduce high nitrogen/phosphate/nutrient runoff. Manage major die-offs by carcass removal and appropriate disposal. Sample marine waters for levels of harmful algae present and to determine safety of shellfish for human consumption.
Rodent control poisons (anticoagulants, metal phosphides, hypercalcemia products, zinc phosphide toxicosis)	Non-target species, particularly raptors and wild canids and felids, geese and pasture-based migratory songbirds in the Willamette Valley	Application during high rodent population seasons and cycles, and when applied off-label by inappropriate methods of delivery and during periods identified as high-risk for non-target species.	Applicators must follow label restrictions for legal application and avoidance of primary and secondary toxicity to non-target species.

Disease or Disease-Causing Organism	Vulnerable Species	Conditions that Promote Disease Issues	Management Approaches
Canine distemper	Raccoons, foxes, skunks, coyotes, wolves, and seals	Observed in raccoon and fox populations when population densities are high. Spillover from domestic dogs can occur. Infected wildlife also put unvaccinated dogs at risk.	Continue to promote prevention (e.g., by not feeding raccoons). Use caution when moving nuisance raccoons. Promote vaccination programs in domestic pets.
Rabies	Bats, raccoons, skunks, foxes, wolves, and any mammalian species. Unvaccinated dogs and domestic cats are at highest risk. Human rabies is rare in the U.S. Bat strain rabies is the only documented variant identified in Oregon.	Handling of sick or dead bats, exposure of pets to sick bats or other wild mammals resulting in contact or a biting incident, and unvaccinated domestic pets can result in transmission. Bat strain rabies occurs naturally at very low prevalence levels (<1%) in bat populations in Oregon. In 2010, a spillover event occurred in the fox population in southwest Oregon.	Continue to promote vaccination programs in domestic pets. Conduct outreach and education to teach people to avoid sick wild mammals or those with unusual behavior. Follow zoonotic disease guidance by the Centers for Disease Control and Prevention.

Disease or Disease-Causing Organism	Vulnerable Species	Conditions that Promote Disease Issues	Management Approaches
Canine parvovirus (includes several closely-related viruses, such as feline panleucopenia)	Raccoons, foxes, coyotes, and wolves, principally. Canine parvovirus can infect unvaccinated domestic cats.	Exposure to unvaccinated dogs and domestic cats (e.g., outdoor cats, abandoned cats, and feral cat colonies)	Promote pet vaccination programs. Promote benefits to cats, wildlife, and people when cats are kept indoors. Discourage community feral cat colonies.
Leptospirosis	All mammalian wildlife but especially marine mammals (seals, sea lions, porpoises)	A multi-serotype bacterial disease transmitted from contaminated urine of infected animals	Conduct outreach regarding the importance of avoiding contact with sea lions and sea lion carcasses along Oregon's coast. Leptospirosis is considered a zoonotic disease.
Tularemia	All mammals but especially rodent and lagomorph species	Tularemia is generally transmitted through the bite of a flea or tick. This bacterial disease can be more prevalent when mammalian hosts occur at higher population densities.	Tularemia is a zoonotic disease with a worldwide distribution. Sick or deceased rodents or rabbits should not be handled without gloves and additional protective equipment.

Disease or Disease-Causing Organism	Vulnerable Species	Conditions that Promote Disease Issues	Management Approaches
Plague	Rodent species (particularly mice) can serve as hosts and can suffer high rates of mortality (i.e., prairie dogs). Many mammals are susceptible; canids are refractory.	Fleas act as vectors. Conditions are most conducive to transmission during high rodent population cycles. Birds, lagomorphs, and carnivores may maintain or disseminate the disease by transporting fleas or ticks or infected prey.	Plague is widespread in wild rodent populations west of the 100th meridian. Control can be achieved through an oral vaccination program or burrow dusting with insecticides. Plague is a zoonotic disease.
Notoedric mange	Western grey squirrels, northern and southern flying squirrels	Transmission is primarily through direct contact of affected and unaffected animals and transfer of the mite *Notoedres centrifera*. Increased squirrel densities associated with competition for sparse food resources can be conducive to spread.	Minimize artificial feeding and movement of animals.

Disease or Disease-Causing Organism	Vulnerable Species	Conditions that Promote Disease Issues	Management Approaches
Exotic biting lice (*Cervicola* (*Damalinia*) spp., *Bovicola tibialis*)	Black-tailed, white-tailed, and mule deer	Lice are passed through direct contact between deer and probably from common use of bedding sites.	Conduct public education to discourage congregating deer by feeding or baiting. *Cervicola* is widespread in the black-tailed deer population from Washington to central California. *Bovicola* is found in scattered pockets of mule deer in Oregon, Nevada, Idaho, Washington, and California.
Cervid adenoviral hemorrhagic disease	Black-tailed, white-tailed, and mule deer	Transmission is through direct nose to nose contact between infected and uninfected deer. Exposed animals may become diseased in acute or chronic state or mount an antibody response in the absence of disease. Outbreaks in deer fawns in rehabilitation facilities have resulted in high mortality.	Avoid movement of adult deer and deer fawns to unaffected populations or areas. Conduct public education to discourage congregating deer by feeding or baiting. Restrict rehabilitating deer fawns at facilities with consistent adenoviral hemorrhagic disease outbreaks.

Disease or Disease-Causing Organism	Vulnerable Species	Conditions that Promote Disease Issues	Management Approaches
Epizootic hemorrhagic disease	White-tailed deer are highly susceptible. Black-tailed and mule deer may also exhibit the disease.	*Culicoides* spp. gnats are the insect vectors of this virus. Drought and low water conditions with concentrations of susceptible animals at limited watering sites provide conditions conducive to amplification of the virus and disease outbreaks in riparian habitats.	Continue annual surveillance in previously affected areas (southwest Oregon). Conduct public education to discourage congregating deer by feeding or baiting.
Elk hoof rot disease – (*Treponema* bacterial-associated syndrome)	Roosevelt elk	Found in northwest Oregon elk populations. Causal bacterial agent belongs to the genus *Treponema*. Wet pastures and environmental conditions are thought to facilitate *Treponema*-associated elk hoof rot disease.	Avoid movement and translocation of elk from infected areas. Consider research in novel habitat treatments. Continue monitoring with the aid of citizen science.

Disease or Disease-Causing Organism	Vulnerable Species	Conditions that Promote Disease Issues	Management Approaches
Respiratory disease in wild sheep	Rocky Mountain bighorn sheep, California bighorn sheep	Northwest Rocky Mountain populations are primarily affected. *Mycoplasma ovipneumoniae* and *Manheimia* and *Pasteurella* spp. respiratory pathogens are transmitted to wild sheep from domestic sheep and goats. This disease occurs primarily in northeast Hells Canyon populations of bighorn sheep shared with Washington and Idaho.	Maintain separation of wild and domestic sheep and goats. Implement management actions to enhance habitat and maintain or improve population densities. Support research designed to mitigate effects of respiratory disease on sheep populations. Consider population management manipulations of infected herds using adaptive management strategies.

Disease or Disease-Causing Organism	Vulnerable Species	Conditions that Promote Disease Issues	Management Approaches
Salmon poisoning disease. The disease in canids is caused by a rickettsial organism (*Neorickettsia helminthoeca*) present in a trematode parasite (*Nanophyetus salmincola*).	Salmonids and a restricted number of non-salmonid fish species acquire the rickettsial parasite, which infects a stream snail (*Oxytrema silicula*) commonly eaten by the fish. Canids and bears can then acquire the rickettsial infection upon eating infected fish.	This disease is primarily found in the Cascade Range and associated tributaries. Exposure of fish to the infective stage of the worm life cycle and increased snail populations promote the disease.	Educate pet owners about the potential risks for dogs eating parasitized salmon, clinical signs of the disease, and when to seek veterinary care for required antibiotic treatment.

FISH DISEASES OF MANAGEMENT CONCERN

Disease or Disease-Causing Organism	Vulnerable Species	Conditions that Promote Disease Issues	Management Approaches
Sea-star wasting-densovirus (Parvoviradae) associated with mortality	Many species of sea stars, urchins of concern	Unknown. Causes rapid degeneration of animal. Associated with high levels of mortality. Urchins carry disease but have not yet been detected expressing it.	Further research and monitoring are needed.
Infectious hematopoietic necrosis virus	Most salmonid stocks	Stress situations, such as spawning or adverse environmental conditions	Reduce movements of infected fish and track different isolates of the virus.
Erythrocytic inclusion body syndrome	Several salmonid stocks	Unknown, but condition depresses immune system and other diseases become patent	Nutrition may affect severity of infection.

Disease or Disease-Causing Organism	Vulnerable Species	Conditions that Promote Disease Issues	Management Approaches
Viral hemorrhagic septicemia virus	North American strain causes little mortality in salmonids but can cause high losses in marine species like herring, sardines, and mackerel.	Young immuno-incompetent fish and spawning adults. Fish spread the virus horizontally. Virus may be passed on to progeny.	Avoidance by limiting exposure. Monitor for the presence of the European strain which is much more virulent.
Infectious pancreatic necrosis virus	Most salmonid stocks and a few other marine species	Fish to fish transmission and vertically transmitted from parent to progeny	Avoidance by limiting exposure. Screen spawning adults for virus and cull eggs from positive parental groups.
White sturgeon iridovirus, white sturgeon herpesvirus	White sturgeon and possibly other related species	Likely vertically transmitted from parents to progeny. High stress environmental conditions may lead to outbreaks.	Limit transfer of known carriers. Examine fish and stock history.
Bacterial kidney disease caused by *Renibacterium salmoninarum*	Salmonid stocks	Exposure to infected fish and transferred within the egg from infected females	In hatcheries, reduce the pathogen by culling eggs from infected females and using antibiotic injections and feedings.

Disease or Disease-Causing Organism	Vulnerable Species	Conditions that Promote Disease Issues	Management Approaches
Columnaris disease caused by the bacterium *Flavobacterium columnare*	Freshwater fish, relatively uncommon in coldwater marine fish	Warm water conditions, exposure to other infected individuals	Where possible, augment water flows to increase quantity and decrease temperature.
Furunculosis caused by the bacterium *Aeromonas salmonicida*	Salmonid stocks, some other species	Exposure to infected fish	Use antibiotic treatments where possible.
External fungal infections (water molds) caused by multiple species of fungi	Most common in freshwater fish	Stress situations, such as spawning, low water, low temperature (particularly a rapid temperature drop for freshwater fish), and body injuries	Fungal spores ubiquitous and no possible control of environmental conditions. Educate about condition.
Tapioca disease, caused by the myxosporean parasite *Henneguya salminicola*	Several species but most noted in Chinook and coho salmon	Unknown. Rarely detrimental to fish but a concern for anglers due to cysts in flesh.	Provide education on the parasite and the safety of consuming flesh.

Disease or Disease-Causing Organism	Vulnerable Species	Conditions that Promote Disease Issues	Management Approaches
Ceratomyxosis caused by the myxosporean parasite *Ceratomyxa shasta*	Salmonid stocks	Exposure to infectious stage of parasite that originates in a worm. Warm, slow water and low flows can increase contact with agent.	Where possible, augment water flows to increase quantity and decrease temperature.
White spot caused by the protozoan *Ichthyophthirius multifiliis*	Freshwater fish	Exposure to infected individuals, warm water conditions	Where possible, augment water flows to increase quantity and decrease temperature.
Black spot caused by Strigeid trematodes (*Neascus*)	All fish but more common in warmwater species	Exposure to infected snails. Complex life cycle involving birds, increased snail populations.	Provide education on the source of the parasite and that it does not affect humans.
Yellow grub caused by *Clinostomum marginatum*	All fish but more common in warmwater species	Exposure to infected snails. Complex life cycle involving birds, increased snail populations.	Provide education on the source of the parasite and that it does not affect humans.
White grub caused by *Posthodiplostomum minimum*	All fish but more common in warmwater species	Exposure to infected snails. Complex life cycle involving birds, increased snail populations.	Provide education on the source of the parasite and that it does not affect humans.
Tapeworms caused by *Proteocephalus* sp.,*Diphyllobothrium* sp.,*Bothriocephalus* sp.	All fish	Ingestion of intermediate host carrying infectious stage of the parasite	Provide education on the source of the parasites and the proper handling of fish for consumption. Zoonotic potential.

Disease or Disease-Causing Organism	Vulnerable Species	Conditions that Promote Disease Issues	Management Approaches
Copepods, fish lice, and anchor worms caused by *Salmincola* sp., *Argulus* sp., *Lernaea* sp.	All fish	Exposure to infected individuals, low water conditions, or overpopulation	Where possible, augment water flows to increase quantity and decrease temperature.
NIX (nuclear inclusion X)	Razor clams	Unknown. Affects gill tissue (branchial epithelium). Associated with high levels of mortality in Washington.	Further research and monitoring are needed.
Trematode	Razor clams	Unknown. Found in the gonad.	Further research and monitoring are needed.
Domoic acid diatom (*Pseudo-nitzschia* sp.)	Birds and mammals	Unknown environmental conditions	Involve Oregon Department of Agriculture, National Oceanic and Atmospheric Administration, Oregon State University, and Oregon Department of Fish and Wildlife in research and monitoring.

Disease or Disease-Causing Organism	Vulnerable Species	Conditions that Promote Disease Issues	Management Approaches
Paralytic shellfish toxin - dinoflagellate	Birds and mammals	Unknown environmental conditions	Involve Oregon Department of Agriculture, National Oceanic and Atmospheric Administration, Oregon State University, and Oregon Department of Fish and Wildlife in research and monitoring.
Shrimp barnacle (*Sylon* sp.)	Pink shrimp (*Pandalus jordani*), spot prawns (*Pandalus platyceros*)	Unknown. Widely distributed in shrimp and prawns in Northern Hemisphere but only recently noted by Oregon shrimpers fishing in southern Washington. Parasite generally kills host.	Further research and monitoring are needed.
Needle disease-microsporidian (*Nadelspora canceri*)	Dungeness crab	Unknown. More prevalent in Dungeness crab living in bays and estuaries. Needle-shaped spores are found in the muscle. Can greatly increase crab mortality.	Further research and monitoring are needed.
Vibrio pathogen (*Vibrio tubiashii*)	Oysters and clams	Causes premature death in larvae.	Further research and monitoring are needed.

Disease or Disease-Causing Organism	Vulnerable Species	Conditions that Promote Disease Issues	Management Approaches
Parasitic isopod (*Orthione griffenis*)	Mud shrimp (*Upogebia pugettensis*)	Probable introduction from Asia. Gill parasite associated with population decline.	Further research and monitoring are needed.

EMERGING DISEASES OF MANAGEMENT CONCERN

Disease or Disease-Causing Organism	Vulnerable Species	Conditions that Promote Disease Issues	Surveillance and Management Recommendations
Chronic wasting disease of cervids	Deer, elk, moose	A fatal neurological prion-associated disease transmitted via direct contact between infected and non-infected susceptible cervids through saliva, urine, and feces. Indirect contact infection is possible from long-term environmental contamination of susceptible animals.	Not presently identified in Oregon. Conduct surveillance of hunter-harvested animals and animals observed with clinical signs. Ban importation of live cervids and hunter-harvested neural tissues from wild cervids taken in affected states.
Meningeal worm (*Parelaphostrongylus tenuis*)	White-tailed deer. Moose, elk, caribou, mule deer, black-tailed deer, and antelope are aberrant hosts.	Non-pathogenic to white-tailed deer but causes severe neurologic signs and death in aberrant hosts.	Prevent movement of wild cervids from meningeal worm endemic areas.
Meningoencephalitis associated with *Carnobacterium maltaromaticum*-like bacteria	Juvenile salmon sharks	Unknown. Documented in juvenile salmon sharks breeding along the California coast during late summer and early fall.	Further research and monitoring are needed.

Disease or Disease-Causing Organism	Vulnerable Species	Conditions that Promote Disease Issues	Surveillance and Management Recommendations
Morbillivirus (phocine and cetacean) in marine mammals	Seals, dolphins, whales	Unknown	A number of unusual mortality events documented along the eastern U.S. in dolphins. Further research and monitoring are needed.
Pigeon paramyxovirus (PPMV-1)	Pigeons and doves	Congregation of birds at feeders or watering sites promotes spread of the disease since it is spread via direct contact and feces.	Currently not identified in Oregon, but has caused massive die-offs of Eurasian Collared Doves in western states, such as Colorado, Arizona, and Montana. Surveillance and monitoring are needed.
Salamander chytrid fungus (*Batrachochytrium salamandrivorans*)	Salamanders, especially newts	Unknown. Globalization and lack of biosecurity, importation of infected species via the pet trade, and internet shipments of amphibians likely promote spread.	Maintain strict biosecurity and importation protocols. Evaluate novel biosecurity measures. Increase public awareness and education of risks to conservation, species impacts, and global health. Further research and monitoring are needed.

Disease or Disease-Causing Organism	Vulnerable Species	Conditions that Promote Disease Issues	Surveillance and Management Recommendations
Snake fungal disease (*Ophidiomyces ophiodiicola*)	Fungal dermatitis in snake species currently in nine states, including Illinois, Florida, Massachusetts, Minnesota, New Jersey, New York, Ohio, Tennessee, and Wisconsin.	Unknown	Further research and monitoring are needed.
White-nose syndrome	Cave-dwelling, hibernating bat species (13 of 15 Oregon species)	Low temperatures and high humidity; bat hibernacula in caves are affected. Potential effects on migratory tree bats are unknown. Primary cause of mortality is skin infection by *Pseudogymnoascus destructans*, but the process is unknown and exact conditions for infection and mortality are unknown.	Conduct active monitoring of susceptible bats and habitats. An interagency plan and decontamination protocols have been developed.