ECOREGIONS

Contents

ECOREGIONS

State Wildlife Action Plan ecoregions provide information on each of Oregon's nine ecoregions, which are geographic areas of the state where ecosystems are generally similar, sharing things like natural communities, species, and climate. Information is provided on the characteristics, conservation issues and priorities, changing climate conditions, limiting factors, recommended approaches, **Species of Greatest Conservation Need**, and **Key Habitats** for each ecoregion.

For the inland portion of the state, the State Wildlife Action Plan uses the **Environmental Protection Agency's (EPA) Level III Ecoregions**, but combines the Snake River Plain with the Northern Basin and Range. The SWAP designates the Nearshore ecoregion from the outer boundary of Oregon's Territorial Sea at 3 nautical miles to the supratidal zone affected by wave spray and overwash at extreme high tides on our ocean shoreline, and up into the portions of estuaries where species depend on the saltwater that comes in from the ocean.

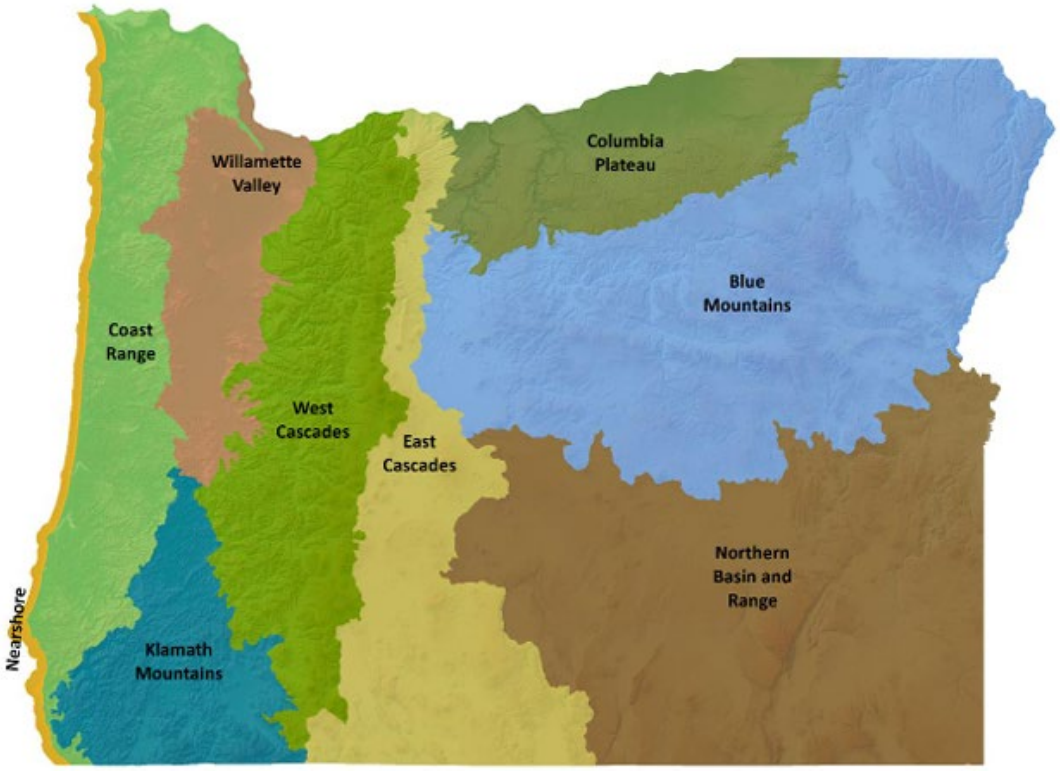


Figure 1. Oregon's nine ecoregions.

ECOREGIONS

Blue Mountains

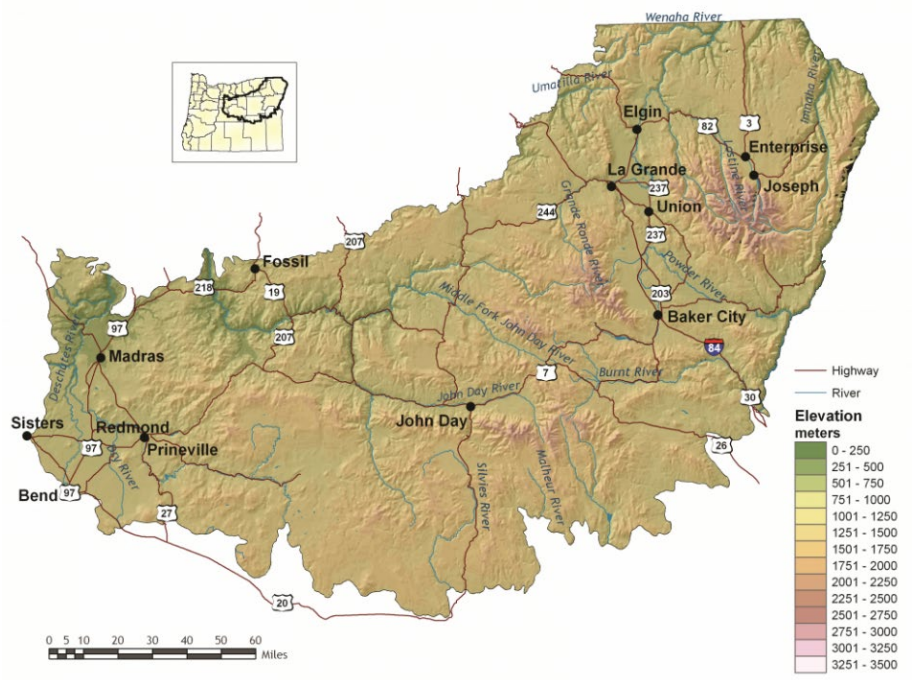
BLUE MOUNTAINS

DESCRIPTION

At 23,984 square miles, the Blue Mountains ecoregion is the largest ecoregion in Oregon. The Blue Mountains ecoregion is a diverse complex of mountain ranges, valleys, and plateaus that extends beyond Oregon into the states of Idaho and Washington. This ecoregion contains deep rock-walled canyons, glacially cut gorges, sagebrush steppe, juniper woodlands, mountain lakes, forests, and meadows. Broad alluvial-floored river valleys support ranches surrounded by irrigated hay meadows and agricultural fields. The climate varies because of elevational differences but, overall, the ecoregion has short, dry summers and long, cold winters. Because much of the precipitation falls as snow, snow melt gives life to the rivers and irrigated areas.

Wood products and cattle production dominate the economy of the ecoregion, but agriculture along river valleys supports a variety of crops. The ecoregion sustains some of the most robust ungulate populations in the state and attracts tourists year-round, offering scenic lakes and rivers, geologic features, alpine areas, and numerous wildlife viewing opportunities. It includes the Prineville-Bend-Redmond metropolitan area, one of the fastest growing areas in the state, along with the cities of La Grande, Baker, Enterprise, and John Day.

CHARACTERISTICS



Important Industries

Agriculture, livestock (e.g., beef cattle, dairy cattle, sheep), forest products, manufacturing, outdoor recreation (e.g., hunting, fishing, skiing, camping, wildlife viewing)

Major Agricultural Products

Wheat, alfalfa, grass seed, meadow hay, potatoes, onions, sugar beets, field corn

Important Nature-based Recreational Areas

John Day Fossil Beds National Monument, Hells Canyon National Recreational Area and Hells Canyon Wilderness, Wallowa Lake, Crooked River National Grasslands. Umatilla National Wildlife Refuge, John Day and Grande Ronde Rivers, Lake Billy Chinook, and Smith Rock State Park. Black Canyon, Mill Creek, Eagle Cap, Strawberry Mountain, North Fork John Day and Wenaha-Tucannon Wilderness Areas. Philip W. Schneider, Bridge Creek, Ladd Marsh, Wenaha, Elkhorn, and Minam Wildlife Areas.

Elevation

1,000 feet (Snake River) – 9,838 feet (Sacajawea Peak)

Important Rivers

Deschutes, Crooked, Burnt, Grande Ronde, Imnaha, John Day, Malheur, Powder, Silvies, Snake, Umatilla, Wallowa

CONSERVATION ISSUES AND PRIORITIES

The Blue Mountains ecoregion contains some of the largest intact native grasslands in the state and several large areas managed for conservation values. Nonetheless, habitats have been impacted by interrelated changes in ecological processes due to fire suppression, selective harvest practices, and unsustainable grazing. These changes have increased the vulnerability of habitats to invasive species, disease, and uncharacteristically severe wildfire.

Habitat loss has been the most severe in lower elevation valley bottom habitats, such as riparian areas, wetlands, and shrublands. These low-elevation habitats are highly fragmented where native vegetation has been converted to agricultural or urban land uses. Therefore, maintaining connectivity and corridors for wildlife is especially important in these areas. Other limiting factors, such as increasing recreational pressure and invasive species, have the potential to impact all habitats in this ecoregion.

Key Conservation Issues of particular concern in the Blue Mountains ecoregion include **Climate Change**, **Disruption of Disturbance Regimes** (fire), **Land Use Changes**, **Water Quality and Quantity**, **Barriers to Animal Movement**, and **Invasive Species**. In addition to statewide issues, uncontrolled off-highway recreational vehicle use and unregulated horse herds are of increasing concern in this ecoregion.

CLIMATE

The Blue Mountains climate has both continental and Mediterranean influences, with warm, dry summers and cold winters. Mean annual temperature and precipitation vary widely depending upon elevation.

Warming is projected in all seasons across the Blue Mountains, with the largest increases projected in the summer. Summer average temperature is projected to increase by as much as 8°F for the 2040-2069 period, and as much as 12°F by the end of the century under a high emissions scenario (SSP585; Figure 1). Winters in the Blue Mountains are also projected to become warmer, and summers drier. Late summer total precipitation is projected to decrease by as much as 12% for the 2069-2099 period (Figure 2). Cool season precipitation projections show an increase in precipitation of 16%, with more of it falling as rain instead of snow. Growing degree days are projected to more than double by the 2069-2099 period under the high emission scenario (SSP585). Frost days are projected to decrease from 210 per year to fewer than 150 per year, on average, by the end of the century.

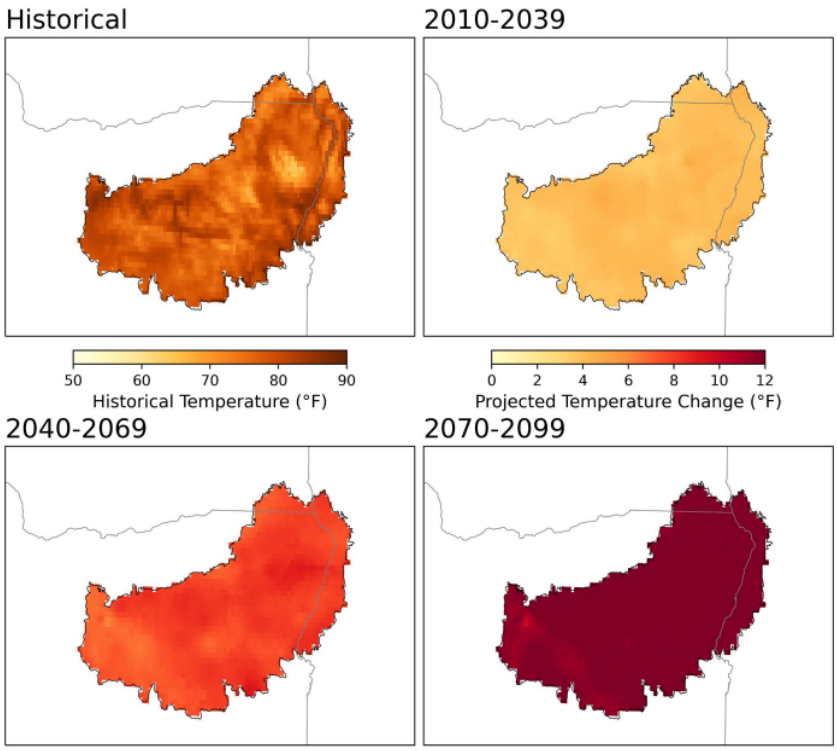


Figure 1. Model median historical (1950-2010) and future projections of summer maximum temperature change for three periods (2010-2039, 2040-2069, 2070-2099) under a high emission scenario (SSP585) for the Blue Mountains. Future projections show increasing temperatures over the century, with slightly less warming in the southwestern Blue Mountains (Raymond and Fusco, 2024).

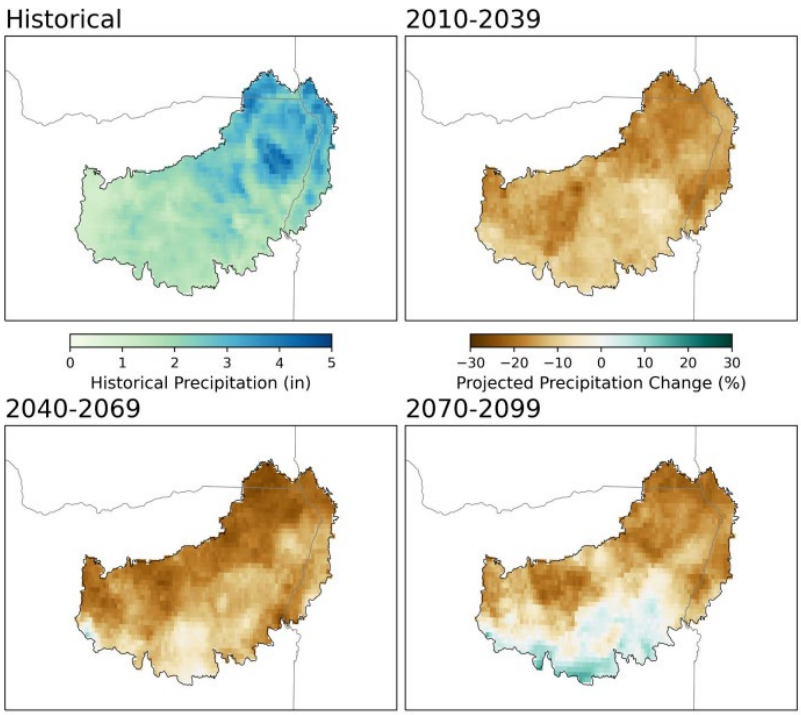


Figure 2. Model median historical (1950-2010) total late summer precipitation and projected percent change for three future periods (2010-2039, 2040-2069, 2070-2099) under a high emission scenario (SSP585) for the Blue Mountains. Future projections show decreasing late summer precipitation across the northern Blue Mountains throughout the century, and a slight increase for the southernmost Blue Mountains in the 2069-2099 time period. Confidence is low in projected changes in late summer precipitation after the 2010-2039 period due to variability among models (Raymond and Fusco, 2024).

LIMITING FACTORS AND RECOMMENDED APPROACHES

Limiting Factor: *Land Use Conversion and Urbanization*

CMP Direct Threats 1, 2.1, 2.3, 7.2

The western portion of the Blue Mountains ecoregion includes the cities of Madras, Redmond, Prineville, and eastern Bend, one of the fastest growing metropolitan areas of the state. Rapid conversion to urban land uses threatens habitats and traditional land uses such as agriculture. Impacts to mule deer winter range are of particular concern. Northeast Oregon is increasingly popular with travelers, and habitat fragmentation due to rural development and recreation is a concern in some areas. While important economically, some agricultural uses contribute to habitat degradation for native fish and wildlife species. For example, open grazing allotments in forests have significantly damaged understory and riparian habitat in several areas.

Although many acres in this ecoregion are managed for wildlife and recreational values, these areas are primarily limited to higher mountain forests and alpine areas, or steep canyonlands. Lower elevation vegetation types, such as valley bottom **grasslands**, **riparian** areas, **wetlands**, and **shrublands**, are mostly on private lands. Most remnant low-elevation native habitats occur as fragmented patches with poor connectivity.

Recommended Approach

Because important low-elevation habitats are primarily privately-owned, working with private landowners and local governments on voluntary cooperative approaches to improve habitat is the key to long-term conservation. Tools such as financial incentives, regulatory assurance agreements, and conservation easements may help landowners take actions to benefit species and habitats. Where feasible, maintain and restore habitats using a landscape approach to increase connectivity between habitat patches. Work with community leaders and local governments to ensure ecologically and environmentally conscientious growth. Support and implement existing **land use regulations** to preserve farmland and rangeland, open spaces, recreation areas, and natural habitats. Coordinate with local SWCDs, watershed councils, NRCS, and NGOs to communicate the importance of managing fish and wildlife habitats on private lands.

On public lands, unsustainable grazing should be curtailed. Federal land managers should develop adaptive grazing management plans that limit stocking rates based on ecological conditions and implement rotational grazing among allotments to allow for vegetation recovery. Incorporating emerging technologies like virtual fencing can help manage herd distribution more precisely, keeping animals out of riparian zones or other sensitive ecological areas without the need for physical barriers. Restoration activities can also improve habitat on degraded rangelands through removal of invasive species and reseeding with native vegetation.

Limiting Factor: *Altered Fire Regimes*

CMP Direct Threats 7.1, 11.3, 11.4

In ponderosa pine habitat types, fire suppression and past forest practices have resulted in young, dense mixed-species stands where open, park-like stands of ponderosa pine once dominated. Increasing encroachment by smaller Douglas-firs and true firs places the forest at greater risk of severe wildfire, disease, and damage by insects. The spread of native junipers and non-native annual grasses throughout the ecoregion has also significantly increased fuel loads. Wildfire risk is further exacerbated by warming climate conditions and changes to patterns of precipitation, resulting in more frequent, higher intensity megafires. Dense understories and insect-killed trees make it difficult to

reintroduce natural fire regimes because hazardous fuel levels increase the risk of stand-replacing fires. Additionally, young forests are often lacking in mature trees and snags that serve as critical wildlife habitat for some species. Efforts to reduce fire danger and improve forest health may help to restore habitats but require careful planning to provide sufficient habitat features that are important to fish (e.g., large woody debris, riparian vegetation) and wildlife (e.g., snags, downed logs, hiding cover). Similarly, wildfire reforestation efforts should be strategically planned to create stands with a diversity of tree age classes, understory vegetation, and natural forest openings.

Recommended Approach

Use an integrated approach to forest health issues that considers historical conditions, fish and wildlife conservation, **natural fire intervals**, and silvicultural techniques. Encourage forest management at a broad scale to address limiting factors. Implement fuel reduction projects to reduce the risk of forest-destroying wildfires, considering site-specific conditions and goals. Fuel reduction strategies need to address the habitat structures that are important to wildlife, such as snags and downed logs, and work to maintain them at a level to sustain wood-dependent species. Reintroduce fire where feasible; prioritize sites and applications where intervention is likely to be most successful. Use prescribed burns to enhance quality of forage and cover for a diversity of species. Where fire is not feasible, explore alternatives, such as thinning and masticating, that can help mimic natural disturbance. Monitor forest health initiatives and use adaptive management techniques to ensure efforts are meeting habitat restoration and wildfire prevention objectives with minimal impacts on fish and wildlife. In the case of post-wildfire recovery, maintain high snag densities and replant with native tree, shrub, grass, and forb species. Manage reforestation after wildfire to create species and structural diversity, based on local management goals.

Limiting Factor: *Water*

CMP Direct Threats 7.2, 11.4

Water quantity is a limiting factor for fish and wildlife. Changing climate conditions are leading to rising temperatures and altered patterns of precipitation, which affect water availability across different times of year. High demands for water, including for use in irrigation, can drastically reduce water availability. In streams, seasonal low flows due to changing climate conditions and over-allocation of water for agricultural uses can limit habitat suitability and reproductive success for many fish and wildlife species. In areas where urbanization is increasing, particularly in central Oregon around Bend, Madras, and Redmond, the demand for water is contributing to a decrease in the supply of groundwater. This reduces groundwater discharge of cold water to rivers and streams, subsequently reducing the availability of both cold water refugia and suitable habitat for cold-water dependent species. Water quality can also limit species and habitats. Runoff from

agricultural areas can contaminate waterways. Warming temperatures, combined with higher nutrient levels due to agricultural runoff, is increasing the prevalence of toxic cyanobacterial blooms.

Recommended Approach

Provide incentives and information about water usage and sharing during low flow conditions (e.g., late summer). Promote water management actions that enable climate resilience and adaptation. Invest in watershed-scale projects for cold water and flow protection. Identify and protect cold water rearing and refugia habitat for aquatic species. Increase awareness and manage timing of applications of potential aquatic contaminants. Improve compliance with water quality standards and pesticide use labels administered by the **DEQ** and **EPA**. Work on implementing **Senate Bill 1010** (Oregon Department of Agriculture) and **DEQ Total Maximum Daily Load** water quality plans.

Limiting Factor: *Invasive Species*

CMP Direct Threat 8.1

Invasive plants and animals disrupt and degrade native communities, diminish populations of at-risk native species, and threaten the economic productivity of resource lands. Invasive plants, particularly noxious weeds, are easily spread and may quickly outcompete native species. While not as disruptive, invasive animals have caused problems for native fish and wildlife species and have become a nuisance and impacted people economically. In this ecoregion, unregulated horse herds, including the Murderers Creek herd and Big Summit herd, are of particular concern, competing with native wildlife for vegetation and access to water, and trampling sensitive riparian habitats. In aquatic habitats, smallmouth bass, walleye, brook trout and American bullfrogs are problematic invasives. Several mussel species, including zebra, quagga, and golden mussels, pose significant threats to aquatic systems. Non-native annual grasses, including cheatgrass, ventenata, and medusahead have rapidly expanded in perennial grass systems, displacing desirable forage for wildlife. Invasion of these species can also increase fuel loads by establishing in interspaces between sagebrush or other shrubs and perennial grasses, which were historically bare of vegetation.

Changing climate conditions and fire suppression have also led to the expansion of western juniper throughout the ecoregion. Western juniper is a native species, and **old growth juniper trees** in rocky outcrops offer benefits to native wildlife. However, the expansion of western juniper in the Blue Mountains has degraded some grassland, sagebrush, riparian, large-diameter juniper, and aspen habitats. Western juniper expansion may reduce water availability in many seasonal and some perennial streams. In riparian areas, junipers replace deciduous shrubs and trees that are more beneficial to riparian wildlife. In many of the grassland and sagebrush habitats, 20–30-year-old juniper

trees form dense stands that are not suitable for many wildlife species that require the open sagebrush or grassland habitats that are now in decline. These dense stands also act as fuel for wildfire, contributing to large, high-intensity fires that destroy sagebrush habitat.

Recommended Approach

Promote dialogue between fish and wildlife managers, landowners, and land managers to develop management plans based on common priorities. Engage in outreach to educate the public on the negative impacts of invasive species and provide information on how to prevent invasions. Emphasize prevention, risk assessment, early detection, and quick control to prevent new **invasive species** from becoming fully established. Use multiple site-appropriate tools (e.g., mechanical, chemical, biological) to control the most damaging invasive species. Emphasize efforts to focus on key invasive species in high priority areas, particularly where **Key Habitats** and **Species of Greatest Conservation Need** occur. Cooperate with partners through habitat programs to reduce noxious weeds and other invasive species and to educate people about invasive species issues. Promote the use of native plants for restoration and revegetation. At some sites in sagebrush communities, it may be desirable to use "assisted succession" strategies, using low seed rates of non-invasive non-native plants in conjunction with native plant seeds as an intermediate step in rehabilitating disturbances.

Limiting Factor: *Recreational Activity*

CMP Direct Threats 1.3, 6.1

Activities like hiking, biking, hunting, fishing, camping, skiing, and off-road vehicle use can create sensory stressors for wildlife, with sound, light, and unusual smells that may deter species from moving through certain areas. Many species will avoid areas near trails, campgrounds, and access roads when humans are present. Human recreation may contribute to destruction of sensitive vegetation, harassment of wildlife from off-leash pets, and contamination of areas with refuse. Dispersed recreation can cause new roads and trails to fragment the landscape and can cause the spread of invasive species from other locations.

Recommended Approach

Plan new recreational trail systems carefully and with consideration for native wildlife and their habitats. Take advantage of abandoned or closed roads, rail lines, or previously impacted areas for conversion into trails. Work with land management agencies, such as the USFS, to designate areas as high value recreation and low habitat impact areas. Limit the use of motorized vehicles in sensitive areas, including off-road vehicles and electric bicycles. Institute road and/or area closures to protect species during sensitive times of

year and decommission roads when possible. In high use areas, establish permitted entry systems to decrease recreational pressure. Engage in outreach to educate the public on the negative impacts of recreational activities and provide information on prevention. Follow guidelines for responsible recreation, such as **Leave No Trace**, to minimize impacts.

REFERENCES

Raymond, C. L. and E. J. Fusco (Eds.). 2024. The State of Climate Adaptation Science for Ecosystems in the Northwest U.S. Prepared by the Climate Impacts Group for the Northwest Climate Adaptation Science Center. https://depts.washington.edu/nwclimateadaptation/socs/

ECOREGIONS

Coast Range

COAST RANGE

DESCRIPTION

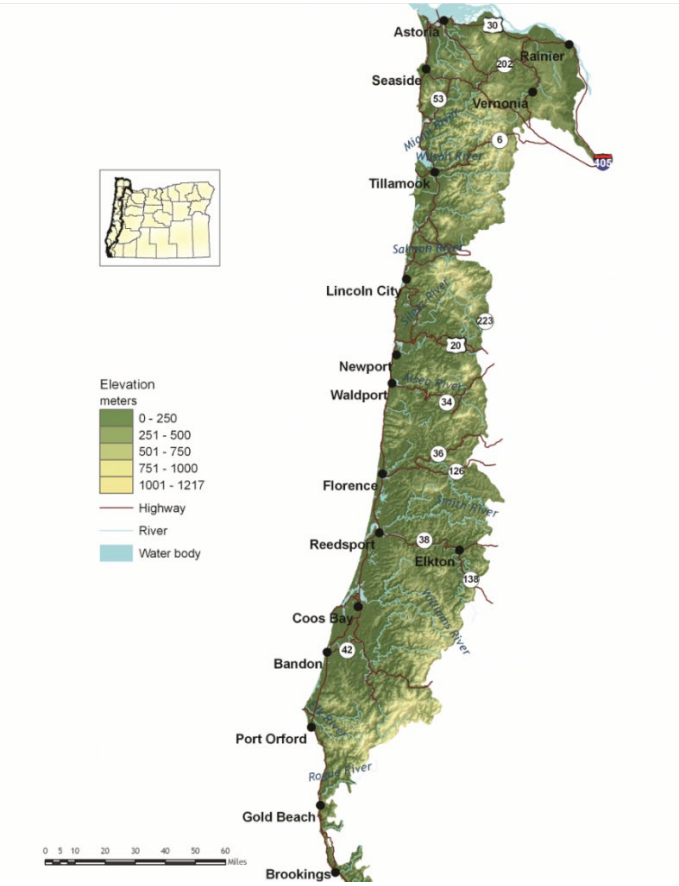
Oregon's Coast Range ecoregion is known for its dramatic scenery. It is also extremely ecologically diverse, with habitats ranging from open sandy dunes to lush forests and from marshes to headwater streams. Along the coastline, habitats are directly influenced by the marine environment and include beaches, estuaries, and headlands. The Coast Range includes the highest density of streams found in the state, and deciduous riparian vegetation is distinct from surrounding coniferous forests. The Coast Range ecoregion includes the entire reach of the Oregon coastline, bordering the **Nearshore** ecoregion, and extends east through coastal forests to the border of the **Willamette Valley** and **Klamath Mountains** ecoregions.

The topography is highly variable, from coastal mountain ranges characterized by steep mountain slopes and sharp ridges to coastal lowlands. Elevation varies from sea level to Marys Peak, which is roughly 4,100 feet high; however, main ridge summits are approximately 1,400-2,500 feet.

The Coast Range's climate is influenced by its topography and cool, moist air from the ocean, making it the wettest and mildest in the state. These conditions are ideal for Oregon's highly productive temperate rainforests, which are important ecologically and for local economies. Most of the ecoregion is dominated by coniferous forests. Large forest fires are historically infrequent but are severe when they occur. For example, the Tillamook Burn, a series of wildfires that occurred from 1939-1951, burned approximately 350,000 acres. Warming temperatures and changes in timing and patterns of precipitation due to climate change may increase fire frequency and severity in this ecoregion.

Some towns in Oregon's Coast Range ecoregion include Astoria, Bandon, Brookings, Cannon Beach, Elkton, Florence, Gold Beach, Lincoln City, Newport, Tillamook, Waldport, and Yachats. The largest urban area on the coast is in Coos Bay/North Bend, which serves as a hub for fishing, shellfish, forest products, and transportation. Forestry remains the primary industry in the interior portion of the ecoregion. The Oregon coast offers excellent recreational opportunities, and tourism is important to local communities. Commercial and recreational fishing and fish processing are significant components of the economy. The Coast Range is a popular destination for retirees, so retirement services are important to coastal communities.

CHARACTERISTICS



Important Industries

Forest products, agriculture, commercial fishing, fish processing, tourism and recreation, and retirement services

Major Agricultural Products

Livestock forage, timber, beef and dairy cattle

Important Nature-based Recreational Areas

Coos Bay, Tillamook Bay, Oregon Dunes National Recreation Area, Siuslaw National Forest, Clatsop and Tillamook State Forests, Elliot State Research Forest, Lower Rogue River, South Slough National Estuarine Research Reserve, Cape Kiwanda, Jewell Meadows Wildlife Area, Coquille Valley Wildlife Area

Elevation

From 0 to 4,100 feet

Important Rivers

Alsea, Chetco, Clastskanie, Coos, Coquille, Illinois, Lewis and Clark, Necanicum, Nehalem, Nestucca, Rogue, Siletz, Siuslaw, Trask, Umpqua, Wilson, Yaquina, Youngs

CONSERVATION ISSUES AND PRIORITIES

Demand for property development is increasing due to growing numbers of people recreating, relocating, and retiring along the Oregon coast. Development in many communities is putting higher demands on surface water in streams, reducing flows during critical time periods. Tidal and lowland habitats, which are important for rearing fish, are also being significantly impacted by coastal development and agriculture. Growth of communities along US Highway 101 creates barriers to wildlife movement between coastal and inland habitats, and new roadways needed to accommodate growth impact fish at stream crossings and increase mortality risks for wildlife. Tourism is greatly increasing fish and wildlife exposure to human presence, particularly for shorebirds and waterfowl that use bays and mudflats near towns to feed and rest during migration.

Careful resource planning helps to balance these increasing demands while maintaining coastal fish, wildlife, and habitats. Coordinated, broad-scale planning is especially important given the diversity of the Coast Range ecoregion. Although many plans currently exist, such as the Northwest Forest Plan, there is a continuing need to consider the unique requirements of transitional zones such as estuaries, and to integrate marine and inland conservation planning.

Much of the ecoregion is publicly owned and managed to balance recreation, tourism, and conservation. However, ownership in the northern part of the ecoregion is particularly fragmented. Restoration of watershed processes and functions (e.g., floodplain connectivity), and restoration of habitat complexity (e.g., woody debris) to stream and **riparian areas** are major concerns throughout the entire Coast Range ecoregion. Restoring flows to headwater streams maintains ecological connections important for many species.

Changing climate conditions, such as warming temperatures and altered timing and patterns of precipitation, are impacting weather patterns. Shifts in water availability throughout the year may contribute to habitat loss for fish and amphibians, and warmer, drier summers are expected to increase the risk of wildfire. Warming stream temperatures are limiting summer rearing of some anadromous fish species. Altered hydrology, changes in storm patterns, and warming temperatures may also impact stream flows and estuaries, which serve as important habitat for many invertebrates, fish, and marine and terrestrial wildlife species.

Key Conservation Issues of particular concern in the Coast Range ecoregion include **Land Use Changes**, **Climate Change**, and **Invasive Species**. In addition to the statewide issues, oil spills, loss of estuarine habitat, recreational use, and loss of habitat connectivity are of particular concern in coastal areas.

CLIMATE

The Coast Range terrain is varied, with steeply sloping mountains, hills, sand dunes, and beaches. The climate is maritime with warm, dry summers and mild, very wet winters. Mean annual temperature and precipitation fluctuate considerably due to the large variation in latitudes and elevations.

Warming is projected in all seasons across the Coast Range ecoregion, with the largest increases projected for the summer. For a high emissions scenario (SSP585), summer average temperature is projected to increase by as much as 5°F for the 2040-2069 period and by as much as 8°F by the end of the century (Figure 1). Winters in the Coast Range are projected to be wetter, and summers are projected to be drier in the future. In late summer (July – September), total precipitation is projected to decrease by as much as 20% by the end of the century (Figure 2). For the cool season, projections show an increase in precipitation of 9%. The confidence in changes in cool season precipitation is greater than in late summer precipitation. For a high emissions scenario (SSP585), growing degree days are projected to double by the end of the century. Frost days are projected to decrease from an average of 63 per year to about 15–30 per year, on average, for the 2070-2099 period.

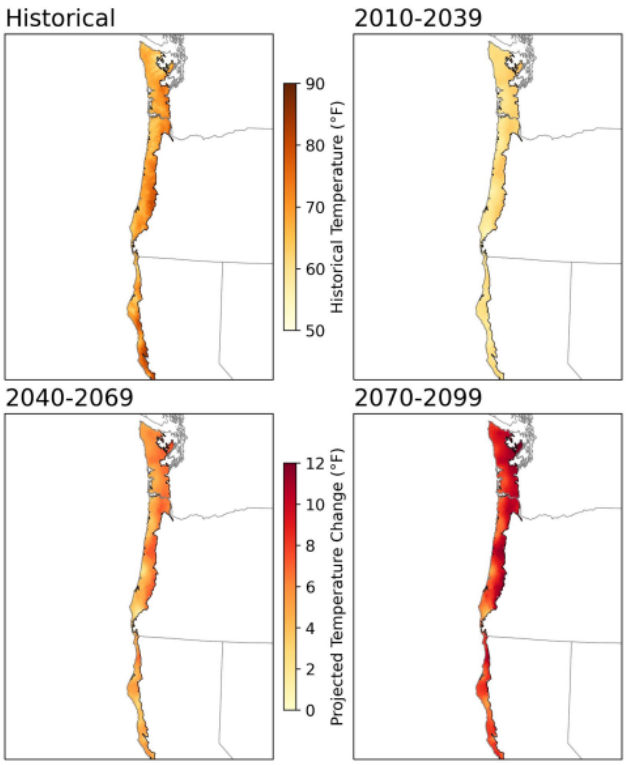


Figure 1. Model median historical (1950-2010) and future projections of summer maximum temperature change for three periods (2010-2039, 2040-2069, 2070-2099) under a high emission scenario (SSP585) for the Coast Range. Future projections show increasing temperatures through the century, with less warming in areas adjacent to the Pacific Ocean (Raymond and Fusco, 2024).

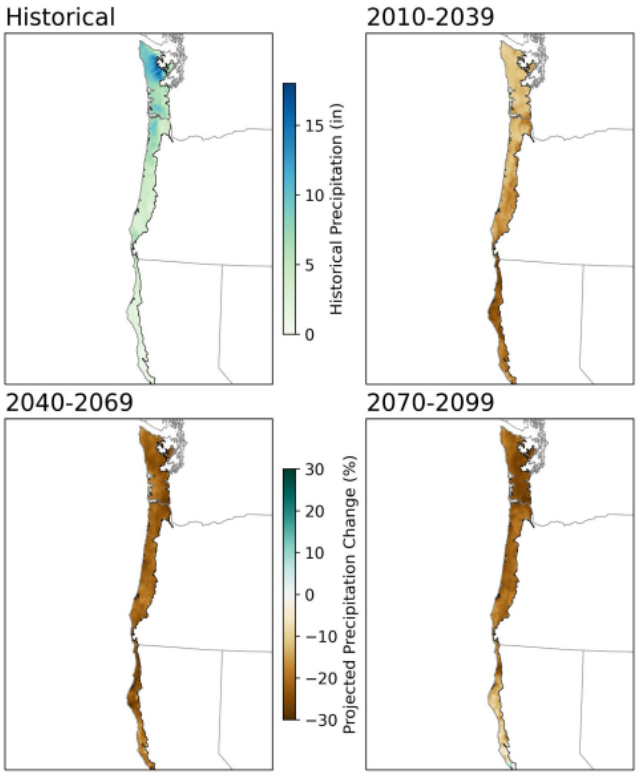


Figure 2. Model median historical (1950-2010) total late summer precipitation and projected percent change for three future periods (2010-2039, 2040-2069, 2070-2099) under a high emission scenario (SSP585) for the Coast Range. Future projections show decreasing late summer precipitation, with a greater decrease projected for the northern part of the ecoregion for the 2070-2099 period (Raymond and Fusco, 2024).

LIMITING FACTORS AND RECOMMENDED APPROACHES

Limiting Factor: *Land Use Conversion and Urbanization*

CMP Direct Threats 1, 2.1, 2.3, 7.2

Some areas of the Coast Range are developing rapidly, especially coastal communities, such as Cannon Beach, Lincoln City, and Newport. Steep slopes limit the amount of land available for development, and concentrate it in sensitive areas, particularly flatter lowlands and wetlands near rivers and estuaries. Residential development contributes to habitat loss and can contribute to loss of industry, such as agriculture and forestry. Historic draining of wetlands and marshes for agricultural use has also had significant impacts. Coastal rivers, **wetlands**, and **estuaries** were altered when side channels were diked, marshes drained, and channels deepened. These changes removed necessary habitat complexity, degraded water quality, and reduced estuarine habitat for fish and wildlife.

Recommended Approach

Work with community leaders and local governments to encourage planned, efficient growth. Support existing **land use regulations** to preserve farmland and forestland, open spaces, recreation areas, wildlife refuges, and natural habitats. Provide outreach about the benefits of wetland and tideland restoration. Support riparian buffers on all streams. Where possible, remove dikes and tide gates to restore estuarine habitats. Where tide gates need to be retained, replace older gates with side-hinged or aluminum gates that improve fish passage and hydrologic functions.

Limiting Factor: *Water*

CMP Direct Threats 7.2, 11.4

Water quantity is a limiting factor for fish and wildlife. Changing climate conditions are leading to rising temperatures and altered patterns of precipitation, which affect water availability across different times of year. Surface water is the primary source of drinking water for nearly all municipal and community water providers along the coast. Some water providers currently face water shortages, and future shortages are anticipated due to decreasing supplies and increasing demand, especially during peak tourism season.

Water quality can also limit species and habitats. Runoff from agricultural and urban areas can contaminate waterways. Landscape-scale application of herbicides in industrial timber operations can also negatively impact water quality. Warming temperatures, combined with higher nutrient levels due to agricultural runoff, are increasing the prevalence of toxic algal blooms, leading to shellfish fishery closures and fish and wildlife mortality. Timber harvest on steep slopes without control measures and agricultural grazing practices in moist soils along the coast contribute to increased sedimentation in streams, wetlands, and estuaries, causing changes in plant community composition, reducing habitat complexity, and altering water circulation and nutrient flows.

Recommended Approach

Provide incentives and information about water usage and sharing during low flow conditions (e.g., late summer). Promote water management actions that enable climate resilience and adaptation. Invest in watershed-scale projects for cold water and flow protection. Identify and protect cold water rearing and refugia habitat for aquatic species. Increase awareness and manage timing of applications of potential aquatic contaminants. Improve compliance with water quality standards and pesticide use labels administered by the **DEQ** and **EPA**. Work on implementing **Senate Bill 1010** (Oregon Department of Agriculture) and **DEQ Total Maximum Daily Load** water quality plans.

Limiting Factor: *Habitat Fragmentation*

CMP Direct Threats 1, 2.1, 2.3, 3.3, 8.1

Increasing traffic volumes, road density, recreational pressure, resource extraction, and aging water control structures contribute to habitat loss and fragmentation and create significant **barriers to animal movements.** In this ecoregion, US Highway 101 runs north to south, limiting connectivity between coastal dunes, estuaries, and other shoreline habitats to inland wetlands, grasslands, and forests. At the northern end of the Coast Range, US Highway 30 bisects the Columbia River floodplain marshes and upstream tidal rivers. While Oregon Forest Practices Act rules help to maintain some structural components and diversity on the landscape, commercial timber harvest can fragment forested habitats, reduce tree species diversity, and limit forest structural complexity. Many water control structures, such as culverts, are old and have not been well-maintained. These aging structures are often inundated with sediment and may be perched above water courses, preventing use by wildlife and blocking movement of fish. Older tide gates alter hydrologic functions, block fish passage, and reduce estuarine habitats.

Recommended Approach

Work with community leaders, agency partners, tribes, and forest managers to **protect wildlife movement corridors** and to fund and implement site-appropriate habitat enhancement and restoration efforts to facilitate wildlife movement. Promote the protection, restoration, and maintenance of **Priority Wildlife Connectivity Areas,** following the guidelines outlined in **Oregon's Wildlife Corridor Action Plan**. Work with the Oregon Department of Transportation and county and city transportation departments to improve wildlife passage across roadways and replace aging water control structures to improve hydrologic function and permit fish passage. Prioritize timber harvest practices that retain a diversity of tree and shrub species and habitat structural components, with variable density thinning to help retain connections between forested areas.

Preserve existing farmland while restoring ecological functions that have been lost or degraded, particularly in tidal lowlands. Provide incentives (e.g., financial assistance, conservation easements) and information about the benefits of maintaining fish and wildlife habitat. Broad-scale conservation strategies will need to focus on restoring and maintaining more natural ecosystem processes and functions within areas that are managed primarily for other values. This may include an emphasis on more "conservation-friendly" management techniques for existing land uses, and restoration of some key ecosystem components such as estuarine function.

Limiting Factor: *Invasive Species*

CMP Direct Threat 8.1, 8.2

Non-native plant and animal invasions disrupt native communities, diminish populations of at-risk native species, and threaten the economic productivity of resource lands and waters. Invasive plants have increased substantially during the past several decades. In this ecoregion, Himalayan blackberry is widespread, with significant local impacts to meadows, riparian areas, and grasslands. Other invaders include reed canary grass, purple loosestrife, and yellow flag iris. Along the coast, European beach grass, introduced to stabilize shifting sands along roads, and gorse, introduced as an ornamental "living fence", have substantial negative impacts. European beach grass alters dune formation and has narrowed beaches, drastically reducing open, sandy habitats that are critical to native species. Gorse crowds out native plants and chokes streams, reducing fish and wildlife habitat, and is also highly flammable, significantly increasing wildfire risk.

Invasive animals have also caused significant issues in the Coast Range. Non-native smallmouth bass have been illegally introduced to several areas in the ecoregion, including the Coquille Basin and Eel Lake, negatively impacting a variety of native fish species. American bullfrogs are rapidly expanding, competing with native species for limited resources or preying on native species and/or their eggs or young. Nutria degrade water quality and destabilize stream banks, while competing with native species, such as American beaver and muskrat, for food. Barred owls, expanding westward from their native range in the eastern US, compete directly with the native, threatened Northern spotted owl for food and habitat. Barred owls may also hybridize with spotted owls.

Emerging threats from invasive invertebrates are also becoming a concern in this ecoregion. The non-native emerald ash borer defoliates tree species characteristic of riparian habitats, such as Oregon ash, putting riparian areas, and in-stream habitats that depend on shading from bankside trees, at risk.

Recommended Approach

Emphasize prevention, risk assessment, early detection, and quick control to prevent new **invasive species** from becoming fully established. Prioritize management and control efforts to focus on key invasive species in high priority areas, particularly where **Key Habitats** and **Species of Greatest Conservation Need** occur. Where needed, use multiple site-appropriate tools (e.g., mechanical, chemical, and biological) to control the most damaging invasive species. Work with partners to implement measures to prevent unintentional introduction of non-native species (e.g., implement existing ballast water treatment regulations). Provide information to the public about the ecological and economic damage that invasive species cause. Work with the **Oregon Invasive Species Council** and other partners to educate people about invasive species issues and to prevent introductions of potentially high-impact species. Provide technical and financial assistance to landowners interested in controlling invasive species on their properties. Promote the use of native species for restoration and revegetation.

Limiting Factor: *Recreational Activity*

CMP Direct Threats 1.3, 4.1, 5.1, 5.2, 5.4, 6.1

Activities like hiking, biking, hunting, fishing, camping, jet boating, foraging, unmanned aerial vehicle (UAV), and off-road vehicle use can create sensory stressors for wildlife, with sound, light, and unusual smells that may disrupt behavior and deter species from moving through certain areas. Recreation contributes positively to the Coast Range's economy and local communities and is managed carefully in many areas. However, increasing numbers of recreationists can impact sensitive areas, such as shorebird nesting areas, tidepool habitats, and haul out sites for marine mammals. There are concerns with off-leash dogs in some areas. Off-highway vehicle use and target shooting are increasing on public forestlands, especially in areas near cities. In many areas, off-highway vehicle and mountain bike use is not closely managed, leading to habitat destruction as users create new networks of unsanctioned, unregulated trails. Dispersed recreation can cause new roads and trails to fragment the landscape and can cause the spread of invasive species from other locations. As inland areas experience more very hot days and more lands in inland ecoregions are closed to the public due to wildfire, public lands in the Coast Range are experiencing greater use.

Recommended Approach

Work with state and federal forest management agencies to plan recreational use and to increase education and outreach for recreationists and associated businesses. Work with land management agencies such as the USFS to designate areas as high value recreation and low habitat impact areas. Institute road and/or area closures to protect species during sensitive times of year and decommission roads when possible. Monitor to ensure that OHV rules for use and public lands motor vehicle use maps are enforced by the managing agencies. Improve public awareness of sensitive areas through signage and kiosks. Follow guidelines for responsible recreation, such as **Leave No Trace**, to minimize impacts.

Limiting Factor: *Oil Spills*

CMP Direct Threats 4.1, 4.3, 9.2

Oil spills along the coast can have devastating effects on coastal habitats, fish, shellfish, and wildlife. Tidal flux can spread oil or other hazardous materials around sensitive habitats very quickly. Rapid response in the event of a spill is essential. Additionally, spills of hazardous materials or oil from vehicles traveling on roads along the coast could potentially impact nearby rivers, wetlands, estuaries, fish, and aquatic wildlife.

Recommended Approach

Ensure rapid response and preparedness for spills of hazardous substances. Oregon Department of Environmental Quality's (DEQ) **Marine Oil Spill Prevention Program** and the Pacific States/British Columbia **Oil Spill Task Force** work with multiple parties and interested partners to address these concerns and quickly identify appropriate actions.

REFERENCES

Raymond, C. L. and E. J. Fusco (Eds.). 2024. The State of Climate Adaptation Science for Ecosystems in the Northwest U.S. Prepared by the Climate Impacts Group for the Northwest Climate Adaptation Science Center. https://depts.washington.edu/nwclimateadaptation/socs/

ECOREGIONS

Columbia Plateau

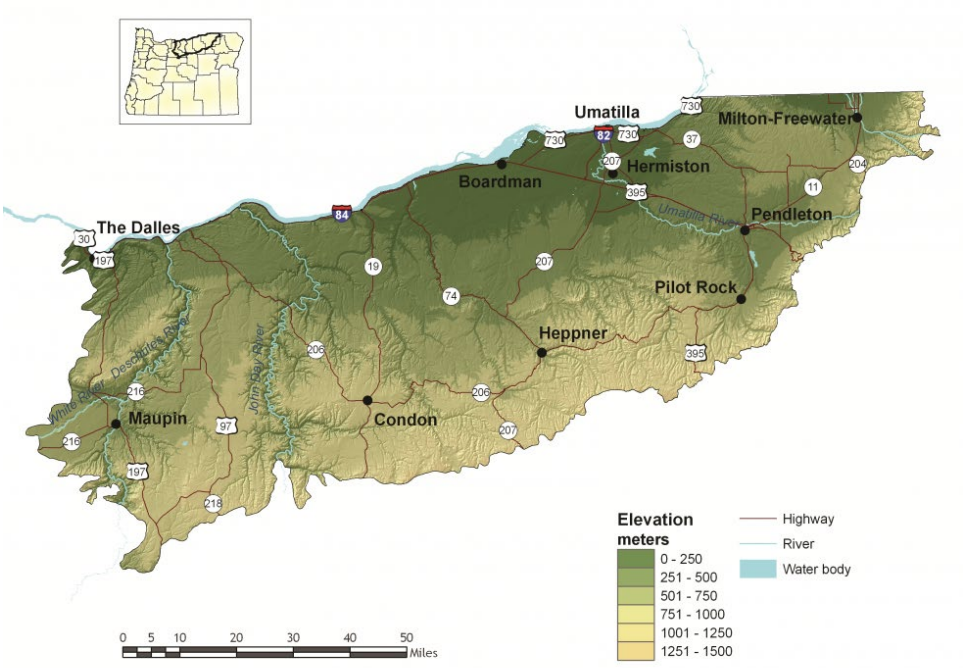
COLUMBIA PLATEAU

DESCRIPTION

The Oregon portion of the Columbia Plateau ecoregion extends from the eastern slopes of the Cascade Mountains to the border of the Blue Mountains ecoregion. The **Columbia River** delineates the northern border of the ecoregion in Oregon and has greatly influenced the surrounding area with cataclysmic floods and large deposits of wind-borne silt and sand. Over time, winds scoured the floodplain, depositing silt and sand across the landscape and creating ideal conditions for agriculture: rolling lands, deep soil, and plentiful flowing rivers. The ecoregion is made up of lowlands, with an arid climate, cool winters, and hot summers.

The Columbia Plateau ecoregion is characterized by sagebrush steppe and grassland habitats with extensive areas of dryland farming and irrigated agriculture. The Columbia Plateau produces the vast majority of Oregon's grain, and grain production is the heart of the agricultural economy. The Columbia Plateau is second only to the Willamette Valley for agricultural production in Oregon. More than 80 percent of the ecoregion's population and employment is located in Umatilla County, which includes the cities of Pendleton and Hermiston. Other population centers include The Dalles, Condon, and Heppner. Most of the Umatilla Indian Reservation is found in the Columbia Plateau ecoregion.

CHARACTERISTICS



Important Industries

Agriculture, food processing, energy (solar and wind), livestock, retail and services, construction, recreation

Major Agricultural Products

Grain, barley, potatoes, onions, fruit

Important Nature-based Recreational Areas

Cold Springs National Wildlife Refuge (NWR), Umatilla NWR, the canyons of the lower Deschutes and John Day Rivers, Lower Deschutes Wildlife Area, Willow Creek Wildlife Area, Irrigon Wildlife Area, Coyote Springs Wildlife Area, Power City Wildlife Area

Elevation

100 feet (The Dalles) to over 4,000 feet along the southern border

Important Rivers

Columbia, Deschutes, John Day, Umatilla, Walla Walla

CONSERVATION ISSUES AND PRIORITIES

Almost all the Columbia Plateau ecoregion is privately owned. Conservation opportunities on public lands are limited but should focus on maintaining connectivity among high quality habitat patches.

Water availability is a concern in this ecoregion, and demands for water include agricultural, industrial, and domestic use. Water quality in the Columbia Plateau ecoregion is affected by these demands, particularly in summer months when flows are reduced. Restoring flow to headwater streams is essential to maintain ecological connections. Maintaining aquifers is also critical.

Key Conservation Issues of particular concern in this ecoregion include **Water Quality and Quantity** and **Invasive Species**. In addition to the statewide issues, soil erosion, habitat fragmentation, and large-scale **energy development** are of conservation concern in this ecoregion.

CLIMATE

The Columbia Plateau ecoregion consists of irregular plains and hills. The climate is dry and desert-like with hot, dry summers and cold winters. Mean annual precipitation is low, especially in the western area of the ecoregion due to the rain-shadow effect of the Cascade Range. Most summer precipitation evaporates quickly, leaving little water for streams and reservoirs.

Warming is projected in all seasons across the region, with the largest increases project in summer. The average summer temperature is projected to increase by as much as 7°F for the 2040-2069 period, and as much as 12°F for the 2070-2099 period under a high emissions scenario (SSP585; Figure 1). Late summer precipitation is projected to decrease as much as 24% for a high emissions scenario (SSP585) in the 2070-2099 period (Figure 2). Cool season precipitation projections show an increase in precipitation of as much as 16% for the 2070-2099 period. Confidence is high in these projected precipitation changes. Growing degree days are projected to double by the 2070-2099 period under a high future scenario. Frost days are projected to decrease from 125 per year until there are fewer than 60, on average, under the high emissions scenario (SSP585).

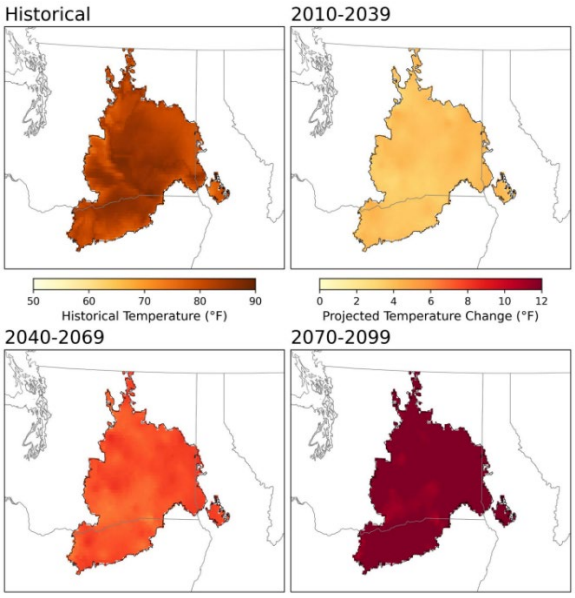


Figure 3. Model median historical (1950-2010) and future projections of summer maximum temperature change for three periods (2010-2039, 2040-2069, 2070-2099) under a high emission scenario (SSP585) for the Columbia Plateau. Future projections show increasing temperatures over the next century that is spatially uniform over the Columbia Plateau (Raymond and Fusco, 2024).

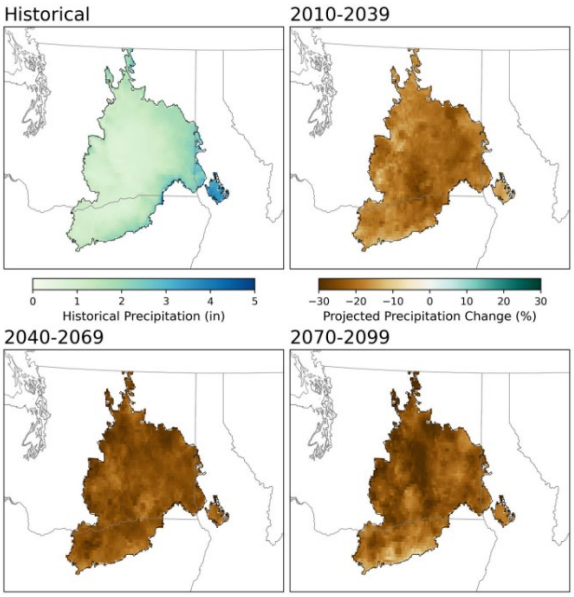


Figure 4. Model median historical (1950-2010) total late summer precipitation and projected percent change for three future periods (2010-2039, 2040-2069, 2070-2099) under a high emission scenario (SSP585) for the Columbia Plateau. Future projections show decreasing late summer precipitation across all of the Columbia Plateau ecoregion (Raymond and Fusco, 2024).

LIMITING FACTORS AND RECOMMENDED APPROACHES

Limiting Factor: *Water*

CMP Direct Threats 7.2, 9.3, 11.4

Water quantity is a limiting factor for fish and wildlife. Changing climate conditions are leading to rising temperatures and altered patterns of precipitation, which affects water availability across different times of year. In streams, seasonal low flows can limit habitat suitability and reproductive success for many fish and wildlife species. Reduced water availability for plants can affect the quality and availability of forage for many terrestrial species. In areas where urbanization is increasing, the demand for water is contributing to a decrease in the supply of groundwater. This reduces groundwater discharge of cold water to rivers and streams, subsequently reducing the availability of both cold water refugia and suitable habitat for cold-water dependent species. Many communities in the Columbia Plateau ecoregion are reliant on aquifers for water, and agricultural irrigation and private interests, such as aquifer use to cool computers in data centers, may threaten local water supplies. There are seven critical groundwater areas in Oregon, five of which are within the Columbia Plateau.

Water quality can also limit species and habitats. Runoff from agricultural areas can contaminate waterways. Warming temperatures, combined with higher nutrient levels due

to agricultural runoff, are increasing the prevalence of harmful algal blooms in waterways like the lower John Day and Deschutes Rivers. These harmful algal blooms can cause large-scale fish die-off, sicken or kill wildlife, impact drinking water, and reduce habitat for fish and wildlife by blocking sunlight and creating hypoxic zones, also known as dead zones.

Recommended Approach

Provide incentives and information about water usage and sharing during low flow conditions (e.g., late summer). Promote water management actions that enable climate resilience and adaptation. Invest in watershed-scale projects for cold water and flow protection. Identify and protect cold water rearing and refugia habitat for aquatic species. Increase awareness and manage timing of applications of potential aquatic contaminants. Improve compliance with water quality standards and pesticide use labels administered by the **DEQ** and **EPA**. Work on implementing **Senate Bill 1010** (Oregon Department of Agriculture) and **DEQ Total Maximum Daily Load** water quality plans.

Limiting Factor: *Habitat Fragmentation*

CMP Direct Threats 2.1, 2.3, 3.3, 8.1

The impact of human activity in the Columbia Plateau is high. The majority of the prairie and shrub-steppe habitat has been converted for agricultural uses. The remaining **Key Habitats** for at-risk native plant and animal species are limited and largely confined to small and often isolated fragments, such as roadsides and sloughs. These remaining parcels have the potential to be converted to agriculture, and there are few opportunities for large-scale protection or restoration of native landscapes. Existing land use and land ownership patterns present challenges to large-scale ecosystem restoration.

Recommended Approach

Provide incentives (e.g., financial assistance, conservation easements) and information about the benefits of maintaining bird and other wildlife habitat. Broad-scale conservation strategies will need to focus on restoring and maintaining more natural ecosystem processes and functions within a landscape that is managed primarily for other values. This may include an emphasis on more "conservation-friendly" management techniques for existing land uses, and restoration of some key ecosystem components such as **riparian** function. "Fine filter" conservation strategies that focus on needs of individual **Species of Greatest Conservation Need** and key sites are particularly important in this ecoregion.

Because approximately 84 percent of the Columbia Plateau ecoregion is privately-owned, voluntary cooperative approaches are the key to long-term conservation using tools such as financial incentives, regulatory assurance agreements, and conservation easements.

Where appropriate, plan development carefully to maintain existing native habitats. Identifying important habitat areas and directing mitigation from ongoing energy development may be another protection strategy. Promote the protection, restoration, and maintenance of **Priority Wildlife Connectivity Areas,** following the guidelines outlined in **Oregon's Wildlife Corridor Action Plan**.

Limiting Factor: *Invasive Species*

CMP Direct Threat 8.1

Invasive plant and animal species disrupt native communities, diminish populations of at-risk native species, and threaten the economic productivity of resource lands including farmland and rangeland. Differences in county policies and funding availability regarding invasive species have resulted in some inconsistencies in approach. Non-native annual grasses, such as cheatgrass and medusahead, have rapidly expanded in perennial grass systems in the Columbia Plateau, displacing desirable forage for wildlife and livestock. Invasion of cheatgrass has also increased fuel loads substantially, leading to catastrophic fire events. Invasive species such as yellow star thistle, Russian thistle, and Russian olive are also of concern, growing rapidly to crowd out native species.

Recommended Approach

Emphasize prevention, risk assessment, early detection, and quick control to prevent new **invasive species** from becoming fully established. Use multiple site-appropriate tools (e.g., mechanical, chemical and biological) to control the most damaging invasive species. Focus on key invasive species in high priority areas, particularly where **Key Habitats** and **Species of Greatest Conservation Need** occur. Ensure cooperation and collaboration between counties, landowners, land managers, and other entities with invasive species policies and interests. Promote the use of native species for restoration and revegetation.

Limiting Factor: *Energy Development*

CMP Direct Threat 3.3

Climate change and global economies are increasing pressure for renewable energy development, including wind, solar, and geothermal energy. Energy projects offer environmental benefits but also have impacts on fish, wildlife, and their habitats. Wind energy potential is especially high in the Columbia Plateau. The area is increasingly challenged with the need to balance the state's interest in clean energy development with local natural resource conservation needs.

Recommended Approach

Plan energy projects carefully, using the best available information and consultation with biologists. See the Key Conservation Issue on **Land Use Changes**, the **Oregon Department of Fish and Wildlife Solar Siting Guidance** and the **Oregon Columbia Plateau Ecoregion Wind Energy Siting and Permitting Guidelines.** Focus potential mitigation efforts from energy siting into areas of greatest habitat integrity in the region. Avoid siting new facilities within critical movement and migration areas, including **Priority Wildlife Connectivity Areas**.

Limiting Factor: *Soil Erosion*

CMP Direct Threats 2.1, 9.3, 9.5

Soil loss through erosion and decreases in soil quality jeopardize the productivity of native habitats and agricultural lands. Agricultural use, particularly tilled production without the use of cover crops, is prevalent in the Columbia Plateau ecoregion. This region also sees characteristically high, sustained winds, contributing to soil loss. Sandy soils along the Columbia River are particularly susceptible to erosion from high winds. Soil erosion decreases water infiltration, which is essential for productive habitats and groundwater recharge, and can also increase sediment loading in streams, as well as air-borne pollutants.

Recommended Approach

Use incentives to promote no-till farming and agricultural practices that do not allow land to lay bare for long periods of time. Support no-till practices that use crop rotation and cover crops. Encourage participation and support for programs such as the Natural Resources Conservation Service's **Conservation Reserve Program**, which promote practices that can offset or minimize soil erosion and degradation.

REFERENCES

Raymond, C. L. and E. J. Fusco (Eds.). 2024. The State of Climate Adaptation Science for Ecosystems in the Northwest U.S. Prepared by the Climate Impacts Group for the Northwest Climate Adaptation Science Center. https://depts.washington.edu/nwclimateadaptation/socs/

ECOREGIONS

East Cascades

EAST CASCADES

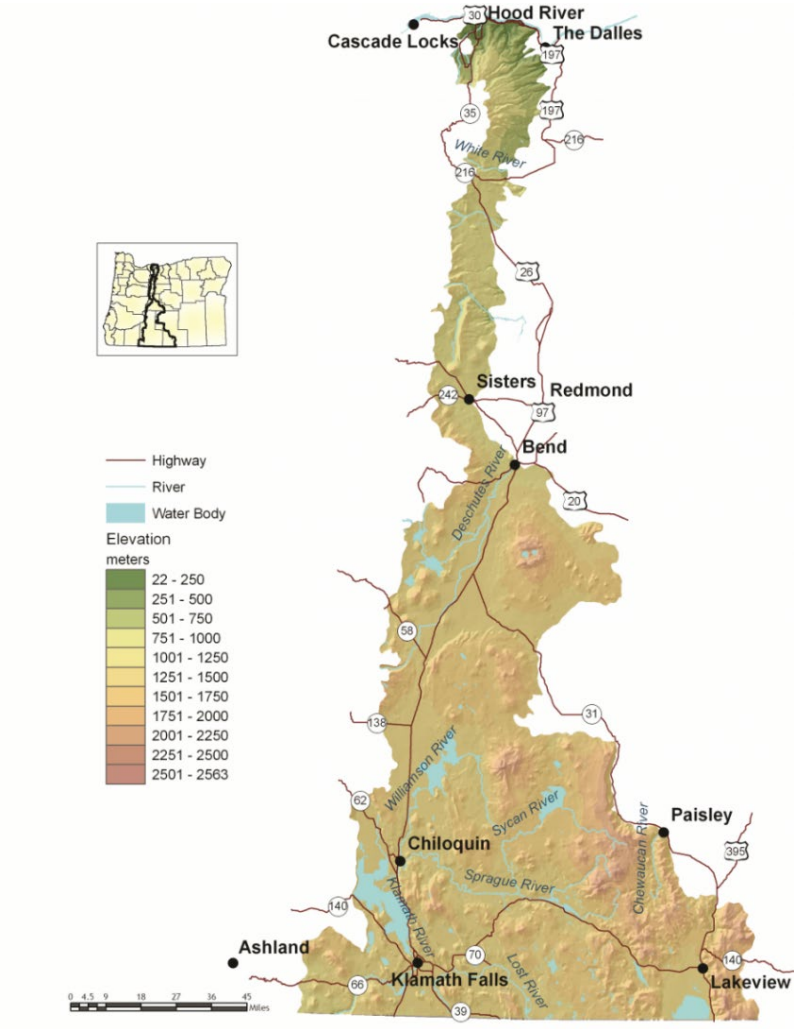
DESCRIPTION

The East Cascades ecoregion extends from just east of the Cascade Mountains' summit to the warmer, drier high desert to the east. Stretching the full north-to-south length of the state, the East Cascades is narrow at the Columbia River but becomes wider toward the south. This ecoregion varies dramatically from its cool, moist border with the West Cascades ecoregion to its dry eastern border with the Northern Basin and Range ecoregion. The climate is generally dry, with wide variations in temperature. The East Cascades ecoregion includes several peaks and ridges in the 6,000-7,000-foot range, but overall, the slopes on the east side of the Cascade Mountains are less steep than the West Cascades ecoregion. The East Cascades' volcanic history is evident through numerous buttes, lava flows, craters, and lava caves, and in the extensive deep ash deposits created by the explosion of historical Mt. Mazama during the creation of Crater Lake.

The terrain ranges from forested uplands to marshes and agricultural fields at lower elevations. The northern two-thirds of the East Cascades ecoregion is drained by the Deschutes River, ultimately flowing into the Columbia River. Most of the southern portion of the East Cascades ecoregion is drained by the Klamath River, with a small portion draining into Goose Lake, a closed basin. In general, the East Cascades is drier than the West Cascades, with fewer rivers flowing over the mountain slopes. However, the East Cascades ecoregion is characterized by many lakes, reservoirs, and marshes, providing exceptional habitat for species closely associated with water, including waterbirds, amphibians, fish, aquatic plants, and aquatic invertebrates.

When compared to Oregon's other ecoregions, the East Cascades has the second-highest average income (the Willamette Valley ecoregion supports the highest per-capita income). Much of this income is related to tourism and recreation, but forestry and agriculture also provide important roles. Towns include Bend, Klamath Falls, Lakeview, and Hood River; many communities in this ecoregion are experiencing rapid population growth. Most of the Warm Springs Reservation is found in the East Cascades ecoregion.

CHARACTERISTICS



Important Industries

Recreation (tourism and hospitality), forest products, agriculture

Major Agricultural Products

Fruit (Hood River Valley), carrot seed (Jefferson County), wood, onions, potatoes, strawberries, barley (Klamath Basin), alfalfa, and cattle (Lake County)

Important Nature-based Recreational Areas

Klamath Basin National Wildlife Refuge Complex, Goose Lake, Newberry Crater National Monument, high Cascade lakes along Century Drive, Pine Mountain, Warner Mountains, Gearhart and Badger Creek Wilderness Areas, Metolius and Deschutes sub-basins, White River Wildlife Area

Elevation

70 feet (in the Columbia River Gorge area) to over 8,000 feet (peaks in the southeastern portion of the ecoregion)

Important Rivers

Deschutes, Hood, Klamath, Metolius, Link, Williamson, Sycan, and Sprague

CONSERVATION ISSUES AND PRIORITIES

The habitats of the East Cascades ecoregion are varied, from sagebrush flats to alpine fields. The conservation issues are similarly diverse, as well as complex. Timber harvest practices, grazing, and fire suppression have altered the distribution and structure of much of the ecoregion's historical ponderosa pine forests and oak woodlands and have degraded many of the riparian and **wetland** habitats. Rapidly expanding urban and rural residential development is another major emerging conservation issue, resulting in development within riparian zones, the loss of ungulate winter range, and water diversions to support development. Along with this development, traffic volumes on US Highway 20 and US Highway 97 continue to increase, creating a major barrier to wildlife movement. Lastly, a high percentage of historic wetlands have been converted to agricultural and other uses in the Klamath Basin, and water continues to be a complex and challenging issue in the area.

Key Conservation Issues of particular concern in the East Cascades ecoregion include **Invasive Species**, **Disruption of Disturbance Regimes**, **Water Quality and Quantity**, and **Land Use Changes**. In addition to the statewide issues, habitat fragmentation and increasing recreational use are of concern in this ecoregion.

CLIMATE

The East Cascades terrain includes sloping mountains and high plateaus. The climate is more continental with greater temperature extremes and less precipitation. Summers are warm and dry; winters are cold. The frost-free period is typically short, especially on the high peaks, and the mean annual precipitation varies considerably with elevation. With increased temperatures, the frost-free period in the East Cascades will lengthen.

Warming is projected in all seasons across the East Cascades, with the greatest increases projected for the summer. The average summer temperature is projected to increase by as much as 7°F for the 2040-2069 period, and as much as 12°F for the 2070-2099 period under a high emissions scenario (SSP585; Figure 1). Late summer total precipitation is projected to decrease in the north and increase in the south of the ecoregion; however,

confidence is low in the projected changes in summer precipitation after 2039 (Figure 2). Projections of cool season precipitation show an increase of as much as 9% under a high emissions scenario (SSP585) for the 2070-2099 period. Under a high (SSP585) scenario, growing degree days are projected to double by the 2070-2099 period and frost days are projected to decrease from over 200 per year to 120 per year, on average, by the end of the century.

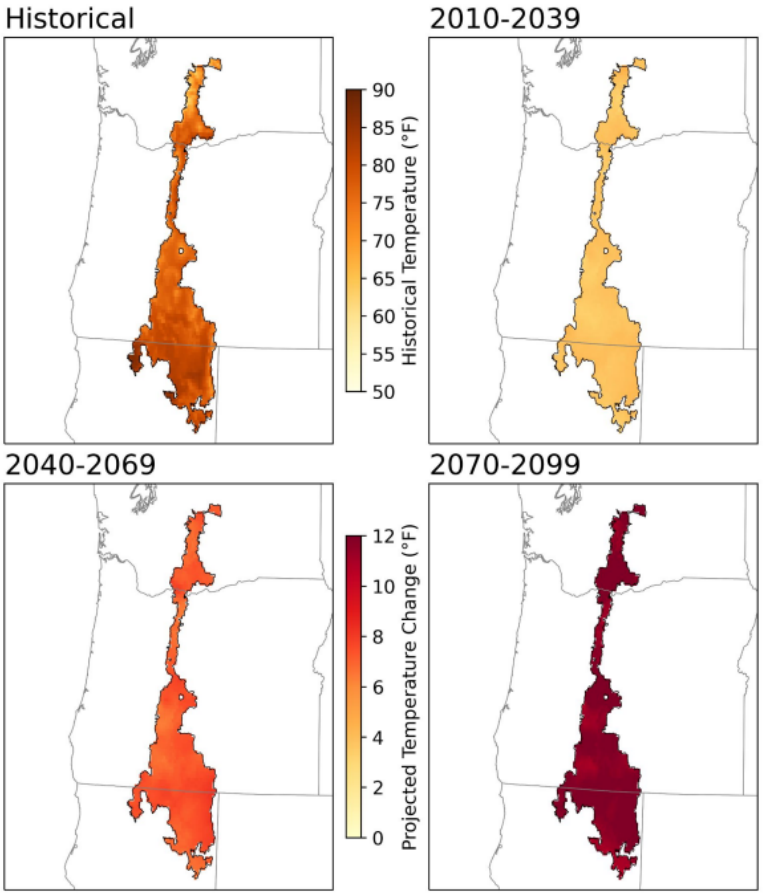


Figure 1. Model median historical (1950-2010) and future projections of summer maximum temperature change for three periods (2010-2039, 2040-2069, 2070-2099) under a high emission scenario (SSP585) for the East Cascades. Future projections show increasing temperatures over the next century, with slightly less warming in the western section of the region with higher elevation (Raymond and Fusco, 2024).

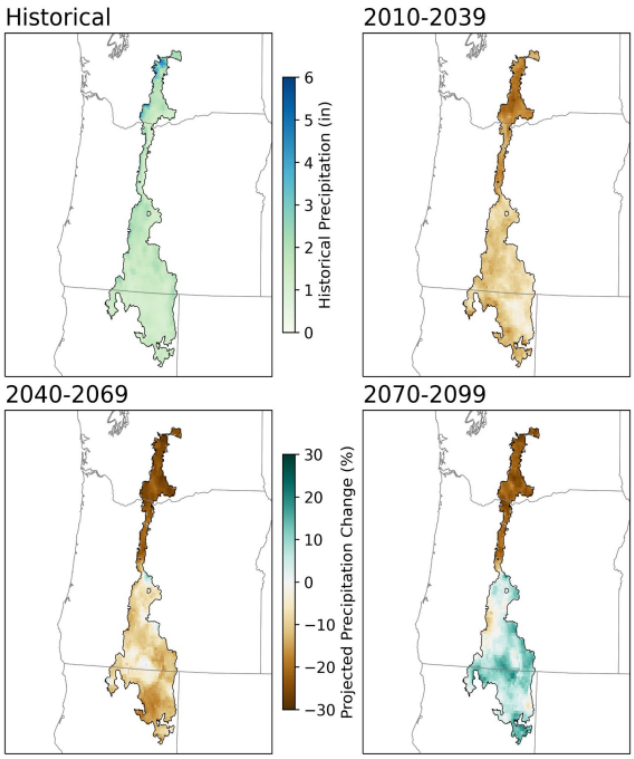


Figure 2. Model median historical (1950-2010) total late summer precipitation and projected percent change for three future periods (2010-2039, 2040-2069, 2070-2099) under a high emission scenario (SSP585) for the East Cascades. Future projections show decreasing late summer precipitation across the north through the century and an increase for the south for the end of the century. Confidence is low in projected changes in late summer precipitation after the 2010-2039 period (Raymond and Fusco, 2024).

LIMITING FACTORS AND RECOMMENDED APPROACHES

Limiting Factor: *Land Use Conversion and Urbanization*

CMP Direct Threats 1, 2.1, 2.3, 7.2

The East Cascades ecoregion includes some of the fastest growing areas of the state (e.g., Bend, Klamath Falls). Rapid urban and rural residential development contributes to habitat loss, and can threaten traditional land uses, such as agriculture and forestry. Residential development can also fragment habitat into small patches, isolating wildlife populations. Residential development is increasing in sensitive habitats, such as wetlands, riparian areas, and **cliffs and rims**, where raptors nest. Some agricultural uses contribute to habitat degradation for native wildlife species. For example, open grazing allotments in forests have significantly damaged understory and riparian habitat in many areas.

Recommended Approach

Cooperative approaches with both large and small private landowners are critical. Work with community leaders and local governments to encourage **planned, efficient growth**. Support existing land use regulations to preserve forestland, farmland, rangeland, open spaces, recreation areas, wildlife refuges, and natural habitats. Work with community leaders and agency partners to **protect wildlife movement corridors** and to fund and implement site-appropriate habitat enhancement and restoration efforts to facilitate wildlife movement. Encourage condensing development and utilize pre-existing disturbance footprints for new developments when possible. Work with counties to update Wildlife Inventories.

Limiting Factor: *Altered Fire Regimes*

CMP Direct Threats 7.1, 11.3, 11.4

Past forest practices and fire suppression have resulted in young, dense mixed-species stands where open, park-like stands of ponderosa pine once dominated. Shading from encroaching trees as a result of fire suppression has reduced the vigor of shrubs, particularly bitterbrush, an important forage plant for many wildlife species. Forest crowding and reduced fire resiliency is also a significant issue in oak habitat, as large legacy oaks have become surrounded by dense stands of younger trees.

Wildfire risk is further exacerbated by warming climate conditions and changes to patterns of precipitation, and more frequent, higher intensity megafires are becoming more common. Young, dense, mixed conifer forests are also at increased risk of forest-destroying crown fires, disease, and damage by insects. Additionally, past forest practices have contributed to forests that are lacking in mature trees and snags that serve as critical wildlife habitat for some species. Efforts to reduce fire danger and improve forest health may help to restore habitats but require careful planning to provide sufficient habitat features that are important to wildlife (e.g., snags, downed logs, hiding cover).

Increasing residential and resort development in forested habitats makes prescribed fire difficult in some areas and increases risk of high-cost wildfires. Although many residential interface “fireproofing” measures can be implemented with minimal effects to wildlife habitat, proper planning is necessary to avoid unintentionally and unnecessarily harming habitat.

Recommended Approach

Use an integrated approach to forest health issues that considers historical conditions, wildlife conservation, natural fire intervals, and silvicultural techniques. Evaluate individual stands to determine site-appropriate actions, such as monitoring in healthy stands or thinning, mowing, and prescribed fire in at-risk stands. Where appropriate, thin smaller trees in the understory and develop markets for small-diameter trees.

Implement fuels reduction projects to reduce the risk of forest-destroying wildfires, considering site-specific conditions and goals. Fuels reduction strategies need to consider the habitat structures that are required by wildlife, such as snags and downed logs, and try to maintain them at a level to sustain wood-dependent species. Design frequency and scale of prescribed fire to meet the habitat needs of a diversity of species. Monitor forest health initiatives and use adaptive management techniques to ensure efforts are meeting habitat restoration and forest-destroying fire prevention objectives with minimal impacts on wildlife. Work with homeowners and resort operators to reduce vulnerability of properties to wildfire while maintaining habitat quality. Highlight successful, environmentally sensitive fuels management programs. In the case of post-wildfire recovery, maintain high snag densities and replant with native tree, shrub, grass, and forb species. Manage reforestation after wildfire to create species and structural diversity, based on local management goals.

Limiting Factor: *Water*

CMP Direct Threats 7.2, 11.4

Water quantity is a limiting factor for fish and wildlife, and water availability is a significant issue in this ecoregion. Changing climate conditions are leading to rising temperatures and altered patterns of precipitation, which affect water availability across different times of year, and drought conditions are occurring more frequently. In high elevation areas, loss of snowpack due to warming climate conditions is affecting habitat for many species along the Cascade crest and is leading to reduced stream flow and peak flow rates that are occurring earlier in the year. In streams, seasonal low flows can limit habitat suitability and reproductive success for many fish and wildlife species. In areas where urbanization is increasing, particularly around Bend and Klamath Falls, the demand for water, along with regular droughts, has led to a decrease in the supply of groundwater. This reduces groundwater discharge of cold water to rivers and streams, subsequently reducing the availability of both cold water refugia and suitable habitat for cold-water dependent species. Dwindling groundwater supplies further contribute to wetland loss and altered timing in the availability of water in seasonal wetlands, impacting habitat for many fish and wildlife species.

Water quality can also limit species and habitats. Runoff from agricultural areas can contaminate waterways. Warming temperatures, combined with higher nutrient levels due to agricultural runoff, are increasing the prevalence of toxic cyanobacterial blooms.

Recommended Approach

Provide incentives and information about water usage and sharing during low flow conditions (e.g., late summer). Promote water management actions that enable climate resilience and adaptation. Invest in watershed-scale projects for cold water and flow

protection. Identify and protect cold water rearing and refugia habitat for aquatic species. Increase awareness and manage timing of applications of potential aquatic contaminants. Improve compliance with water quality standards and pesticide use labels administered by the **DEQ** and **EPA**. Work on implementing **Senate Bill 1010** (Oregon Department of Agriculture) and **DEQ Total Maximum Daily Load** water quality plans. Work with NRCS and other partners to support water-smart practices, like conversion from flood to piped irrigation, on working lands.

Limiting Factor: *Habitat Fragmentation*

CMP Direct Threats 1, 2.1, 2.3, 3.3, 8.1

Increasing traffic volumes, road density, and recreational pressure associated with development is contributing to habitat loss and fragmentation and creates **barriers to animal movements**, especially in National Forest and Wilderness Areas near urban centers and along US Highway 20 and US Highway 97. In non-forested areas, habitats for at-risk native plants and some animal species are largely confined to small and often isolated fragments, such as roadsides and sloughs. These remaining parcels have potential to be converted to agriculture or developed for solar energy production, and there are few opportunities for large-scale protection or restoration of native landscapes. Existing land use and land ownership patterns in many areas, particularly the Klamath Basin, present challenges to large-scale ecosystem restoration. In-stream barriers to movement, such as dams and undersized or poorly maintained culverts and bridges, may limit passage of fish and aquatic wildlife.

Recommended Approach

Work with community leaders and local governments to **protect wildlife movement corridors** and to fund and implement site-appropriate habitat enhancement and restoration efforts to facilitate wildlife movement. Promote the protection, restoration, and maintenance of **Priority Wildlife Connectivity Areas,** following the guidelines outlined in **Oregon's Wildlife Corridor Action Plan**.

Remove barriers to movement wherever possible. Ensure that waterways remain passable for fish and aquatic wildlife at culverts and bridges. Inventory fencing locations and conditions. Remove fencing that is no longer needed or in poor condition; modify needed fencing to be **wildlife friendly**. Work with the Oregon Department of Transportation and county and city transportation departments to improve wildlife passage across roadways. In forested habitats, maintain vegetation to provide screening along open roads, prioritize roads for closure based on transportation needs and wildlife goals, and/or manage road use during critical periods.

Provide incentives (e.g., financial assistance, conservation easements) and information about the benefits of maintaining bird and other wildlife habitat. Broad-scale conservation strategies will need to focus on restoring and maintaining more natural ecosystem processes and functions within areas that are managed primarily for other values. This may include an emphasis on more "conservation-friendly" management techniques for existing land uses, and restoration of some key ecosystem components such as riparian function.

Limiting Factor: *Invasive Species*

CMP Direct Threat 8.1, 8.2

Non-native plant and animal invasions disrupt native communities, diminish populations of at-risk native species, and threaten the economic productivity of resource lands. Non-native annual grasses, particularly cheatgrass, have infiltrated perennial grass systems in the eastern portion of the East Cascades ecoregion, displacing desirable forage for wildlife and livestock. Non-native fish and wildlife species are also causing detrimental impacts. In the East Cascades, the Pokegama horse herd has increased substantially, well above Appropriate Management Levels and outside of the established Herd Management Area. Unregulated horse herds have significant negative impacts, competing with native wildlife for vegetation and access to water, increasing soil erosion, and trampling sensitive habitats. American bullfrogs are rapidly expanding, competing with native species for limited resources or preying on native species and/or their eggs or young. Non-native fish, introduced to many high elevation lakes, have similar impacts, particularly for native amphibians.

Recommended Approach

Emphasize prevention, risk assessment, early detection, and quick control to prevent new **invasive species** from becoming fully established. Use multiple site-appropriate tools (e.g., mechanical, chemical, and biological) to control the most damaging invasive species. Prioritize efforts to focus on key invasive species in high priority areas, particularly where **Key Habitats** and **Species of Greatest Conservation Need** occur. Promote the use of native species for restoration and revegetation.

Limiting Factor: *Energy Development*

CMP Direct Threat 3.3

Climate change and global economies are increasing pressure for renewable energy development, including solar energy. Solar energy potential is especially high in the East Cascades. Solar energy projects offer environmental benefits but also have significant

impacts on wildlife and their habitat. Many solar energy facilities have large footprints. Federal requirements for facilities to be fully fenced make any remaining habitat within a solar field inaccessible to most terrestrial wildlife species, which results in lost habitat and may disrupt critical movement and migration pathways. Solar facilities are also a collision risk for birds, as reflection of sunlight off the panels may cause solar fields to resemble large water bodies. In addition to solar, hydropower production is also prevalent, and geothermal production is increasing. The area is increasingly challenged with the need to balance the state's interest in clean energy development with local natural resource conservation needs.

Recommended Approach

Plan energy projects utilizing all available resources, including the **ODFW Solar Siting Guidelines**. Work with prospective energy developers to incorporate interior project designs to offer potential habitat services for pollinator and avian species, where appropriate. See the Key Conservation Issue on **Land Use Changes**. Consider the broader landscape context when planning new facilities, including habitat connectivity, cumulative impacts, fish and wildlife species presence, and mapped or modeled suitable habitat. Ensure new facilities minimize negative impacts to fish and wildlife. For example, establish fish ladders or bypass channels to reduce fish passage barriers at dams, and use wildlife-permeable fencing or allow egress to permit passage for medium-sized animals through solar fields.

Limiting Factor: *Recreational Activity*

CMP Direct Threats 1.3, 4.1, 5.1, 5.2, 5.4, 6.1

Increasing demands for year-round recreational activity, including new mountain bike trails, ski lifts, and skill parks, can disturb wildlife. Activities like hiking, biking, hunting, fishing, camping, skiing, and off-road vehicle use can create sensory stressors for wildlife, with sound, light, and unusual smells that may deter species from moving through certain areas. Recreational pressure is increasingly significant in the East Cascades along the Cascade crest as residential communities grow. This region offers access to many trail systems across several National Forests and Wilderness Areas.

Recreational pressure can lead to an increase in wildlife stress response and behavioral changes that ultimately impact reproductive rates and population abundance. Human recreation may contribute to destruction of sensitive vegetation, harassment of wildlife from off-leash pets, spread of invasive species, and contamination of areas with refuse. Many species will avoid areas near trails, campgrounds, and access roads when humans are present. New winter tire and headlamp technologies are allowing mountain bicyclists access to important wildlife areas that were previously inaccessible due to snow. Trail

riding can now occur day or night throughout the year, which can disturb wildlife during critical life stages. Rock climbing too close to cliff-nesting birds such as Golden Eagles can result in nest abandonment. Expanded road and trail systems developed to help accommodate higher numbers of visitors are increasing habitat fragmentation and risks of behavioral impacts to wildlife.

Recommended Approach

Ensure that large patches of unfragmented habitat remain free from recreational pressure. Plan new recreational trail systems carefully and with consideration for native wildlife and their habitats. For example, limit night riding to certain areas to minimize disturbance to wildlife, avoiding areas more sensitive to damage such as wetlands. Take advantage of abandoned or closed roads, rail lines, or previously impacted areas for conversion into trails. Identify user-created roads and trails and decommission or enforce closures of these areas. Work with land management agencies such as the USFS to designate areas as high value recreation and low habitat impact areas. Institute road, area, and/or seasonal closures to protect species during sensitive times of year and decommission roads when possible. In high use areas, establish permitted entry systems to decrease recreational pressure. Research recreation impacts, including growing use of vehicles such as electric bicycles, and incorporate findings into recreation planning and habitat conservation. Engage in outreach and education to increase public awareness of recreation impacts to fish and wildlife species; develop messaging to communicate the need for “responsible recreation”.

REFERENCES

Raymond, C. L. and E. J. Fusco (Eds.). 2024. The State of Climate Adaptation Science for Ecosystems in the Northwest U.S. Prepared by the Climate Impacts Group for the Northwest Climate Adaptation Science Center.
https://depts.washington.edu/nwclimateadaptation/socs/

ECOREGIONS

Klamath Mountains

KLAMATH MOUNTAINS

DESCRIPTION

The Klamath Mountains ecoregion covers much of southwestern Oregon, including the Klamath Mountains, Siskiyou Mountains, the interior valleys and foothills between these and the Cascade Range, and the Rogue and Umpqua river valleys. Several popular and scenic rivers run through the ecoregion, including the Umpqua, Rogue, Illinois, and Applegate rivers. Historically, this ecoregion is known for some of the best anadromous fish habitat in Oregon. While the Klamath Mountains ecoregion has an abundance of rivers and streams, lakes and ponds are relatively rare and found almost exclusively in montane environments.

Within the ecoregion, there are wide ranges in elevation, topography, geology, and climate. The elevation ranges from about 60 to more than 7,500 feet, from steep mountains and canyons to gentle foothills and flat valley bottoms. This variation, along with the varied marine influence, supports a climate that ranges from the lush, rainy western portion of the ecoregion to the dry, warmer interior valleys and cold, snowy mountains.

Plate tectonics have played a major role in creating the complex mosaic of landforms and rock types in this ecoregion. The geology of the Klamath Mountains can be better described as a patchwork rather than the layer-cake geology of most of the rest of the state. In the Klamath Mountains, serpentine mineral bedrock has weathered to a soil rich in heavy metals, including chromium, nickel, and gold, and in other parts, mineral deposits have crystallized in fractures. In fact, mining was the first major resource use of the ecoregion following Euro-American settlement, and Jacksonville was Oregon's most classic "gold rush" town.

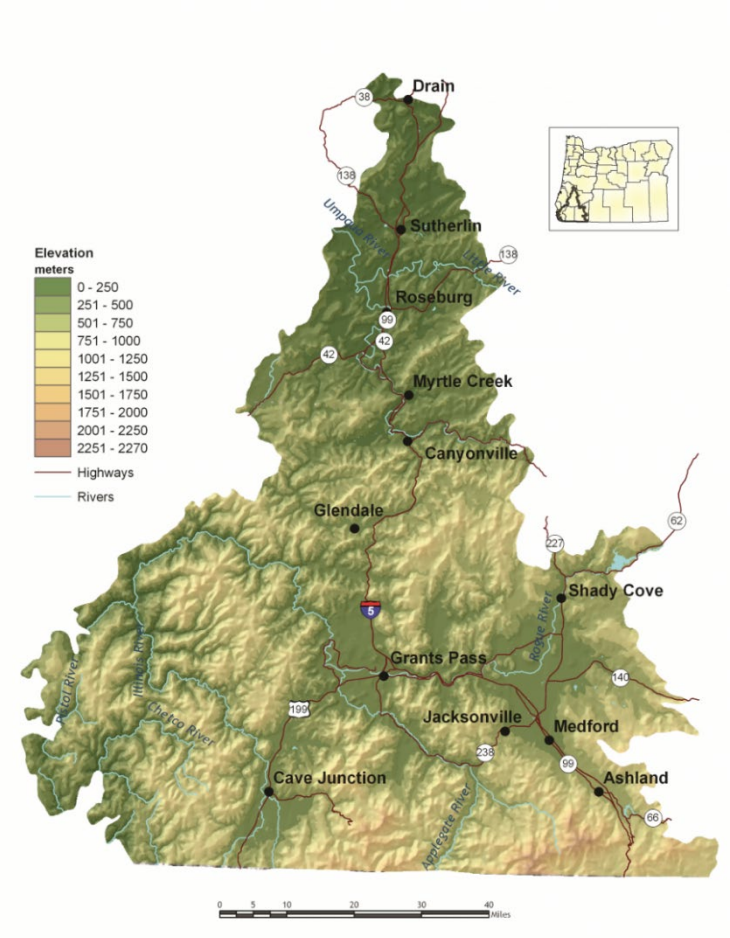
Because of its unique geology, geography, and extreme climatic variation, the Klamath Mountains ecoregion boasts high species diversity, including many species found only locally. In fact, the Klamath-Siskiyou region was included in the World Wildlife Fund's assessment of the 200 most important locations for species diversity worldwide. The region is particularly rich in plant species, including many pockets of endemic communities and some of the most diverse plant communities in the world. For example, there are more kinds of cone-bearing trees found in the Klamath Mountains ecoregion than anywhere else in North America. In all, of the 4,000 native plants in Oregon, more than half are found in the Klamath Mountains ecoregion. This biodiversity hotspot is species-rich for reptiles and amphibians, too, with 38 different native species calling the region home. The ecoregion also boasts many unique invertebrates, although many of these are not well studied. The complexity of topographies and microclimates have allowed the Klamath Mountains to act as a refuge from climate changes in the past, promoting species diversity,

but land use changes and rapidly warming temperatures now threaten many of the region's endemic species.

In June 2000, President Clinton established the Cascade-Siskiyou National Monument, which encompasses 86,774 acres of forest and grassland. This National Monument is the first U.S. National Monument set aside solely for the preservation of biodiversity. The United States Congress then expanded the protected area by designating the adjacent Soda Mountain Wilderness in 2009, which encompasses 24,100 acres. These protected lands are managed by the Bureau of Land Management (BLM).

While panning for gold first drew European settlers to the Klamath Mountains ecoregion, today's communities have a wide range of industries and economies, including agriculture, timber production, healthcare, manufacturing, and tourism. Many retirement communities are rapidly growing in the Ashland and Grants Pass areas.

CHARACTERISTICS



Important Industries

Forest products, service, tourism, trade, healthcare, new electronics, transportation equipment

Major Agricultural Products

Fruit (including wine grapes), vegetables, livestock, dairy farms, nursery products, timber, cannabis

Important Nature-based Recreational Areas

Cascade-Siskiyou National Monument, Oregon Caves National Monument, Rogue-Siskiyou National Forest, Applegate Lake, Emigrant Lake, Howard Prairie Lake, Lost Creek Lake, Red Buttes and Kalmiopsis Wilderness Areas, Table Rock, North Bank Habitat Management Area, Denman Wildlife Area

Elevation

600 feet to 7,500 feet (Mt. Ashland)

Important Rivers

Applegate, Rogue, Chetco, Coquille, Umpqua, South Umpqua, North Umpqua, Illinois

CONSERVATION ISSUES AND PRIORITIES

While the Klamath Mountains ecoregion is unique, it embodies many of the conservation issues facing other parts of Oregon. For example, increasing population growth and development in rural residential and urban communities strain resources, particularly in the southern and eastern portions of the ecoregion. The demand for further development is concentrated along the important transportation corridors, particularly Interstate 5, where most of the region's population lives. Development is not only a direct threat to the conservation of biodiversity at building sites but also to the long-term ecological management of this region.

Linear infrastructure, such as roadways, needed to accommodate growth, impacts fish at stream crossings and increases mortality risks for wildlife. Decades of poor practices have led to significant fish passage issues, with many culverts and other structures undersized, inundated, or poorly maintained. Population growth also affects water availability, with increased demands for agricultural, industrial, and domestic water use. Stress on water systems is particularly high in summer months when flows are reduced.

The **Northwest Forest Plan** covers many of the forests found in the western part of the ecoregion. Overall, these habitats are challenged by decades of fire suppression, a need to reduce excessive fuel loads that have accumulated in the dry interior, and by checkerboard ownership patterns that can make resource planning particularly challenging. Grasslands in the Klamath Mountains ecoregion are home to many endemic and at-risk plant communities but are also impacted by invasive grasses and by conversion to development. Despite ongoing threats, habitat protection efforts, as well as local collaborative conservation via watershed councils and other groups, have been successful at improving water quality and riparian conditions in the ecoregion.

Key Conservation Issues of particular concern in the Klamath Mountains ecoregion include **Land Use Changes**, **Disruption of Disturbance Regimes,** and **Invasive Species**. In addition to the statewide issues, loss of habitat connectivity and water availability are of concern in this ecoregion. Many unique plant and soil features are found in this ecoregion, including granitic sediments in many streambeds. These features are highly sensitive to local disturbances.

CLIMATE

The Klamath Mountain region includes mountainous terrain and steep slopes, foothills, terraces, and floodplains. The climate is mild and Mediterranean with warm summers that typically have a long dry period and mild winters. Mean annual precipitation varies greatly between the low dry areas to the wetter high mountains. Mean annual temperature and number of frost-free days vary considerably with elevation.

Warming is projected in all seasons across the Klamath Mountains ecoregion, with the largest increases projected in the summer. Summers are projected to be warmer and drier, which is expected to lead to longer drought periods. Summer average temperature is projected to increase by as much as 6°F for the 2040-2069 period, and as much as 10°F for the 2070-2099 period under a high emissions scenario (SSP585; Figure 1). Late summer total precipitation is projected to decrease as much as 15%, and cool season precipitation projections show an increase of 7% (2070-2099) period. Precipitation projections, however, show low confidence in their results due to high model variability (Figure 2). Growing degree days are projected to double for the 2070-2099 period under a high emissions scenario (SSP585). Frost days are projected to decrease from 138 per year on average until there are between 30-80 per year, on average, for the 2070-2099 period under a high (SSP585) scenario.

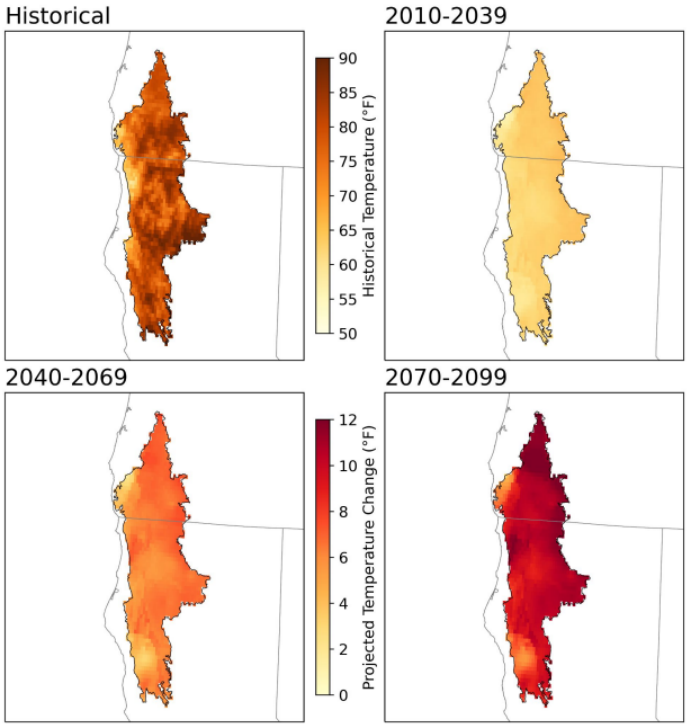


Figure 5 Model median historical (1950-2010) and future projections of summer maximum temperature change for three periods (2010-2039, 2040-2069, 2070-2099) under a high emission scenario (SSP585) for the Klamath Mountains. Future projections show increasing temperatures through the century, with slightly less warming in areas of the ecoregion that are closer to the coast (Raymond and Fusco, 2024).

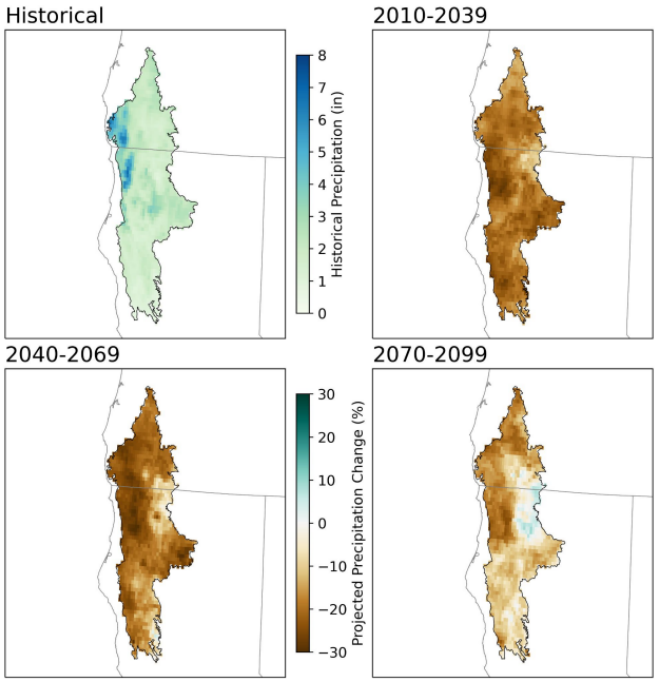


Figure 6 Model median historical (1950-2010) total late summer precipitation and projected percent change for three future periods (2010-2039, 2040-2069, 2070-2099) under a high emission scenario (SSP585) for the Klamath Mountains. Future projections show decreasing late summer precipitation across the western Klamath Mountains ecoregion through the century and a slight increase for the eastern Klamath Mountains in the 2070-2099 time period (Raymond and Fusco, 2024).

LIMITING FACTORS AND RECOMMENDED APPROACHES

Limiting Factor: *Land Use Conversion and Urbanization*

CMP Direct Threats 1, 2.1, 2.3, 7.2

Many communities in the Klamath Mountains ecoregion are expanding, particularly Central Point and Roseburg. Rapid urbanization can strain the ability of sensitive habitats, such as valleys, wetlands, and aquatic habitats, to continue to provide valued ecological functions and services. Development escalates the potential for conflict between people and wildlife. For example, more road traffic increases the likelihood of collisions with migrating species, creating hazards for both motorists and wildlife. Development in this area threatens the region's unique geomorphic features and the diversity of plant and animal life they support.

Conversion of habitat for cannabis cultivation is also increasing in the Klamath Mountains. Cannabis cultivation can have disproportionately large impacts on the area under production. Cultivators often use substantial quantities of pesticides, including

insecticides and rodenticides, to discourage wildlife from foraging on plants. In addition to killing pests, insecticides are toxic to native insect pollinators and other beneficial arthropods and decomposers. Anticoagulant rodenticides often result in poisoning or secondary poisoning of numerous non-target species. Additionally, cannabis is a water-intensive crop, and cultivation occurs during the dry season in the Klamath Mountains when water availability is already significantly decreased. Cultivation often requires stream diversions, which can alter habitat for fish and wildlife, change flow regimes, interfere with fish passage, and increase water temperatures.

Recommended Approach

Cooperative approaches with private landowners are the key to long-term conservation. Essential tools include financial incentives, conservation easements, and informational resources. Work with community leaders and local governments to ensure planned, efficient growth. Support and implement existing **land use regulations** to preserve farm and range land, open spaces, recreation areas, and natural habitats for wildlife. Support strategic land acquisition/protection, emphasizing species and habitats underrepresented in current protected sites. Ensure that local wildlife services are sufficiently maintained to help residents manage wildlife damage issues. Apply **best management practices** for cannabis cultivation to limit negative impacts to fish and wildlife and their habitats.

Limiting Factor: *Altered Fire Regimes*

CMP Direct Threats 7.1, 8.2, 11.3, 11.4

Historically, the Klamath Mountains ecoregion was dominated by fire-adapted vegetation and experienced widely variable fire regimes, ranging from areas with relatively short fire return intervals to areas with greater than 50-year return intervals. Fire suppression and certain silvicultural practices have damaged forest health, resulting in undesirable changes in vegetation and increased intensity of wildfires as a result of increased fuel loads. Wildfire risk is further exacerbated by warming climate conditions and changes to patterns of precipitation, and more frequent, higher intensity megafires are becoming more common. Elevated levels of tree mortality due to drought, disease, and insects like fir borer, engraver, and mountain pine beetles have further increased fire risk in this ecoregion.

The cumulative impacts of these forest changes have drastically increased threats to biodiversity, not only from damage due to more frequent, higher-intensity wildfires, but also as a result of the loss of the frequent, mixed-severity fires needed to maintain structural diversity and a range of different species of vegetation in some forest types. Efforts to reduce fire danger can help to restore fish and wildlife habitat, but they require careful planning. Reintroducing fire can be challenging in the Klamath Mountains because

of high volatility of fuels, “checkerboard” land ownership patterns, and scattered rural residential developments.

Recommended Approach

Use an integrated approach to fuels management and forest health issues that considers historical conditions, wildlife conservation, natural fire intervals, and silvicultural techniques. Encourage forest management at a broad scale to address limiting factors. Reintroduce fire where feasible. Prioritize sites and applications. Increase resources to help private landowners implement hazard reduction techniques. Maintain important wildlife habitat features, such as snags and logs, to sustain wood-dependent species. In areas where prescribed fire is undesirable or difficult to implement, use mechanical treatment methods (e.g., chipping, cutting for firewood) that minimize soil disturbance. Monitor efforts and use adaptive management techniques to ensure these practices are meeting habitat restoration and wildfire prevention objectives with minimal impacts on wildlife. Identify sub-basins with unique granitic sediment features that are especially at risk.

Limiting Factor: *Water*

CMP Direct Threats 7.2, 11.4

Water quantity is a limiting factor for fish and wildlife. In streams, seasonal low flows can limit habitat suitability and reproductive success for many fish and wildlife species. The Klamath Mountains ecoregion is highly susceptible to drought, with hot, dry summer climates. Changing climate regimes, such as predicted increased average summer temperatures and changes to patterns in precipitation, add to the likelihood and severity of drought conditions. Human activities, in the form of stream channelization, diversion systems, and irrigation operations, can also impact water availability, in addition to impacting in-stream and riparian habitat for fish and wildlife.

Water quality can also limit species and habitats. Runoff from agricultural areas can contaminate waterways. Warming temperatures, combined with higher nutrient levels due to agricultural runoff, are increasing the prevalence of toxic cyanobacterial blooms. Contaminants left from mining activities are also a concern for water quality. Seepage and leaching of contaminated sediments and groundwater can lead to the introduction of acidic mine drainage and other toxicants into waterways.

Recommended Approach

Provide incentives and information about water usage and sharing during low flow conditions (e.g., late summer). Promote water management actions that enable climate resilience and adaptation. Invest in watershed-scale projects for cold water and flow

protection. Identify and protect cold water rearing and refugia habitat for aquatic species. Increase awareness and manage timing of applications of potential aquatic contaminants. Improve compliance with water quality standards and pesticide use labels administered by the **DEQ** and **EPA**. Work on implementing **Senate Bill 1010** (Oregon Department of Agriculture) and **DEQ Total Maximum Daily Load** water quality plans. Follow guidelines outlined in regional species management plans, including the **Rogue-South Coast Multi-Species Conservation and Management Plan**.

Limiting Factor: *Habitat Fragmentation*

CMP Direct Threats 1, 2.1, 2.3, 3.3, 8.1

The Klamath Mountains ecoregion is naturally diverse and heterogeneous. Some habitat types have been particularly disrupted by fragmentation and **loss of connectivity**, including late-successional forests and valley bottom habitats. However, existing development, growth pressures, high land costs, disconnected land ownerships, and the fragmented nature of remaining native habitats all present barriers to large-scale ecosystem restoration.

Roadways are also a significant contributor to habitat fragmentation in this ecoregion. Interstate 5 bisects the ecoregion, running north to south. The number of lanes, traffic speeds, and volume of freight and motorist traffic make the interstate a near complete barrier to species movement, preventing species dispersal, range expansion, or migration. Undersized, inundated, and/or poorly maintained culverts and bridges also limit or prevent passage of fish and other aquatic species. Other roadways also impede wildlife connectivity and can block fish passage, particularly near urban areas. Densities of vehicle collisions with ungulates around the cities of Roseburg, Grants Pass, and Medford are some of the highest in the state.

Recommended Approach

Broad-scale conservation strategies will need to focus on restoring and maintaining more natural ecosystem processes and functions within a landscape that is managed primarily for other values. This may include an emphasis on conservation-oriented management techniques for existing land uses and restoration of some key ecosystem components, such as **river-floodplain connections** and **riparian** function.

Work with community leaders and agency partners to **protect wildlife movement corridors** and to fund and implement site-appropriate habitat enhancement and restoration efforts to facilitate wildlife movement. Promote the protection, restoration, and maintenance of **Priority Wildlife Connectivity Areas,** following the guidelines outlined in **Oregon's Wildlife Corridor Action Plan**. Work with the Oregon Department of Transportation and county and city transportation departments to improve wildlife

passage across roadways. Follow **fish passage guidelines** to prioritize and implement strategic removal of barriers to fish passage.

Limiting Factor: *Invasive Species*

CMP Direct Threats 8.1, 8.2

Invasive plants are of particular concern in the Klamath Mountains ecoregion. Invasive plants disrupt native communities, diminish populations of at-risk native species, and threaten the economic productivity of resource lands. Scotch broom, cheatgrass, medusahead, and Himalayan blackberry are all prevalent and continue to spread. Non-native fish and wildlife species are also causing detrimental impacts. Feral horse populations have increased within the Cascade-Siskiyou National Monument, expanding beyond the Pokegama Herd Management Area. Unregulated horse herds have significant negative impacts, competing with native wildlife for vegetation and access to water, increasing soil erosion, and trampling sensitive habitats. American bullfrogs are rapidly expanding, competing with native species for limited resources or preying on native species and/or their eggs or young. Other problematic species include red-eared sliders, carp, signal crayfish, and mosquitofish.

Recommended Approach

Emphasize prevention, risk assessment, early detection, and quick control to prevent new **invasive species** from becoming fully established. Use multiple site-appropriate tools (e.g., mechanical, chemical, and biological) to control the most damaging invasive species. Prioritize efforts to focus on key invasive species in high priority areas, particularly where **Key Habitats** and **Species of Greatest Conservation Need** occur. Cooperate with partners through habitat programs and county weed boards to address invasive species problems. Promote the use of native species for restoration and revegetation.

Limiting Factor: *Energy Development*

CMP Direct Threat 3.3

Climate change and global economies are increasing pressure for renewable energy development. Hydroelectric facilities currently cause the greatest impacts to fish and wildlife in the Klamath Mountains ecoregion. Hydroelectric energy production alters stream flow rates and timing in ways that are often at odds with fish and wildlife life cycles, breeding requirements, and other resource needs. Some facilities in the ecoregion have inadequate fish passage structures due to regulatory changes over the course of their permitted timeline. Wind and solar energy production are also increasing, with particular demand for new solar developments.

Recommended Approach

Plan energy projects carefully, using best available information and early consultation with biologists. See the Key Conservation Issue on **Land Use Changes**. Remove dams that are aging, inefficient, or obsolete, and use techniques like fish ladders, management strategies to reduce reservoir sedimentation, and seasonally appropriate flow release to help mitigate the negative environmental impacts of dams. Consider the broader landscape context when planning new facilities, including habitat connectivity, cumulative impacts, fish and wildlife species presence, and mapped or modeled suitable habitat. Use wildlife-permeable fencing or allow egress to permit passage for medium-sized animals through solar fields.

Limiting Factor: *Recreational Activity*

CMP Direct Threats 1.3, 4.1, 5.1, 5.2, 5.4, 6.1

Increasing demands for year-round recreational activity can disturb wildlife. Activities like hiking, biking, hunting, fishing, jet boating, mushroom foraging, and off-road vehicle use can create sensory stressors for wildlife, with sound, light, and unusual smells that may deter species from moving through certain areas. Human recreation may contribute to destruction of sensitive vegetation, harassment of wildlife from off-leash pets, spread of invasive species, and contamination of areas with refuse. Many species will avoid areas near trails, waterways, campgrounds, and access roads when humans are present.

In the Klamath Mountains, extensive off-road vehicle use, both legal and illegal, increase stress for wildlife, and contributes to habitat fragmentation, disease transmission, and spread of invasive vegetation. Particular areas of concern for off-road vehicle impacts include the Applegate Valley, Shady Cove, and Illinois Valley.

Activities on waterways can also have detrimental impacts to fish and wildlife. Paddleboarding, increasing in popularity throughout the region, can affect birds and aquatic wildlife, with increased access to non-motorized waterways. Paddleboard use can also increase the risk of disease transmission without proper cleaning. Jet boat use is also popular in this ecoregion, with a number of commercial jet boat tours provided on the Rogue River. The timing, frequency, and extent of jet boat use in river habitats may create conflicts for anadromous and other fish, as well as wildlife.

Recommended Approach

Plan new recreational trail systems carefully and with consideration for native wildlife and their habitats. For example, limit timing and use of certain areas to minimize disturbance to wildlife, avoiding areas more sensitive to damage such as wetlands. Take advantage of

abandoned or closed roads, rail lines, or previously impacted areas for conversion into trails. Work with land management agencies such as the USFS to designate areas as high value recreation and low habitat impact areas. Institute road and/or area closures to protect species during sensitive times of year and decommission roads when possible. Enforce laws surrounding illegal off-road vehicle use and consider seasonal closures during sensitive times of the year. Consider limiting access of both motorized and non-motorized watercraft to sensitive stream reaches. In high use recreational areas, establish permitted entry systems to decrease recreational pressure.

REFERENCES

Raymond, C. L. and E. J. Fusco (Eds.). 2024. The State of Climate Adaptation Science for Ecosystems in the Northwest U.S. Prepared by the Climate Impacts Group for the Northwest Climate Adaptation Science Center.
https://depts.washington.edu/nwclimateadaptation/socs/

ECOREGIONS

Northern Basin and Range

NORTHERN BASIN AND RANGE

DESCRIPTION

The Northern Basin and Range ecoregion covers the southeastern portion of the state, from Burns south to the Nevada border and from Fort Rock Valley east to Idaho. The name of this ecoregion describes the landscape, with numerous flat basins separated by isolated mountain ranges. This ecoregion encompasses several fault-block mountains, with gradual slopes on one side and steep basalt **rims and cliffs** on the other side. The Owyhee Uplands consist of a broad plateau cut by deep river canyons. Elevations range from 2,070 feet near the Snake River to more than 9,700 feet on the Steens Mountain.

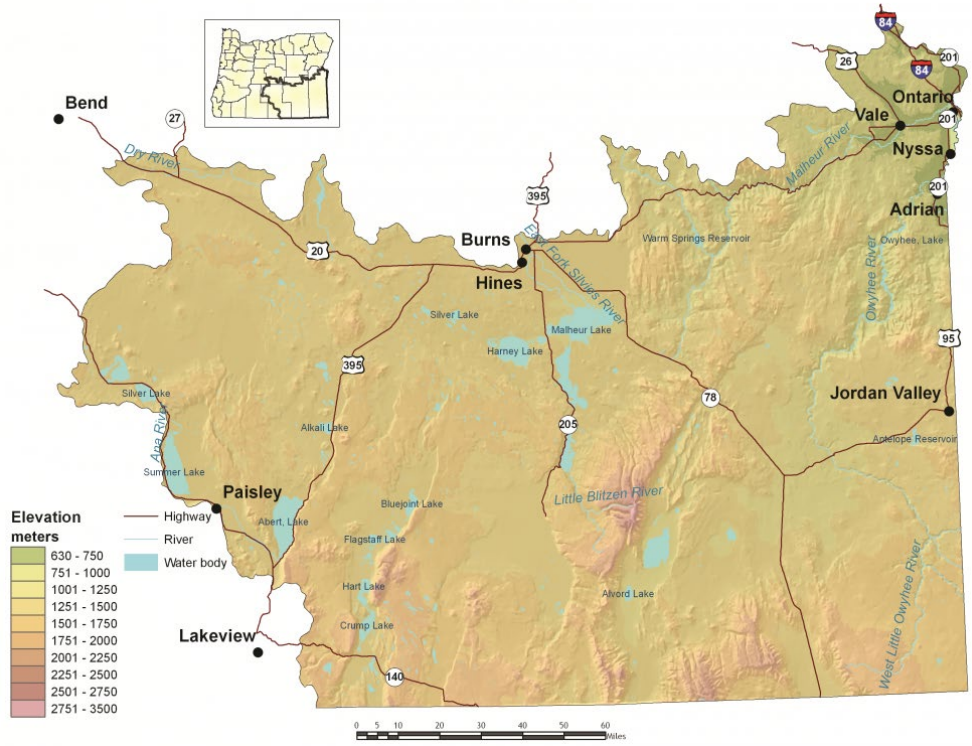
In the rain shadow of the Cascade Mountains, the Northern Basin and Range is Oregon's driest ecoregion, marked by extreme ranges of daily and seasonal temperatures. Much of the ecoregion receives less than 15 inches of precipitation per year, although mountain peaks may receive 30-40 inches per year. The extreme southeastern corner of the state has desert-like conditions, with annual precipitation of only 8-12 inches. Despite regional aridity, natural springs and spring-fed wetlands are scattered around the landscape. Runoff from precipitation and mountain snowpack often flows into low, flat playas where it forms seasonal shallow lakes and marshes. Most of these basins contained large, deep lakes during the late Pleistocene, between 40,000 and 10,000 years ago. As these lakes, which don't drain to the ocean, dried through evaporation, they left salt and mineral deposits that formed **alkali flats**, extremely important stopover sites for migratory shorebirds as a rich source of invertebrate prey.

Sagebrush communities dominate the landscape. Due to the limited availability of water, sagebrush is usually widely spaced and associated with an understory of forbs and perennial bunchgrasses, such as bluebunch wheatgrass and Idaho fescue. The isolated mountain ranges have few forests or woodlands, with rare white fir stands in Steens Mountain and Hart Mountain. However, aspen and **mountain mahogany** are more widespread and can be found in the Trout Creeks, Steens Mountain, Pueblo Mountains, Oregon Canyon Mountain, and Mahogany Mountains, and juniper woodlands comprise a significant portion of the northern end of the ecoregion. In the southern portion of the ecoregion, there are vast areas of desert shrubland, called salt-desert scrub, dominated by spiny, salt-tolerant shrubs. Throughout the ecoregion, soils are typically rocky and thin, low in organic matter, and high in minerals.

The Northern Basin and Range ecoregion is sparsely inhabited, but the local communities have vibrant cultural traditions. The largest community is Ontario, with more than 11,000 people. Other communities include Nyssa, Vale, Burns, and Lakeview, with 1,930 to 3,250 people each. Land ownership is mostly federal and primarily administered by the BLM. Livestock and agriculture are the foundations of the regional economy. Food processing is

important in Malheur County. Recreation is a seasonal component of local economies, particularly in Harney County. Hunting contributes to local economies, as does wildlife viewing, white-water rafting, and camping. Historically, lumber processing and harvesting from the nearby Blue Mountains was the basis of some local communities, particularly for Burns. However, these industries have declined with lower harvests from neighboring federal forests.

CHARACTERISTICS



Important Industries

Livestock, forest products, agriculture, food processing, recreation

Major Agricultural Products

Alfalfa, wheat, hay, corn, oats, onions, sugar beets, potatoes

Important Nature-based Recreational Areas

Summer Lake Wildlife Area, Malheur Lake National Wildlife Refuge, Hart Mountain National Antelope Refuge, Steens Cooperative Management and Protection Area

Elevation

2,070 feet (Snake River) to 9,733 feet (Steens Mountain)

Important Rivers

Chewaucan, Donner und Blitzen, Malheur, Owyhee, Silvies

CONSERVATION ISSUES AND PRIORITIES

Uncontrolled livestock grazing in the decades before the enactment of the Taylor Grazing Act of 1934 caused serious long-term ecological damage throughout the ecoregion. Rangeland conditions have substantially improved since then in most areas, and grazing is now managed more sustainably in many parts of the ecoregion. However, some areas are still impacted by poor grazing practices. In addition, sensitive areas, such as riparian habitats and arid areas of **sagebrush** and **salt desert**, have been slow to recover.

Some areas are still recovering from intensive management in the past, damaged by misguided efforts to rehabilitate overgrazed, degraded rangelands and improve livestock grazing by planting crested wheatgrass, a non-native pasture grass. For example, in 1962 the BLM began a massive effort, the Vale Rehabilitation Project, to remove native sagebrush and establish crested wheatgrass. Over the course of 10 years, the Vale Rehabilitation Project seeded 250,000 acres to crested wheatgrass and used plowing, chaining, and herbicides, reducing sagebrush on as much as 506,000 acres. Modern day restoration efforts focus on returning these areas to healthy, native sagebrush habitat.

Invasive species and altered fire regimes are the greatest terrestrial conservation issues in this ecoregion. Overgrazing and fire suppression, followed by invasion of non-native annual grasses such as cheatgrass, have greatly altered natural fire cycles in many sagebrush steppe habitats. Landscapes formerly comprised of mosaics dominated by bunchgrasses and forbs are now heavily and disproportionately dominated by shrubs (mostly sagebrush) and exotic grasses and forbs. As a result of altered fire regimes, encroachment of juniper has displaced grasses and sagebrush, especially in the northern portions of the ecoregion. However, old-growth juniper naturally occurs in some areas, especially in rock outcrops where grasses and sagebrush are uncommon and where fire is less of a factor. These **old-growth juniper** are extremely beneficial to wildlife.

Greater Sage-Grouse are considered excellent indicators of sagebrush habitat quality. Current efforts to improve conditions for the Greater Sage-Grouse include comprehensive range-wide assessments and conservation planning.

Throughout the Northern Basin and Range ecoregion, water quality is impacted by high temperatures, and in some areas, by bacteria, pollutants, and aquatic weeds. Water is

limited in the ecoregion, fully allocated in storage and other uses. Aquatic habitats are affected by altered channel and flow conditions, obstructions, and poor riparian condition. Efforts to assess the quality of aquatic habitats are ongoing, and priorities include assessment of the impact of federal dams on water quantity and obtaining an understanding of natural temperature and water quality dynamics in the ecoregion. Under **climate change**, drought conditions may become more frequent, resulting in reduced water availability for wetlands in important wildlife areas like Summer Lake, Lake Abert, and Malheur Lake.

Key Conservation Issues in the Northern Basin and Range ecoregion include **Invasive Species**, **Water Quality and Quantity**, and **Disruption of Disturbance Regimes**. In addition to the statewide issues, increasing demand for energy development, ongoing recovery from historical overgrazing, unregulated horse herds, uncontrolled use of off-highway vehicles, and increasing recreational demand are issues in this ecoregion.

CLIMATE

The Northern Basin and Range terrain consists of tablelands, basins, plains, some mountains, and valleys. The climate is arid with both steppe and desert climates, hot summers, and cold winters. Mean annual precipitation varies from minimal in the low areas to considerable in the higher mountainous areas. Increasing temperatures will lead to hotter summers, warmer winters, and more precipitation falling as rain in the winter in the higher elevation areas.

Warming is projected in all seasons across the ecoregion, with the largest increases projected in summer. Summer average temperature is projected to increase by as much as 8°F for the 2040-2069 period and as much as 12°F for the 2070-2099 period under the high emissions scenario (SSP585; Figure 1). Increasing temperatures will lead to hotter summers, warmer winters, and more precipitation falling as rain in the winter in the higher elevation areas. Late summer total precipitation is projected to change depending on time-period and scenario. Cool season precipitation projections show an increase in precipitation of as much as 19% for the 2070-2099 period (Figure 2). Confidence is low, however, in the late summer projections. Growing degree days are projected to double by the 2070-2099 period for the Northern Basin and Range under a high emissions scenario (SSP585). Frost days are projected to decrease from 200 until there are fewer than 150 per year, on average, under the high emissions scenario (SSP585).

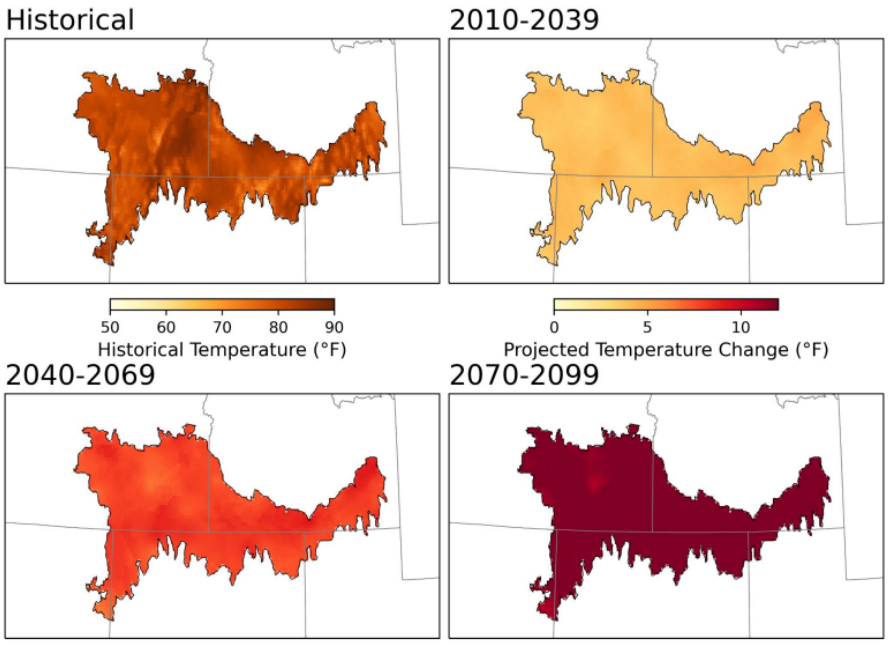


Figure 7. Model median historical (1950-2010) and future projections of summer maximum temperature change for three periods (2010-2039, 2040-2069, 2070-2099) under a high emission scenario (SSP585) for the Northern Basin and Range. Future projections show increasing temperatures through the century for the entire Northern Basin and Range ecoregion (Raymond and Fusco, 2024).

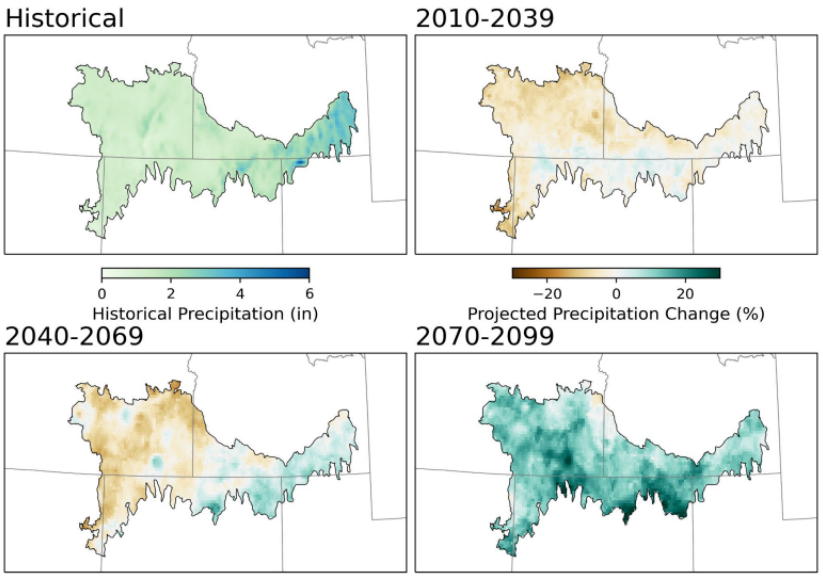


Figure 8. Model median historical (1950-2010) total late summer precipitation and projected percent change for three future periods (2010-2039, 2040-2069, 2070-2099) under a high emission scenario (SSP585) for the Northern Basin and Range. Future projections show varied changes in late summer precipitation across the Northern Basin and Range ecoregion through the next

century. For the 2070-2099 period, projections show an increase in precipitation for the southern are of the Northern Basin and Range ecoregion (Raymond and Fusco, 2024).

LIMITING FACTORS AND RECOMMENDED APPROACHES

Limiting Factor: *Altered Fire Regimes*

CMP Direct Threats 7.1, 8.1, 8.2, 11.3, 11.4

Most **sagebrush-dominated** areas were once a mosaic of successional stages, from recently burned areas dominated by grasses and forbs to old, sagebrush-dominated stands that had not burned for 80 to 300 years. However, fire suppression and intensive grazing practices have reduced this mosaic and resulted in large areas dominated by invasive annual grasses, particularly cheatgrass, or older big sagebrush with a dense understory of invasive annual plants.

Changing climate conditions, including warming temperatures and more frequent and severe droughts, are contributing to increased frequency of fires, resulting in landscapes that are susceptible to the spread of western juniper and cheatgrass. Areas dominated by cheatgrass or other invasive annual grasses are more susceptible to fire ignition and reburning. Juniper invasion and encroachment of other woody vegetation provides fuel for wildfires, leading to higher intensity burns. Large fire events often destroy sagebrush, which are very slow to recover, leaving behind habitat that is no longer suitable for sagebrush-obligate species such as Greater Sage-grouse and pygmy rabbit. Big sagebrush communities with non-native invasive annuals in the understory will not recover from fire without significant intervention.

Recommended Approach

Under current vegetation management conditions, fire is damaging to sagebrush stands. Reintroduction of natural fire regimes may be difficult, and risks loss of sagebrush habitat. In many areas prescribed fire may be impractical. Use mechanical treatment methods that minimize soil disturbance to help remove encroaching juniper and annual invasive grasses that contribute to more frequent, higher-intensity fires. Chemical or biological management techniques can also be explored. In sagebrush habitats that are moderately impacted by invasive annual grasses, use of herbicides may help preserve sagebrush and increase fire resiliency. Engage in research on the efficacy and impacts of new herbicides to control nonnative vegetation.

Where appropriate, reintroduce natural fire regimes using site-appropriate prescriptions that limit risk of sagebrush loss, account for the historical fire regime, and encourage native plant regeneration. Use prescribed fire to create a patchy mosaic of successional stages and avoid large, prescribed fires.

Limiting Factor: *Water*

CMP Direct Threats 7.2, 11.4

Water quantity is a limiting factor for fish and wildlife. Changing climate conditions are leading to rising temperatures and altered patterns of precipitation, which affect water availability across different times of year. In streams, seasonal low flows can limit habitat suitability and reproductive success for many fish and wildlife species. Although many communities in this ecoregion are small, increases in the demand for water for crop irrigation and livestock production, coupled with increasing drought conditions, mean the supply of groundwater is decreasing. Already an arid ecoregion, increases in drought conditions have also resulted in the loss of some marshes and alkali lakes—areas that are critical for wildlife, particularly migrating birds. Water quality can also limit species and habitats. Warming waters provide conditions for increased bacterial growth which can impact fish and wildlife, as well as drinking water supplies.

Recommended Approach

Provide incentives and information about water usage and sharing during low flow conditions (e.g., late summer). Promote water management actions that enable climate resilience and adaptation. Invest in watershed-scale projects for cold water and flow protection. Increase awareness and manage timing of applications of potential aquatic contaminants. Improve compliance with water quality standards and pesticide use labels administered by the **DEQ** and **EPA**. Work on implementing **Senate Bill 1010** (Oregon Department of Agriculture) and **DEQ Total Maximum Daily Load** water quality plans.

Limiting Factor: *Invasive Species*

CMP Direct Threat 8.1, 8.2

Non-native annual grasses, particularly cheatgrass and medusahead, have rapidly expanded in the Northern Basin and Range, displacing desirable forage for wildlife and livestock. These invasive plants disrupt native communities, diminish populations of at-risk native species, and threaten the economic productivity of resource lands. The spread of invasives like cheatgrass and medusahead can also increase the frequency, intensity, and spread of fires, replacing sagebrush and native bunchgrasses, which are adapted to infrequent, patchy fires.

While not nearly as extensive as invasive plants, non-native animals have also impacted native fish and wildlife populations. For example, invasive carp in **Malheur Lake** have damaged one of the most important waterfowl production areas in Oregon, altering ecological dynamics through predation and altering water quality by disturbing sediments.

Brown bullhead have also spread throughout the ecoregion, competing with native species for limited resources or preying on native species and/or their eggs or young. Unregulated horse herds are a concern in many areas, competing with native wildlife for vegetation and access to limited water sources, spreading invasive plant seeds via their manure, and trampling sensitive habitats.

Changing climate conditions and fire suppression have also led to the expansion of western juniper throughout the ecoregion. Western juniper is a native species, and **old growth juniper trees** in rocky outcrops offer benefits to native wildlife. However, the expansion of western juniper in the Northern Basin and Range has degraded some grassland, sagebrush, riparian, large-diameter juniper, and aspen habitats. Western juniper expansion may reduce water availability in many seasonal and some perennial streams. In riparian areas, junipers replace deciduous shrubs and trees that are more beneficial to riparian wildlife. In many of the grassland and sagebrush habitats, 20–30-year-old juniper trees form dense stands that are not suitable for many wildlife species that require the open sagebrush or grassland habitats that are now in decline. These dense stands also act as fuel for wildfire, contributing to large, high-intensity fires that destroy sagebrush habitat.

Recommended Approach

Controlling western juniper in newly invaded areas benefits wildlife and other habitat values. Early control of newly invaded young trees before woodlands become established is often the most successful approach. Develop markets for small juniper trees as a special forest product to reduce restoration costs. Maintain large-diameter juniper trees in the native rocky outcrops and ridges, which are important nesting habitat for passerines and raptors. In some areas, fire can be used to control young juniper. Carefully evaluate sites to determine if **prescribed fire** is appropriate, considering the landscape context, vegetation types, and risk of sagebrush loss.

Emphasize prevention, risk assessment, early detection, and quick control to prevent new **invasive species** from becoming fully established. Use multiple site-appropriate tools (e.g., mechanical, chemical, and biological) to control the most damaging invasive species. Prioritize efforts to focus on key invasive species in high priority areas, particularly where **Key Habitats** and **Species of Greatest Conservation Need** occur. Cooperate with partners through habitat programs and county weed boards to address invasive species problems. Carefully manage wildfires in cheatgrass-dominated areas. Promote the use of native “local” stock for restoration and revegetation where native species have the greatest potential to successfully establish. In some cases, use “assisted succession” strategies, applying low seed rates of non-invasive non-native plants in conjunction with native plant seeds as an intermediate step in rehabilitating disturbances in sagebrush communities.

Promote dialogue between wildlife managers, landowners, and land managers to develop horse management plans based on common priorities. Promote outreach to explain the issue to the public and the impacts of unregulated herds on wildlife and habitat.

Limiting Factor: *Energy Development*

CMP Direct Threat 3.3

Climate change and global economies are increasing pressure for renewable energy development, including solar energy. Solar energy projects offer environmental benefits but also have significant impacts on wildlife and their habitat. Many solar energy facilities have large footprints. Federal requirements for facilities to be fully fenced make any remaining habitat within a solar field inaccessible to most terrestrial wildlife species, which results in lost habitat and may disrupt critical movement and migration pathways. Solar facilities are also a collision risk for birds, as reflection of sunlight off the panels may cause solar fields to resemble large water bodies. The area is increasingly challenged with the need to balance the state's interest in clean energy development with local natural resource conservation needs. The Northern Basin and Range ecoregion offers excellent renewable energy resources, but the ecoregion is particularly sensitive to local **impacts on sagebrush** and other habitats.

Recommended Approach

Plan energy projects carefully, using the best available information and early consultation with biologists. Use available tools and resources found in the **Land Use Changes** and **Climate Change** KCIs and ODFW **Compass**. Consider the broader landscape context when planning new development, including habitat connectivity, cumulative impacts, fish and wildlife species presence, and mapped or modeled suitable habitat. Use wildlife-permeable fencing or allow egress to permit passage for medium-sized animals through solar fields.

Limiting Factor: *Recreational Activity*

CMP Direct Threats 1.3, 4.1, 6.1

Increasing demands for recreational access can disturb animals and degrade habitats. Activities like hiking, biking, hunting, fishing, and foraging, and off-road vehicle use can create sensory stressors for wildlife, with sound, light, and unusual smells that may deter species from moving through certain areas. Human recreation may contribute to destruction of sensitive vegetation, harassment of wildlife from off-leash pets, spread of invasive species, and contamination of areas with refuse. Use of off-highway vehicles (OHVs) is particularly prevalent in the Northern Basin and Range. When limited and controlled, OHV use can be compatible with wildlife conservation. Illegal use, however, is

prevalent, and highly detrimental. In general, OHV use can damage soils, impact sensitive riparian, aquatic, and upland habitats, spread invasive plant seeds, affect wildlife behavior and distribution, and increase the risk of wildfires. Although OHV use is limited to designated roads in some sensitive landscapes, there is little to no enforcement due to lack of funds and law enforcement personnel.

In addition to OHV use, other recreational use, such as camping, soaking in hot springs, rock climbing, and parasailing, is increasing. Use at some sites, such as the Alvord Desert, is high, and often damaging to sensitive desert playa habitat. Although recreational use is still light in comparison to more populated ecoregions, social media is driving increased use of several areas in the ecoregion. This increased recreational pressure could intensify impacts to wildlife and magnify disturbance in areas previously little-used by people.

Recommended Approach

Work cooperatively with land managers and OHV groups to direct use to maintained trails in low-impact areas and improve enforcement of existing rules. Support educational efforts to promote low-impact recreational use such as the **Tread Lightly! Program**. Monitor the impacts of OHV use on priority areas. Support efforts to effectively manage OHV use on public lands, particularly in highly sensitive habitats, and restore damaged areas.

Proactively consider potential impacts to wildlife and habitats when developing or promoting recreational opportunities to encourage compatible uses. Monitor recreational patterns and trends. Institute road and/or area closures to protect species during sensitive times of year and decommission roads when possible. In high use areas, establish permitted entry systems to decrease recreational pressure.

Limiting Factor: *Ongoing Recovery from Historical Overgrazing*

CMP Direct Threats 2.3, 7.3, 8.1

Prior to limitations that were initiated on public lands in the mid-1930s, livestock grazing had a profound influence on landscapes throughout the Northern Basin and Range ecoregion. Many areas experienced serious ecological damage. Conditions on rangelands in general have improved substantially over the past half-century as a result of improvements in livestock management, and most ecosystems are recovering. However, some habitats have been slow to recover, such as some **riparian** areas and **sagebrush** communities, especially where cheatgrass and other invasive annual grasses have invaded.

Recommended Approach

Continue to proactively manage livestock grazing and restore degraded habitats. Minimize grazing during restoration of highly sensitive areas, such as wetlands and riparian areas.

REFERENCES

Raymond, C. L. and E. J. Fusco (Eds.). 2024. The State of Climate Adaptation Science for Ecosystems in the Northwest U.S. Prepared by the Climate Impacts Group for the Northwest Climate Adaptation Science Center. https://depts.washington.edu/nwclimateadaptation/socs/

ECOREGIONS

West Cascades

WEST CASCADES

DESCRIPTION

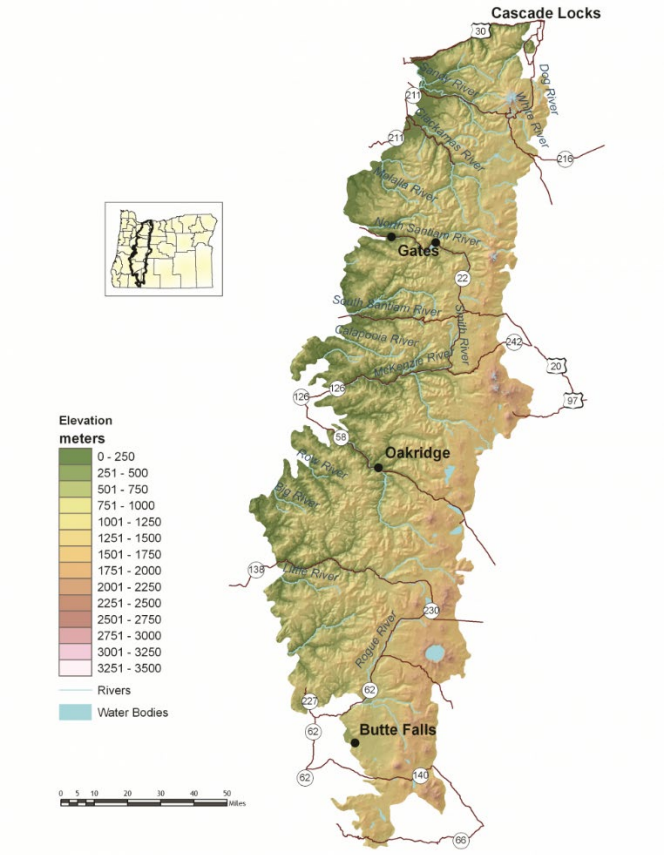
The West Cascades ecoregion extends from just east of the Cascade Mountains' summit to the foothills of the Willamette, Umpqua, and Rogue Valleys, and spans nearly the entire length of the state of Oregon, from the **Columbia River** to within five miles of the California border. The topography and soils of the West Cascades ecoregion have been shaped dramatically by its volcanic past. The West Cascades ecoregion has two geologically distinct areas: the younger volcanic crest (approximately 8 million years old) and the "old Cascades" to the west of the crest (at least 30 million years old). The volcanic crest includes the highest peaks in Oregon: Mt. Hood, Mt. Jefferson, and North, Middle, and South Sisters, all more than 10,000 feet. The "old Cascades" are characterized by long, steep ridges and wide, glaciated valleys.

This ecoregion is almost entirely forested by conifers, although the dominant tree species vary by elevation, site characteristics, and stand history. Douglas-fir is the most common tree below 4,000 feet, often with western hemlock as a co-dominant species. At higher elevations, dominant tree species include Pacific silver fir, mountain hemlock, or subalpine fir. Other common conifers include western redcedar, grand fir, and noble fir. Above approximately 7,000 feet, the conditions are too severe for tree growth, and **alpine parklands** and dwarf shrubs predominate, including some wetlands and barren expanses of rock and ice. In the southern areas, **ponderosa pine**, sugar pine, and incense cedar often are found with Douglas-fir at the lower elevations.

The climate and resulting fire regimes vary with latitude and elevation. The northern portion of the ecoregion is typified by less frequent but more severe fires, whereas the southern portion is typically drier with moderately frequent, mixed-severity, lightning-caused fires. Across the entire region, fire frequency and severity are increasing due to changing climate. At lower elevations, winter conditions are often mild with high rainfall. In contrast, above 4,000 feet, winters are typified by lower temperatures and much of the precipitation occurs as snowfall.

The West Cascades ecoregion is sparsely populated, with towns including Cascade Locks, Butte Falls, Detroit, Gates, Idanha, McKenzie Bridge, Blue River, Oakridge, Westfir, and part of Sandy and Sweet Home (the remainder of which lie in the Willamette Valley ecoregion). Local economies were once entirely dependent on timber harvest but have been greatly affected as market conditions (long-term and broad-scale changes in the forest products marketplace) and shifts in public forest management priorities have shaped Oregon's timber industry. Many towns are increasingly promoting recreational opportunities, including hiking, camping, fishing, hunting, birding, mountain biking, and skiing.

CHARACTERISTICS



Important Industries

Forest products, recreation (hiking, biking, wildlife viewing, hunting, fishing, snow sports)

Major Agricultural Products

Fruits, mint, cattle

Important Nature-based Recreational Areas

Mt. Hood, Willamette, Umpqua, and Rogue River-Siskiyou National Forests, Waldo Lake, Odell Lake, Detroit and Hills Creek Reservoirs, Crater Lake National Park, Three Sisters, Sky Lakes, and Mount Jefferson Wilderness Areas, Willamette Hatchery

Elevation

98 feet (along the western border of the ecoregion) to 11,240 feet (Cascade peaks)

Important Rivers

Clackamas (Oak Grove Fork), McKenzie, Rogue, Umpqua, Breitenbush, Middle Santiam, North and Middle Fork of the Willamette

CONSERVATION ISSUES AND PRIORITIES

As with Oregon's other forested ecoregions, habitats have been impacted by interrelated changes in ecological processes due to fire suppression, selective harvest practices, and unsustainable grazing. These changes have increased vulnerability of forests to insects, disease, and uncharacteristically severe wildfire. In addition, changing climate conditions are also putting this ecoregion at risk, with increased drought prevalence and warming temperatures affecting water availability and contributing to more frequent and severe wildfires. Recreational pressure is also a growing concern, with a variety of impacts resulting from activities like mountain biking, skiing, and off-road vehicle use and associated demands for new trails and facilities.

Key Conservation Issues of particular concern in the West Cascades ecoregion include **Disruption of Disturbance Regimes**, **Water Quality and Quantity**, **Invasive Species**, and **Barriers to Animal Movement**.

CLIMATE

The West Cascades ecoregion is characterized by steep ridges and river valleys to the west and a high plateau to the east. The region has a mild to severe mid-latitude climate with dry, warm summers and mild or cool, very wet winters. The climate varies by latitude and elevation, especially near the volcanoes within this ecoregion.

Warming is projected in all seasons across the Cascades ecoregion, with the largest increases projected for summer. Summer average temperature is projected to increase by as much as 7°F for the 2040-2069 period and as much as 11°F for the 2070-2099 period (Figure 1). Late summer precipitation is projected to decrease by as much as 19% by the 2070-2099 period, and cool season precipitation is projected to increase by 6% (Figure 2). Less precipitation will fall as snow in Cascades in the future, leading to even wetter winters and drier summers. Confidence in cool season projections, however, is low after 2010-2039. Growing degree days are projected to more than double by the 2070-2099 period for this ecoregion under a high emissions scenario (SSP585). Frost days are projected to decrease from 171 per year until there are fewer than 100 per year, on average, under the high emissions scenario (SSP585).

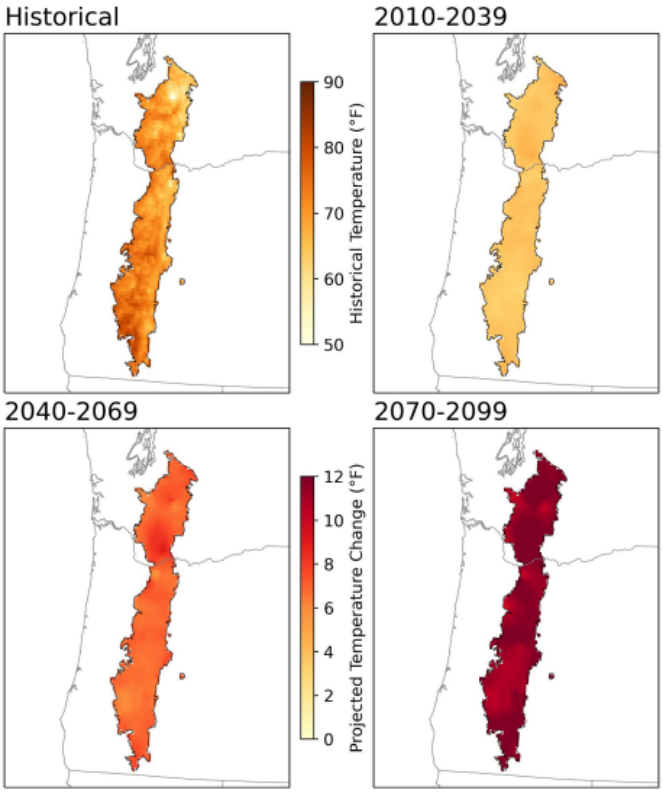


Figure 1. Model median historical (1950-2010) and future projections of summer maximum temperature change for three periods (2010-2039, 2040-2069, 2070-2099) under a high emission scenario (SSP585) for the West Cascades. Future projections show increasing temperatures, with slightly less warming in the southwest (Raymond and Fusco, 2024).

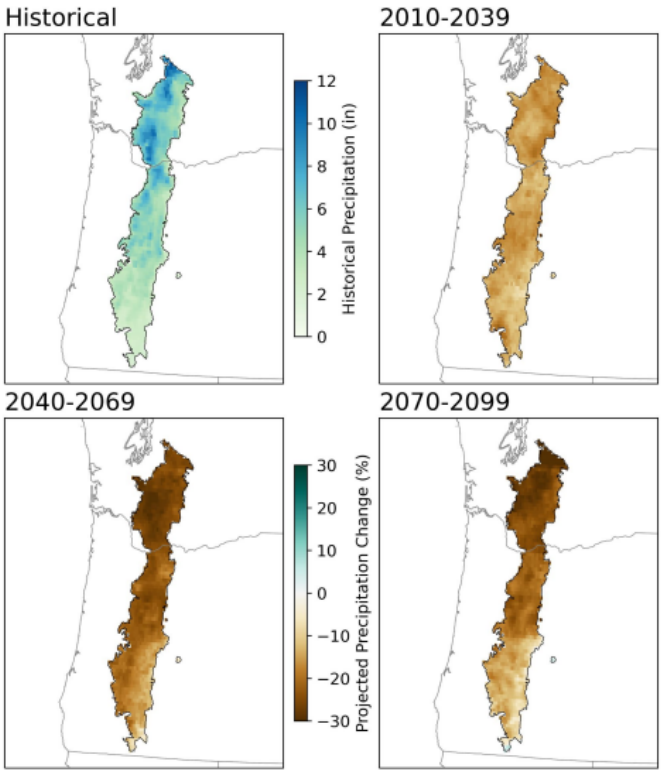


Figure 2. Model median historical (1950-2010) total late summer precipitation and projected percent change for three future periods (2010-2039, 2040-2069, 2070-2099) under a high emission scenario (SSP585) for the West Cascades. Future projections for a high (SSP585) scenario show decreasing late summer precipitation across the region with a greater decrease in the north (Raymond and Fusco, 2024).

LIMITING FACTORS AND RECOMMENDED APPROACHES

Limiting Factor: *Altered Fire Regimes*

CMP Direct Threats 7.1, 11.3, 11.4

Many forests in the West Cascades ecoregion are at risk of losing one or more ecosystem components to wildfire. Fire suppression and certain forest practices have resulted in young, dense, mixed-species stands of trees that are at increased risk of forest-destroying crown fires, disease, and damage by insects. Under changing climate conditions these risks are expected to increase, with warming temperatures and more frequent drought contributing to shorter fire return intervals and more severe fires. Efforts to reduce risks of uncharacteristically severe fires can help to restore habitat but require careful planning to provide sufficient habitat features that are important to wildlife (e.g., snags, downed logs, hiding cover).

Recommended Approach

Use an integrated approach to wildfire issues that considers historical conditions, wildlife conservation, natural fire intervals, and silvicultural techniques. Consider the broader landscape context, including habitat connectivity, cumulative impacts, fish and wildlife species presence, and mapped or modeled suitable habitat when engaging in forest management and wildfire risk mitigation activities. Reintroduce fire where feasible; prioritize sites and applications. Maintain important wildlife habitat features, such as snags and logs, to sustain wildlife species that are dependent on dead wood. Maintain early-, mid-, and late-seral habitats to support a diversity of species. Monitor these efforts and use adaptive management techniques to ensure efforts are meeting habitat restoration and wildfire prevention objectives with minimal impacts on wildlife. Work with homeowners and resort operators to reduce vulnerability of properties to wildfire while maintaining habitat quality. Highlight successful, environmentally sensitive fuel management programs. In the case of post-wildfire recovery, maintain high snag densities and replant with site-adapted native tree, shrub, grass, and forb species. Promote revegetation with native species that are expected to be climate resilient. Prevent colonization of invasive vegetation, such as scotch broom. Manage reforestation after wildfire to create species and structural diversity, based on local management goals.

Limiting Factor: *Water*

CMP Direct Threats 7.2, 114

Water quantity is a limiting factor for fish, wildlife, and livestock. Changing climate conditions are leading to rising temperatures and altered patterns of precipitation, which affect water availability across different times of year, and drought conditions are occurring more frequently. In high elevation areas, loss of snowpack due to warming climate conditions is affecting habitat for many species along the Cascade crest and is leading to reduced stream flow rates and peak flow rates that are occurring earlier in the year. In streams, seasonal low flows can limit habitat suitability, survival, and reproduction for many fish and wildlife species.

Water quality can also limit species and habitats. Runoff from agricultural areas and herbicides applied to forest lands can contaminate waterways. Warming temperatures, combined with higher nutrient levels due to agricultural runoff, are increasing the prevalence of toxic cyanobacterial blooms.

Recommended Approach

Provide incentives and information about water usage and sharing during low flow conditions (e.g., late summer). Promote water management actions that enable climate resilience and adaptation. Invest in watershed-scale projects for cold water and flow

protection. Identify and protect cold water rearing and refugia habitat for aquatic species. Increase awareness and manage timing of applications of potential aquatic contaminants. Improve compliance with water quality standards and pesticide use labels administered by the **DEQ** and **EPA**. Work on implementing **Senate Bill 1010** (Oregon Department of Agriculture) and **DEQ Total Maximum Daily Load** water quality plans.

Limiting Factor: *Habitat Fragmentation*

CMP Direct Threats 1, 2.1, 2.3, 3.3, 8.1

Increasing traffic volumes, road density, recreational pressure, and urban and rural development are contributing to habitat loss and fragmentation, and create significant **barriers to animal movements**. Hydropower systems, including high-head flood control and hydropower dams, also have significant impacts to species movement in this ecoregion. Levees, hydropower canals, and hardened stream banks reduce available habitat for fish and aquatic species and can entrap and kill wildlife. Altered hydrology from these systems, including impacts to temperatures and timing of water availability, can affect fish passage.

Recommended Approach

Work with community leaders and local governments to encourage **planned, efficient growth**. Support existing land use regulations to preserve forestland, farmland, rangeland, open spaces, recreation areas, wildlife refuges, and natural habitats. Work with community leaders and agency partners to **protect wildlife movement corridors** and to fund and implement site-appropriate habitat enhancement and restoration efforts to facilitate wildlife movement. Continue working with **Oregon Watershed Enhancement Board**, Oregon Department of Transportation, Oregon Department of Forestry, USFS, BLM, counties, local municipalities, irrigation districts, and other partners to inventory, prioritize, and provide fish passage at artificial obstructions, leveraging current work done by **ODFW's Fish Passage Task Force** to expand implementation of fish passage priorities. Minimize entrapment risk in hydropower canals by providing crossing structures and escape devices at regular intervals. Provide incentives (e.g., financial assistance, conservation easements) and information about the benefits of maintaining wildlife habitat. Broad-scale conservation strategies will need to focus on restoring and maintaining more natural ecosystem processes and functions within areas that are managed primarily for other values. This may include an emphasis on more "conservation-friendly" management techniques for existing land uses, and restoration of some key ecosystem components such as **riparian** function.

Limiting Factor: *Invasive Species*

CMP Direct Threat 8.1

Invasive plants and animals disrupt and degrade native communities, diminish populations of at-risk native species, and threaten the economic productivity of resource lands. Invasive plants, particularly noxious weeds, have increased substantially. In many cases, the spread of invasives is facilitated by wildfire, as many invasive species can quickly colonize disturbed areas. In this ecoregion, Scotch broom is of particular concern. Scotch broom spreads aggressively to form monocultures, displacing native, beneficial plants and forage grasses, with seeds that can remain viable for decades, making it very difficult to eradicate. Himalayan blackberry is also widespread, with significant local impacts to meadows, riparian areas, and grasslands.

While not as disruptive as invasive vegetation, invasive animals have caused problems for native wildlife species in this ecoregion. A variety of sport fish, introduced to many high elevation lakes, compete with native amphibians for limited resources and prey on native species and/or their eggs or young. Barred Owl, expanding westward from their native range in the eastern US, compete directly with the native, threatened Northern Spotted Owl for food and habitat.

Recommended Approach

Emphasize prevention, risk assessment, early detection, and quick control to prevent new **invasive species** from becoming fully established. Prioritize efforts to focus on key invasive species in high priority areas, particularly where **Key Habitats** and **Species of Greatest Conservation Need** occur. Where needed, use multiple site-appropriate tools (e.g., mechanical, chemical, and biological) to control the most damaging invasive species. During post-fire recovery efforts, use techniques that prevent establishment of or quickly eradicate invasive vegetation. Ensure native species are used during restoration and revegetation efforts and promote native species that are expected to be climate resilient.

Limiting Factor: *Recreational Activity*

CMP Direct Threats 1.3, 4.1, 5.1, 5.2, 5.4, 6.1

Increasing demands for year-round recreational activity can disturb wildlife. Population growth has contributed to increased pressure on natural areas from recreationists, including those engaging in hiking, biking, camping, fishing, hunting, foraging, rafting, backcountry skiing, boating, paddleboarding, and off-road vehicle use. Expanded road and trail systems developed to help accommodate higher numbers of visitors are increasing habitat fragmentation and risks of behavioral impacts to wildlife. Recreational pressure can lead to an increase in wildlife stress response and behavioral changes that ultimately impact reproductive rates and population abundance. Human recreation can contribute to destruction of sensitive vegetation, harassment of wildlife from off-leash pets, spread of

invasive species, and contamination of areas with refuse. Many species will avoid areas near trails, campgrounds, and access roads when humans are present.

Recommended Approach

Plan new recreational trail systems carefully and with consideration for native wildlife and their habitats. For example, limit use and access to certain areas to minimize disturbance to wildlife, avoiding areas more sensitive to damage such as wetlands. Take advantage of abandoned or closed roads, rail lines, or previously impacted areas for conversion into trails. Work with land management agencies such as the USFS to designate areas as high value recreation and low habitat impact areas. Institute road and/or area closures to protect species during sensitive times of year and decommission roads when possible. In high use areas, establish permitted entry systems to decrease recreational pressure. Engage in outreach and education to increase public awareness of recreation impacts to fish and wildlife species; develop messaging to communicate the need for “responsible recreation”.

REFERENCES

Raymond, C. L. and E. J. Fusco (Eds.). 2024. The State of Climate Adaptation Science for Ecosystems in the Northwest U.S. Prepared by the Climate Impacts Group for the Northwest Climate Adaptation Science Center.
https://depts.washington.edu/nwclimateadaptation/socs/

ECOREGIONS

Willamette Valley

WILLAMETTE VALLEY

DESCRIPTION

Bounded on the west by the Coast Range and on the east by the Cascade Range, this ecoregion encompasses 5,308 square miles and includes the Willamette Valley and adjacent foothills. Twenty to 40 miles wide and 120 miles long, the Willamette Valley is an elongated, level alluvial plain with scattered groups of low basalt hills. Elevations on the valley floor are about 400 feet at the southern end near Eugene, dropping gently to near sea-level in Portland. The climate is characterized by mild, wet winters and warm, dry summers. Fertile soil and abundant rainfall make the valley the most important agricultural region in the state.

Societally, the Willamette Valley is a land of contrasts. Bustling urban areas are nestled within rural farmlands. A wide diversity of industries contribute to the vibrant economy. It includes more than half of the state's agricultural-producing counties, and the vast majority of the largest private sector employers (e.g., manufacturing, technology, forest products, agriculture, and services). Interstate 5 runs the length of the ecoregion, contributing to the transportation system and flow of goods while connecting communities. The Willamette Valley is the most urban ecoregion in the state, containing 8 of the 10 largest cities in Oregon. It is also a fast-growing ecoregion. Pressure on valley ecosystems from population growth, land use conversion, recreation, and pollution is likely to increase as population centers expand.

CHARACTERISTICS

Important Industries

Agriculture, manufacturing, technology, forest products, construction, retail, services, government, academia, health care, tourism

Major Agricultural Products

Nursery and greenhouse plants, grass seed, wine grapes, Christmas trees, poultry, dairy, vegetables, small fruits and berries, nuts, grains, hops, cannabis

Important Nature-based Recreational Areas

Smith and Bybee Wetlands Natural Area, Henry Hagg Lake, Fall Creek Lake, Milo McIver State Park, Willamette River Greenway and Water Trail, Willamette Valley National Wildlife Refuge Complex, Fern Ridge Reservoir, McDonald and Dunn Research Forests, Rivers to Ridges parks network, Howard Buford Recreation Area, Tualatin and William L. Finley National Wildlife Refuges, Sauvie Island Wildlife Area, E. E. Wilson Wildlife Area

Elevation

4 feet (Columbia River) to over 2,000 feet in the south

Important Rivers

Willamette, McKenzie, Santiam, Sandy, Molalla, Clackamas, Tualatin, Yamhill, Calapooia, Marys, Muddy, Pudding, Luckiamute, Long Tom

CONSERVATION ISSUES AND PRIORITIES

The Willamette Valley is a steadily growing and densely populated ecoregion, containing the state's three largest metropolitan areas, Portland, Eugene, and Salem. Since the 1850s, much of the ecoregion has been altered by development (agricultural and urban), particularly affecting oak woodland, oak savanna, grassland, riverine, and wetland habitats. The Willamette River has been disconnected from its floodplain, and much of the historical habitat has been fragmented. Most of the Willamette Valley ecoregion is privately-owned, presenting challenges to conservation efforts. Conservation strategies that focus on the needs of individual at-risk species and key sites are particularly critical in this ecoregion.

Historical accounts indicate that prior to European settlement, much of the Willamette Valley was covered by native grasses, forbs, and oak savanna. The Kalapuya people regularly set fires to improve hunting and travel. The fires helped to maintain the Valley's mosaic of grasslands, oak savannas, wet prairies, and other open habitats. The cessation of fire management by indigenous peoples and subsequent fire suppression efforts have led to denser vegetation and encroachment of trees like Douglas-fir, impacting the health of oak woodlands and reducing the size of grasslands and prairies.

Key Conservation Issues of particular concern in the Willamette Valley ecoregion include **Land Use Changes**, **Disruption of Disturbance Regimes** (both fire and floodplain function), and **Invasive Species**. In addition to the statewide factors, specific hazards to wildlife in urban areas and habitat fragmentation are of conservation concern here.

CLIMATE

The Willamette Valley is mostly a low elevation valley with terraces and floodplains encompassed by rolling hills. The climate is Mediterranean, with mild, wet winters and warm, dry summers. Mean annual precipitation varies by elevation, with more occurring in the mountainous foothills. Many tributaries join the Willamette River, entering this ecoregion from the Cascades to the east and Coast Range to the west.

Warming is projected in all seasons across the region, with the largest increases projected for summer. Summer average temperature is projected to increase as much as 6°F for the 2040-2069 period, and as much as 10°F for the 2070-2099 period for a high emissions scenario (SSP585; Figure 1). Warming temperatures will lead to wetter winters and drier

summers. Late summer precipitation is projected to decrease as much as 20% by the end of the century (Figure 2). Models generally agree on late summer precipitation projections, so confidence in these projections is high. Projections of cool season precipitation show an increase of 6% for the same period under a high emissions scenario (SSP585), although there is less confidence in predicted changes in cool season precipitation. Under a high emissions scenario (SSP585), growing degree days are projected to double for the 2070-2099 period, while frost days are projected to decrease from 50 per year on average to fewer than 20 per year on average.

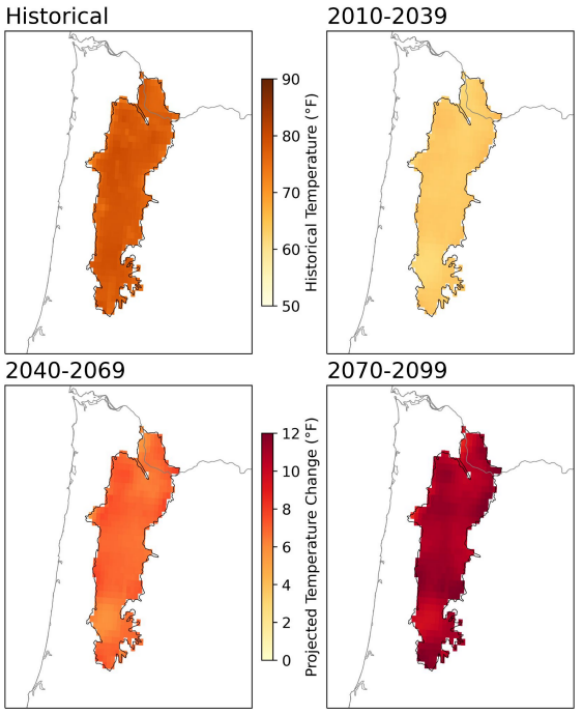


Figure 1. Model median historical (1950-2010) and future projections of summer maximum temperature change for three future periods (2010-2039, 2040-2069, 2070-2099) under a high emission scenario (SSP585) for the Willamette Valley. Future projections show increasing temperatures over the century, with slightly less warming in the southern Willamette Valley (Raymond and Fusco, 2024).

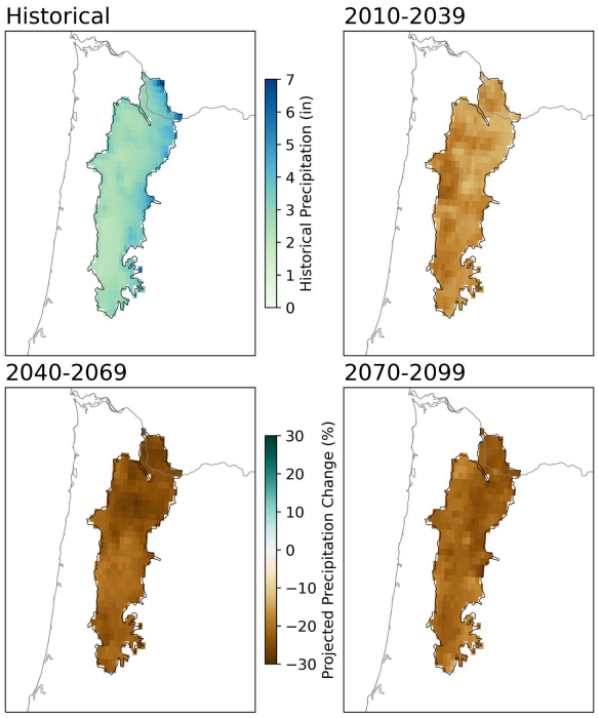


Figure 2. Model median historical (1950-2010) total late summer precipitation and projected percent change for three future periods (2010-2039, 2040-2069, 2070-2099) under a high emission scenario (SSP585) for the Willamette Valley. Future projections show decreasing late summer precipitation across the Willamette Valley ecoregion, with the greatest decrease in the 2040-2069 period under a high (SSP585) scenario (Raymond and Fusco, 2024).

LIMITING FACTORS AND RECOMMENDED APPROACHES

Limiting Factor: *Land Use Conversion and Urbanization*

CMP Direct Threats 1, 2.1, 2.3, 7.2

Of all the ecoregions in Oregon, the Willamette Valley has been most impacted by development and conversion of native habitats to other uses. The fragmented nature of remaining habitat patches in the Willamette Valley creates barriers to movement and dispersal for many species, particularly amphibians, reptiles, invertebrates, and small mammals. Continued fragmentation of remnant habitats, including grasslands and oak woodlands, has resulted in small and disjunct populations that are at an increased risk of genetic isolation and extirpation.

In addition to rural and urban residential and commercial development, conversion of habitat for vineyards is also increasing. Application of fungicides and insecticides applied to protect wine grapes and other crops, including grasses and hazelnuts, may impact the health, survival, and reproduction of pollinators, birds, and fish. The extensive

development of the Willamette Valley ecoregion also means the potential for conflict between people and wildlife is high. For example, agricultural production may cause conflicts with wildlife that are attracted to feed on plants, nuts, or ripened fruit. Lack of suitable habitat may cause bats and birds to nest or roost in houses and other human structures. High road densities and road traffic volumes increase the potential for collisions with wildlife, with hundreds of thousands of animals lost each year to roadkill.

Recommended Approach

Landscape Scale: Because so much of the Willamette Valley ecoregion is privately-owned, voluntary cooperative approaches are the key to long-term conservation using tools such as **financial incentives**, Candidate Conservation Agreements with Assurances, and conservation easements. Careful **land use planning** is also essential. Work with local governments to support and implement existing land use regulations to preserve farmland, open spaces, recreation areas, and natural habitats. Monitor changes in land uses across the landscape and in land use plans and policies.

Within **Urban Areas**: Parks and natural areas, wildlife corridors, and green infrastructure can contribute to conservation, connect people to the natural environment, and enhance the quality of life in communities. Mitigate the impacts of development to the greatest extent possible. Many **Priority Wildlife Connectivity Areas** exist throughout the Willamette Valley that can help maintain important movement corridors for wildlife. Promote programs such as the **Backyard Habitat Certification Program** to increase wildlife habitat and connectivity within urban spaces. Support and promote innovative campaigns and programs to reduce wildlife hazards. Work with municipalities to develop policies, such as wildlife-friendly building guidelines, wildlife-friendly lighting strategies, and integration of fish and wildlife crossings into transportation plans to reduce hazards. Engage in community outreach and education efforts to promote habitat protection and coexistence with wildlife.

Limiting Factor: *Altered Fire Regimes*

CMP Direct Threats 7.1, 11.3, 11.4

Past forest practices and fire suppression have resulted in young, dense, conifer-dominated forests where open-structured habitats like **grasslands**, **oak savannas**, and **wet prairies** once dominated. Maintenance of these **Key Habitats** is dependent, in part, on periodic burning. Forest crowding is a particularly significant issue in oak habitat, as large legacy oaks have become surrounded by dense stands of younger trees. The dense stands that have replaced open-structured habitats are at increased risk of high-intensity fires, disease, and damage by insects. Wildfire risk is further exacerbated by warming climate conditions and changes to patterns of precipitation, and more frequent, moderate to severe wildfires are becoming more common, particularly along the

urban/rural interface surrounding many Willamette Valley communities. Reintroduction of fire poses significant management problems in many areas of the ecoregion. These problems include conflicts with surrounding land use, smoke management, air quality, and safety.

Recommended Approach

Use multiple tools, including mowing and controlled grazing, to maintain open-structured habitats. Ensure that tools are site-appropriate and implemented to minimize impacts to native species. Reintroduce fire at locations where conflicts, such as smoke and safety concerns, can be minimized. Work with communities to ensure that air quality and other local concerns are addressed. Support the formation of Prescribed Burn Associations and other community partnerships to promote and implement controlled burns.

Limiting Factor: *Water*

CMP Direct Threats 7.2, 11.4

Water quantity is a limiting factor for fish and wildlife. Changing climate conditions are leading to rising temperatures and altered patterns of precipitation, which affects water availability across different times of year. In streams, seasonal low flows can limit habitat suitability and reproductive success for many fish and wildlife species. In much of the Willamette Valley, the demand for water for supporting population growth and agricultural production is putting increasing pressure on the supply of groundwater. This decreases groundwater discharge of cold water to rivers and streams, subsequently reducing the availability of both cold water refugia and suitable habitat for cold-water dependent species.

Water quality can also limit species and habitats. Runoff from agricultural areas can contaminate waterways. Warming temperatures, combined with higher nutrient levels due to agricultural runoff, is increasing the prevalence of toxic cyanobacterial blooms, sometimes called “harmful algal blooms” or “HABs”, leading to fish and wildlife mortality and safety issues for people and pets. Stormwater runoff from urban areas and from historic industrial activities, such as the Portland Harbor Superfund site, has introduced a variety of pollutants into wetland and aquatic habitats.

Recommended Approach

Provide incentives and information about water usage and sharing during low flow conditions (e.g., late summer). Promote water management actions that enable climate resilience and adaptation. Invest in watershed-scale projects for cold water and flow protection. Identify and protect cold water rearing and refugia habitat for aquatic species. Increase awareness and manage timing of applications of potential aquatic contaminants.

Improve compliance with water quality standards and pesticide use labels administered by the **DEQ** and **EPA**. Work on implementing **Senate Bill 1010** (Oregon Department of Agriculture) and **DEQ Total Maximum Daily Load** water quality plans.

Limiting Factor: *Habitat Fragmentation*

CMP Direct Threats 1, 2.1, 2.3, 3.3, 8.1

Habitats for at-risk native plant and animal species are largely confined to small and often isolated fragments, such as roadsides and sloughs. Habitat fragmentation also limits **species' ability to move** across the landscape to fulfill life history needs. Opportunities for large-scale protection or restoration of native landscapes are limited. Barriers to large-scale ecosystem restoration include existing development, growth pressures, high land costs, and fragmented land ownerships. Remnant habitat patches in the otherwise highly developed Willamette Valley ecoregion are critical to protect, maintain, and restore. Even small patches of intact habitat can serve as important steppingstones for wildlife movement and migration.

Roadways are also a significant contributor to habitat fragmentation in this ecoregion. Interstate 5 bisects the ecoregion, running north to south. The number of lanes, traffic speeds, and volume of freight and motorist traffic make the interstate a near complete barrier to species movement, preventing species dispersal, range expansion, or migration. The Willamette Valley ecoregion has the highest road density of any ecoregion in the state, significantly impeding wildlife connectivity in urban areas.

Recommended Approach

Broad-scale conservation strategies will need to focus on restoring and maintaining more natural ecosystem processes and functions within a landscape that is managed primarily for other values. This may include an emphasis on more "conservation-friendly" management techniques for existing land uses and restoration of some key ecosystem components, such as river-floodplain connections and **wetland** and **riparian habitats**. "Fine-filter" conservation strategies that focus on needs of individual **Species of Greatest Conservation Need** and **key sites** are particularly critical in this ecoregion. Manage for the full lifecycle of the species to maintain access to breeding, migration, and nonbreeding habitats. Plan for and promote habitat connectivity. Many **Priority Wildlife Connectivity Areas** exist throughout the Willamette Valley that can help maintain important movement corridors for wildlife. Integration of fish and wildlife crossings into transportation plans will help to reduce hazards.

Limiting Factor: *Invasive Species*

CMP Direct Threat 8.1, 8.2

Invasive species disrupt native plant and animal communities and impact populations of at-risk native species. Hundreds of non-native and invasive plants have been introduced in this ecoregion for use as livestock forage, erosion control, and ornamental purposes. Plants such as reed canary grass and water primrose form dense monocultures, displacing native plants in wetland and riparian areas, choking waterways, and reducing foraging and breeding areas for wildlife. Himalayan blackberry is also widespread in this ecoregion, with significant local impacts to meadows, riparian areas, and grasslands. European hawthorn, black locust, and English ivy, among many others, are also highly invasive, outcompeting and engulfing native trees and shrubs.

Invasive animals have also caused significant issues in the Willamette Valley. American bullfrogs are rapidly expanding, competing with native species for limited resources or preying on native species and/or their eggs or young. Nutria degrade water quality and destabilize stream banks, while competing with native species, such as American beaver and muskrat, for food. Eastern fox squirrel and Eastern gray squirrels prey on native birds and compete with native species, such as Western gray squirrels, for food and nest sites. Common snapping turtles prey on native fish and wildlife species, and red-eared sliders compete directly with Northwestern pond turtles and Western painted turtles. Several mussel species, including zebra, quagga, and golden mussels, pose significant threats to aquatic systems. A variety of non-native fish have been introduced to waterways in the ecoregion, such as Gambusia, bass, and sunfish, which compete with native fish for food and prey directly on native fish, amphibians, and/or their eggs or young.

Emerging threats from invasive invertebrates are also becoming a concern in the Willamette Valley. Japanese beetles can infest and defoliate native hardwood trees like oaks and maples. The non-native emerald ash borer defoliates tree species characteristic of riparian habitats, such as Oregon ash, putting riparian areas, and in-stream habitats that depend on shading from bankside trees, at risk. Mediterranean oak borer targets native oak species, including Oregon white oak and California black oak, which have already experienced significant declines in the ecoregion due to habitat loss and development.

Recommended Approach

Emphasize prevention, risk assessment, early detection, and quick control to prevent new **invasive species** from becoming fully established. Use multiple site-appropriate tools (e.g., mechanical, chemical, biological) to control the most damaging non-native species. Prioritize efforts that focus on key invasive species in high priority areas, particularly where **Key Habitats** and **Species of Greatest Conservation Need** occur. Work with the **Oregon Invasive Species Council** and other partners to educate people about invasive species issues and to prevent introductions of potentially high-impact species, such as the zebra mussel. Provide technical and financial assistance to landowners interested in controlling invasive species on their properties. Promote the use of native species for restoration and revegetation.

Limiting Factor: *Altered Floodplain*

CMP Direct Threat 7.2

The floodplain dynamics of Willamette Valley rivers have been significantly altered. Historically, multiple braided channels dispersed floodwaters, deposited fertile soil, moderated water flow and temperatures, and provided a variety of slow-water habitats, such as sloughs and oxbow lakes. Since Euro-American settlement, however, many of the valley's major rivers, including the Willamette, Santiam, and McKenzie Rivers, have largely been confined to a single channel and disconnected from their floodplains. Addition of dikes and levees, bank hardening, and channelization to facilitate agricultural irrigation have all had significant impacts to riparian habitats in the ecoregion. Hydroelectric projects located on the major rivers and their tributaries, while reducing downstream flood risk, have altered hydrology significantly, restricting fish passage and acting as barriers to movement of aquatic wildlife.

Recommended Approach

Cooperative efforts are needed to restore floodplain function and critical off-channel habitats. Using green infrastructure and careful planning for development outside of floodplains can help **maintain floodplain function**. Removing infrastructure such as revetments that channelize rivers can help restore natural stream flows.

Limiting Factor: *Wildlife Hazards*

CMP Direct Threats 1.1, 1.2

Urban landscapes can present a variety of hazards for wildlife. High densities of buildings increase risk of bird collisions with windows. Collisions with vehicles and powerlines and entanglements in fencing are also significant hazards for wildlife in urban areas. Outdoor cats, even well-fed, indoor/outdoor cats, prey on a variety of wildlife species, with significant local impacts to populations of birds, small mammals, and reptiles. Similarly, off-leash dogs in natural areas can disturb, injure, or kill wildlife. Noise and light pollution, as well as other disturbances from human presence and activity, can alter wildlife behavior. Food provided to wildlife, either intentionally with devices like bird feeders or unintentionally by leaving garbage unsecured or by leaving pet food outdoors, can increase disease transfer and can cause human-wildlife conflicts. Illegal encampments can degrade or destroy sensitive fish and wildlife habitats, particularly riparian areas, due to loss of vegetation, felling of snags for use as firewood, and unmanaged human refuse and waste. Additional hazards include exposure to pesticides, rodenticides, and other contaminants, harassment, and poaching. These hazards can significantly impact wildlife and undermine habitat conservation efforts.

Recommended Approach

Support and promote innovative campaigns and programs to reduce wildlife hazards. Work with municipalities to develop policies, such as wildlife-friendly building guidelines, wildlife-friendly lighting strategies, feeding ordinances, and integration of wildlife crossings into transportation plans to reduce hazards. Support research into better understanding of **urban wildlife hazards** and the management strategies to reduce those hazards. Communities can work with local park districts and conservation organizations to support habitat enhancement projects and reduce the need for herbicide use in parks. Communities, local governments, and non-profit organizations can promote **bird-friendly building design** and outreach efforts about the **impacts of cats on wildlife**. Support policies that address housing access to alleviate the pressure for illegal camping on public lands.

REFERENCES

Raymond, C. L. and E. J. Fusco (Eds.). 2024. The State of Climate Adaptation Science for Ecosystems in the Northwest U.S. Prepared by the Climate Impacts Group for the Northwest Climate Adaptation Science Center. https://depts.washington.edu/nwclimateadaptation/socs/

ECOREGIONS

Nearshore

NEARSHORE

DESCRIPTION

Oregon's Nearshore ecoregion offers opportunities for boating, surfing, wildlife viewing, fishing, crabbing, clamming, and recreational pursuits. It supports commercial fish harvests and shipping that includes export of many products and commodities like wood produced in Oregon as well as imports of products from around the world. The Nearshore provides ecosystem services that benefit all Oregonians.

The nearshore environment includes a variety of habitats ranging from submerged high-relief rocky reefs to broad expanses of intertidal mudflats in estuaries. These habitats are described in more detail in the **Nearshore** and **Estuaries** Key Habitats. A vast array of fish, invertebrates, marine mammals, birds, algae, plants, and micro-organisms make their homes here. These habitats and species are integral parts of Oregon's complex nearshore ecosystem, and are interconnected through food webs, nutrient cycling, habitat usage, and ocean currents. They are also influenced by a multitude of other biological, physical, chemical, geological, and human use factors.

The Nearshore ecoregion encompasses the area from the outer boundary of Oregon's Territorial Sea at 3 nautical miles to the supratidal zone affected by wave spray and overwash at extreme high tides on the ocean shoreline, and up into the portions of estuaries where species depend on the saltwater that comes in from the ocean. The Nearshore ecoregion is bordered by the **Coast Range Ecoregion** on the ocean shores and intersects it in Oregon's estuaries where the influence of the terrestrial watersheds are strongest (Figure 1). Humans are an important part of the ecology of the Nearshore ecoregion and coastal communities are an integral part of that ecology (see **Appendix – Coastal Communities**).

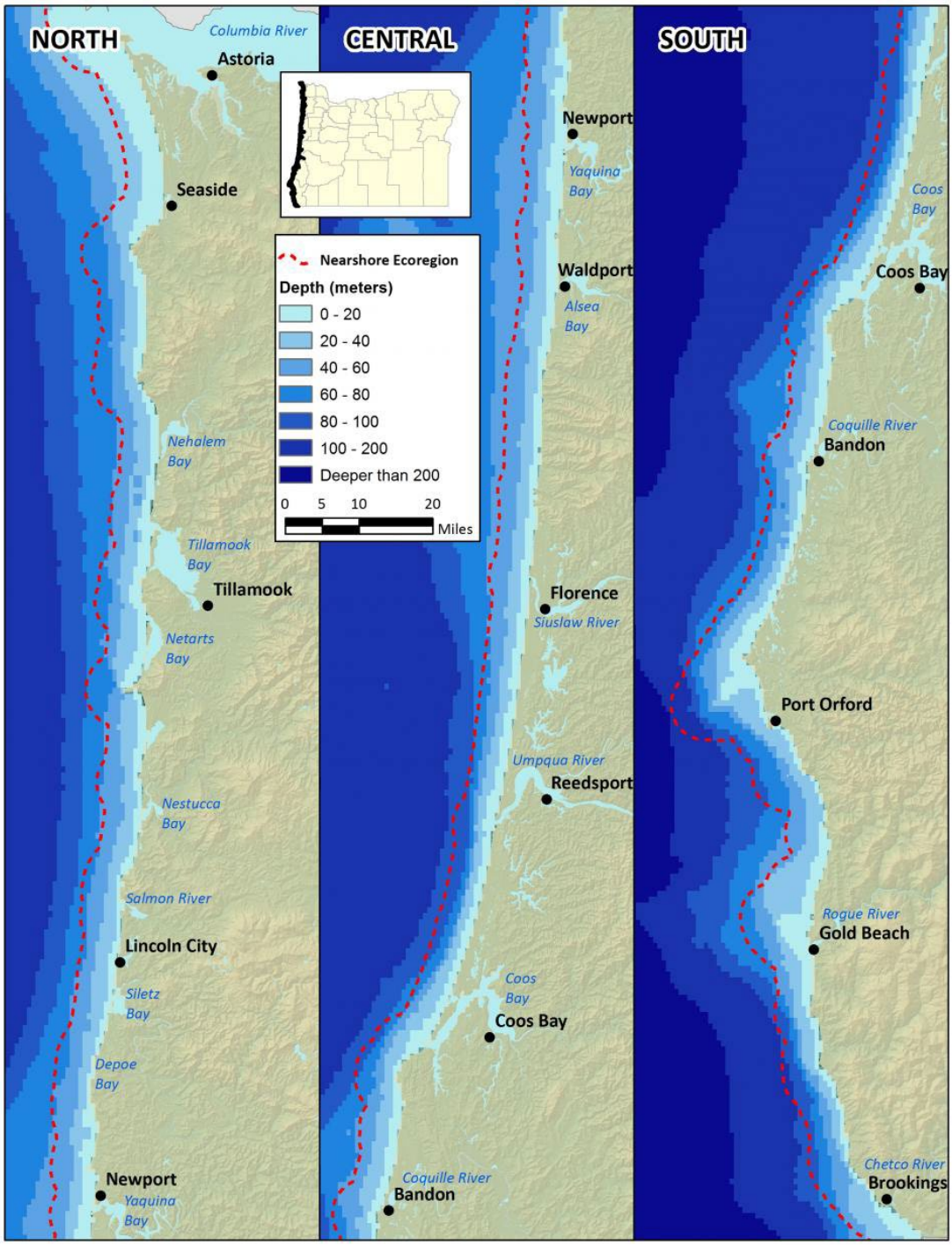


Figure 1. Oregon's Nearshore is defined as the area from the outer boundary of the territorial sea to the shoreline affected by extreme high tides and up into the estuaries where species depend on saltwater from the ocean.

CHARACTERISTICS

The distinct suite of oceanographic features and physical forcing agents that help define the Nearshore ecoregion include the northern portion of the California Current System and the annual seasonal upwelling/downwelling cycle that are responsible for its high productivity (Figures 2 and 3). The eastern boundary current is a part of the North Pacific gyre that moves cold water from the North Pacific toward the equator. It has a southward flowing current over Oregon's shelf and slope and a northward flowing undercurrent over the slope in spring and summer. In winter, the current over the shelf consists primarily of the northward flowing Davidson current (Figure 2).

During spring and summer, winds blowing from a northerly direction drive an upwelling system that brings cold, nutrient-rich, and oxygen-poor waters from depth up onto the continental shelf (Figure 3a). The upwelling process is highly variable on many time scales and is generally stronger and more persistent on the south Oregon coast and more intermittent on the central and northern Oregon coast. In addition to nutrients derived from upwelling, river discharge from the Columbia River provides a major source of nutrients to the Oregon continental shelf, especially along the north coast. The upwelling and river-plume nutrients fuel high phytoplankton productivity which drives an extremely productive marine ecosystem off Oregon. In the fall and winter months winds blowing from a southerly direction cause seasonal downwelling that bring well oxygenated water from the surface downward in the water column (Figure 3b). Surface water temperatures provide a good indication of these seasonal wind forcing differences that bring the cold, nutrient-rich waters to the surface in the summer (Figure 4a) and the warmer waters from offshore to the coast in the winter (Figure 4b). Superimposed on these large-scale processes are smaller scale eddies, gyres, fronts, and other oceanographic phenomena, which together serve to create a complex spatially and temporally dynamic ecosystem.

In 2012, the Coastal and Marine Ecological Classification Standard (CMECS) was adopted in the United States (Federal Geographic Data Committee 2012) as a means to provide a common framework for describing habitat, using a simple, standardized classification scheme and common terminology. The goal of using CMECS is to both enhance scientific understanding and to advance ecosystem-based and place-based resource management through better communication. Components of the CMECS classification framework have been incorporated into the SWAP – in particular, the CMECS approach to evaluating and describing **Nearshore Key Habitats**. For more information on the CMECS Framework see **Appendix - Marine Habitat Classification**.

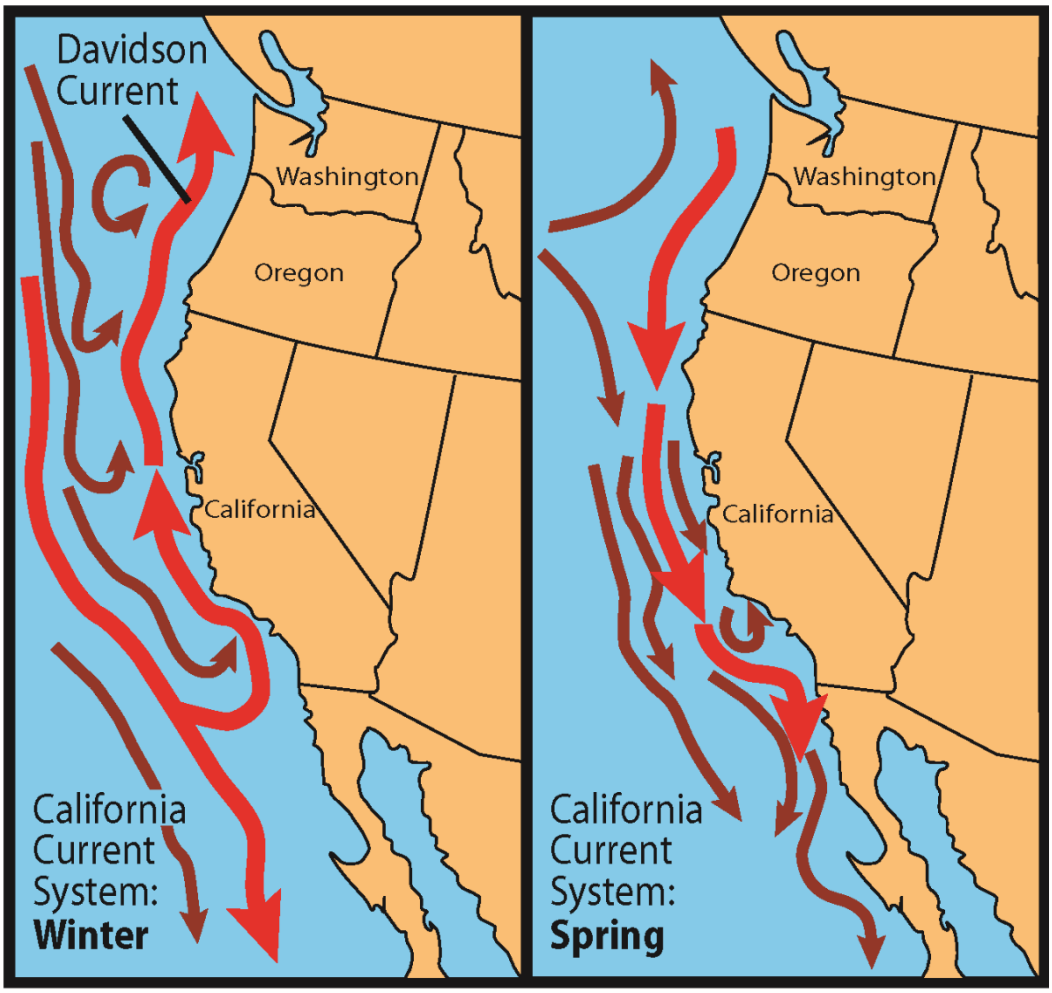


Figure 2. The California Current System typically varies seasonally. (Source P. T. Strub).

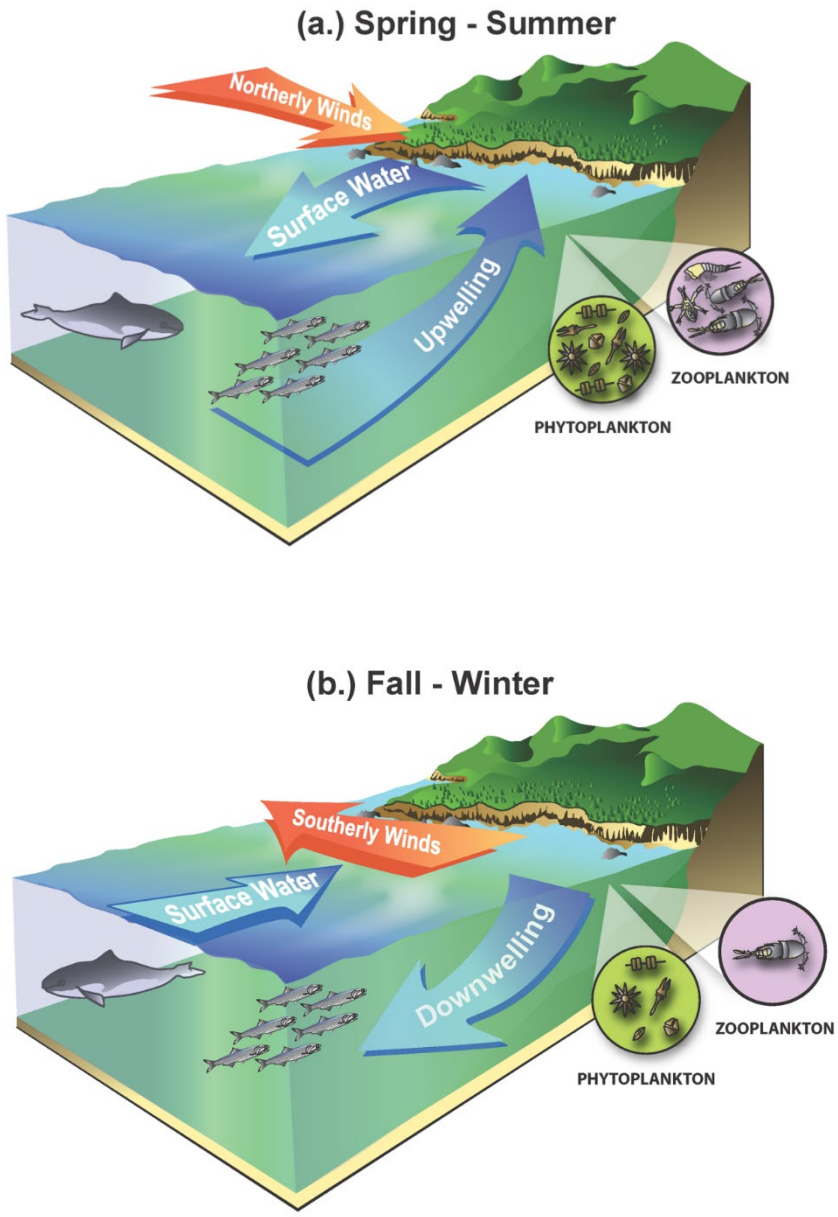


Figure 3. Annual seasonal cycle of spring-summer upwelling and fall-winter downwelling.

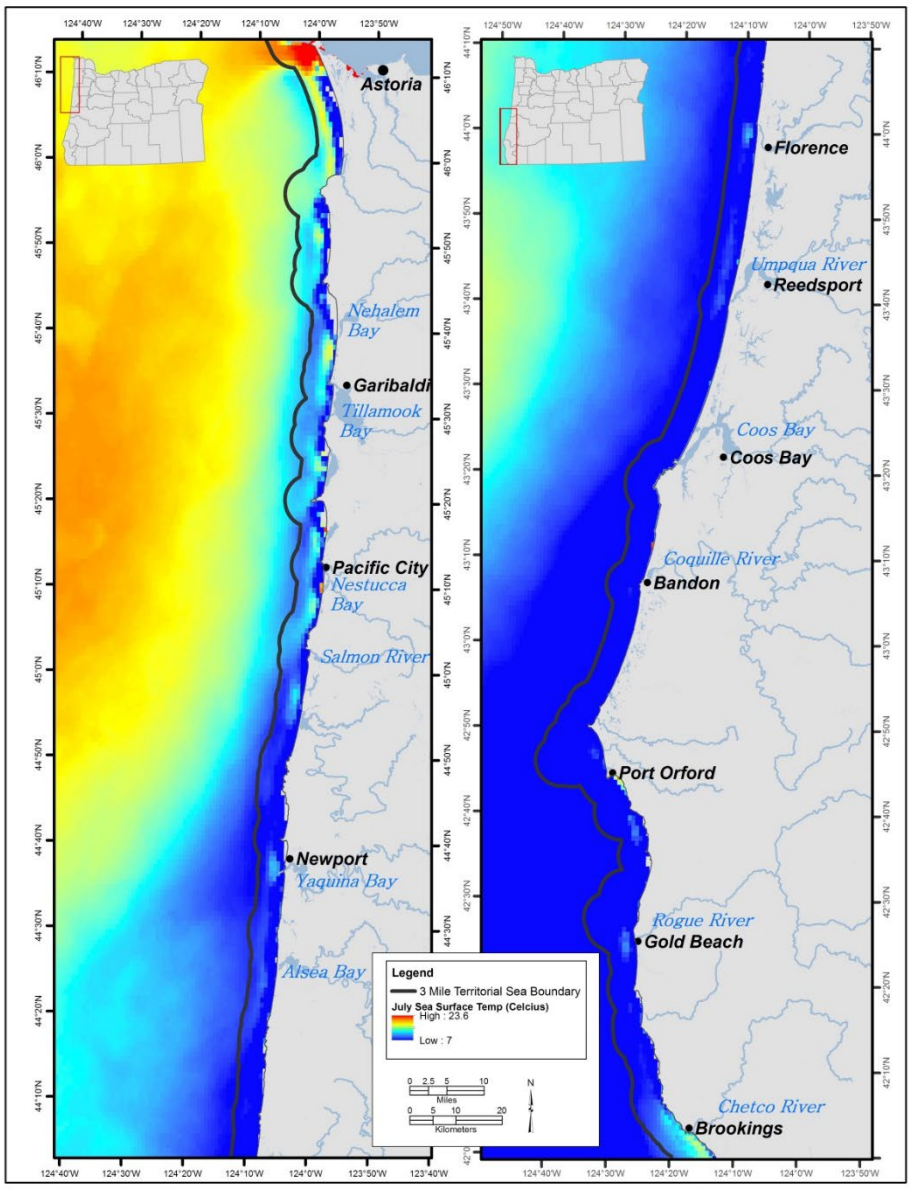


Figure 4a. Average sea surface temperature for July (1997 - 2003). Note the colder water nearshore. (Source: Juan-Jorda Masters Thesis/College of Oceanic and Atmospheric Sciences/ Oregon State University/2006).

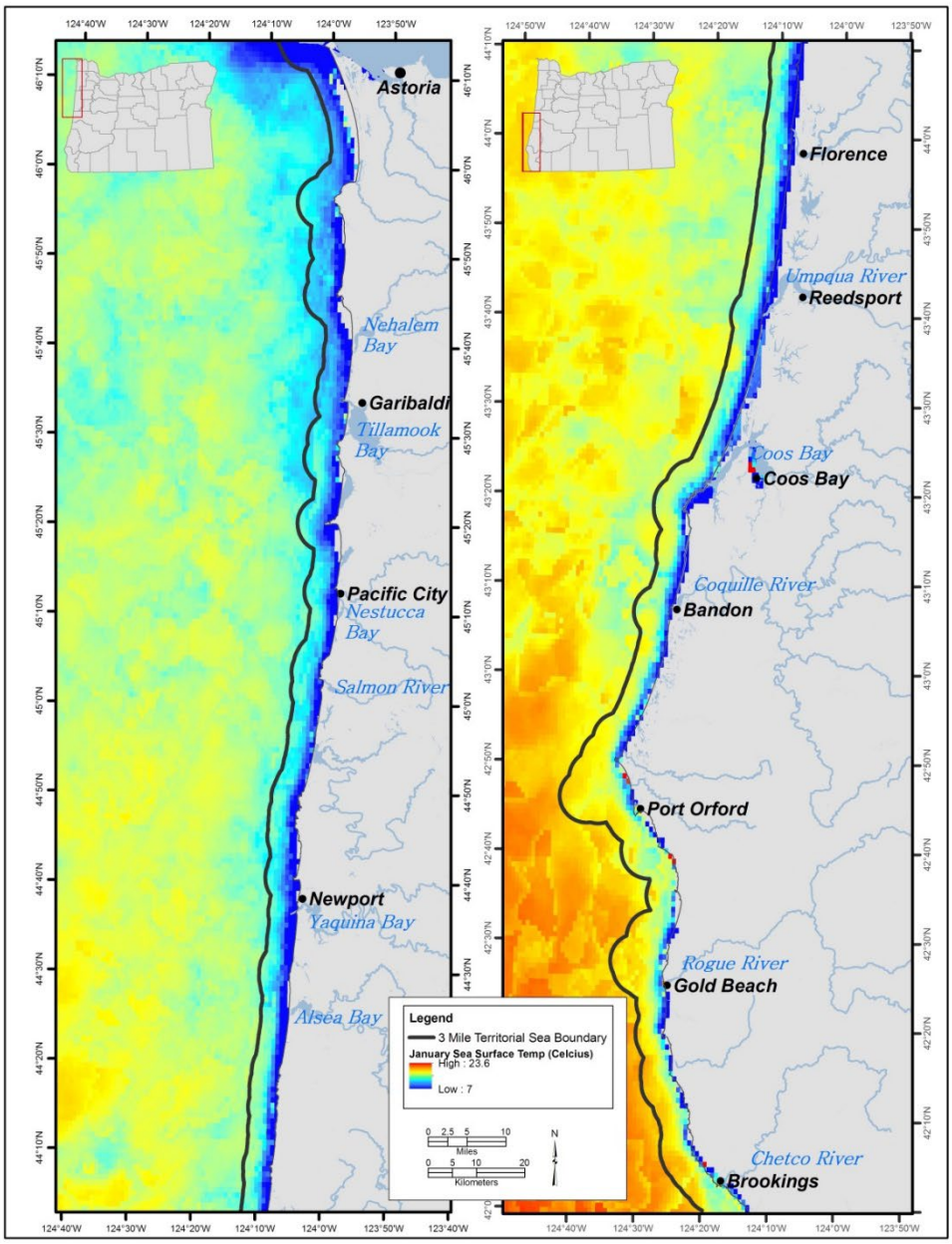


Figure 4b. Average sea surface temperature for January (1997 - 2003). Note the warmer water nearshore. Source: Juan-Jorda Masters Thesis/College of Oceanic and Atmospheric Sciences/ Oregon State University/2006).

Important Industries

Commercial fishing, fish processing, tourism and recreation (including recreational fishing, shellfish harvest, and wildlife viewing), mariculture, and shipping.

Important Nature-based Recreational Areas

All open water, surf zone, subtidal rocky reefs, sandy beaches, rocky intertidal areas, and estuaries. Ecola Point Marine Conservation Area, Chapman Point Marine Garden, Haystack Rock Marine Gardens Cape Falcon Marine Reserve and West Marine Protected Area, Cape lookout Marine Conservation Area, Tillamook Bay, Netarts Bay, Cape Kiwanda Marine Garden, Fogarty Creek Marine Conservation Area, Boiler Bay Marine Research Area, Cascade Head Marine Reserve and its North, South and West Marine Protected Areas, Pirate Cove Marine Research Area, Whale Cove Marine Conservation Area, Otter Rock Marine Garden, Otter Rock Marine Reserve, Yaquina Head Marine Garden, Yaquina Bay, Yachats Marine Garden, Cape Perpetua Marine Garden, Neptune Marine Research Area, Cape Perpetua Marine Reserve and Marine Protected Areas, Coos Bay, Gregory Point Marine Research Area, Cape Arago Marine Research Area, Cape Blanco Marine Research Area, Redfish Rocks Marine Reserve and Protected Areas, Coquille Point Marine Garden, Harris Beach Marine Garden, Brookings Marine Research Area

Elevation

From approximately 10 feet above to 636 feet below sea level

Important Rivers, Estuaries and Bays

Alsea Bay, Chetco River, Columbia River, Coos Bay, Coquille River, Depoe Bay, Elks River, Necanicum River, Nehalem Bay, Nestucca Bay, Netarts Bay, Pistol River, Rogue River, Salmon River, Sand Lake, Siletz Bay, Siuslaw River, Sixes River, Tillamook Bay, Umpqua River, Winchuck River, Yaquina Bay

CONSERVATION ISSUES AND PRIORITIES

Oregon's ecosystem-based management approach recognizes the role human populations play as a part of ecological systems. As human activities in and around the Nearshore ecoregion increase, human impacts on fish, wildlife, and their habitats may also increase. Of Oregon's thirty-three coastal cities, twelve are active ports supporting vessel traffic to and from ocean waters, and all are an integral part of coastal ecology. Coastal development, tourism, recreation, sport and commercial fishing, dredging, rainwater

runoff, wastewater disposal, aquaculture, and energy development are just a few nearshore uses that benefit human communities. However, along with the benefits, there are potentially adverse effects on nearshore resources.

To balance human use benefits with conservation concerns, conservation actions are recommended. These actions address nearshore issues that need immediate or timely attention, are feasible to implement given appropriate funding, and have received some level of public support. There are three general categories of action: 1) education and outreach, 2) research and monitoring, and 3) management and policy. The conservation of marine resources is the responsibility of all users, to ensure the long-term productivity of marine ecosystems. Education and Outreach provide information about the Nearshore to the public which helps shape both Research and Monitoring efforts and Policy and Management of the species habitats in Oregon's Nearshore ecoregion.

Key Conservation Issues (KCIs) of particular concern in the Nearshore ecoregion include **Climate Change**, **Pollution**, **Land Use Changes**, and **Invasive Species**.

Climate Change Impacts

The earth's oceans have absorbed roughly 90% of the heat caused by human emitted greenhouse gases that are warming our planet. The oceans have also actually slowed the warming of the planet by absorbing roughly 30% of the carbon dioxide, but this has dramatically changed ocean chemistry, making the ocean more acidic. The land is also heating up. But the air temperatures over the land adjacent to the ocean will increase faster than ocean temperatures so the difference between temperatures of the nearshore ocean and the adjacent land mass is projected to increase causing both an increase in the northerly winds that drive upwelling and for those northerly winds to occur for more of the annual seasonal cycle. These changes have impacted and will continue to impact Oregon's nearshore waters in multiple ways. Impacts include increasing ocean acidification, increasing hypoxia, increasing stratification of ocean waters, increasing frequency and intensity of marine heat waves, changes to the seasonal cycle of upwelling and downwelling, increases in the size of waves and the intensity of storms, changes in coastal erosion and accretion, changes in freshwater input from rainfall and subsequent runoff, and increases in ocean temperatures. These impacts affect the species that live in Oregon's nearshore waters and their habitats.

LIMITING FACTORS AND RECOMMENDED APPROACHES

Limiting Factor: Public Awareness

Numerous marine species and habitats occur below the water's surface and go unseen by most members of the public. Many people will not have the opportunity to go out on the ocean or even visit the coastline. Without firsthand experience, the effects that humans have on the nearshore ecosystem through pollution, climate change, invasive species and other **Key Conservation Issues** facing nearshore species and their habitats are poorly understood. Education and outreach efforts are needed to increase public awareness about nearshore marine species and habitats, as well as the issues affecting them.

Recommended Approach

Improve education and outreach efforts to disseminate information on species identification and distribution, management regulations, and release techniques designed to reduce discard mortality. Develop curriculum materials and provide information to schools for use in classrooms about the effects humans are having on the Nearshore ecoregion, the Nearshore species that live there, and conservation actions. Employ emerging technologies, blogs, and social media sites. Use local newspapers and literature to share research and conservation actions with adults and children. Display conservation and educational materials at hotels, charter offices, angling shops, real estate offices, malls, parks, marinas, boat ramps, beach access points, and other public areas. Encourage development of local and port groups to facilitate information and knowledge exchange between agencies and local constituents. Design and convene workshops tailored to educate the public on specific topics (e.g., fish, algae, shellfish, non-native species identification workshops).

Limiting Factor: Habitat Alteration

CMP Direct Threats 1, 2.4, 3.3, 6.1, 6.2, 7.3, 8.1, 8.4, 9, 10.2, 11

Disturbance or loss of **Nearshore Habitats** important to nearshore species can result from both direct and indirect sources. Disturbances to vulnerable intertidal habitats are often subtle and can be a consequence of human activities that cause light or noise pollution or result in trampling of intertidal habitats, animals, or plants. Intertidal and submerged habitats are impacted by changes to sediment transport due to altered hydrology, coastal development, shoreline armoring, beach grooming, global climate change, and many other factors. Non-native species introductions may alter physical properties and habitat-forming biological communities (e.g., crowding out native organisms that function as

substrate for other organisms). Certain bottom fishing methods may reduce structural diversity of the sea floor and change benthic communities. Development of renewable energy facilities such as wind and wave energy and their anchors and cables may alter habitats in a variety of ways such as altering winds and currents. Dredging, dredge and fill activities, shellfish mariculture, building dikes and levees, and installation and removal of tide gates are all examples of habitat alteration. Habitat in **Estuaries** has been transformed and altered by the introduction of the non-native species of Japanese eelgrass.

Recommended Approach

Continue to monitor species and habitats to document impacts that may be subtle or may accumulate over time, and to determine areas where disturbance is causing, or could cause, negative impacts to species or habitat. Collaborate with academic and management entities in the study of non-native species, survey intertidal and subtidal habitats for presence, set a baseline of habitat use, and monitor communities for potential spread. Investigate alternative methods (e.g., fishing techniques, shoreline erosion control, development practices) that reduce or remedy negative impacts on habitats. Inform the public about the use of non-disturbing methods appropriate for viewing marine wildlife. Provide new or improved interpretive signage, media inserts, feature articles and booklets about intertidal habitats, fisheries information, and other nearshore ocean resources. Examine alternative methods for cultivation of shellfish. Work with cities, counties, tribes, industries and management agencies in the Coast Range ecoregion on developmental planning efforts to ensure they consider their effects on nearshore habitats such as rainwater runoff, sedimentation, coastal squeeze, etc.

Limiting Factor: Water Quality

CMP Direct Threats 1, 9, 11.2, 11.3, 11.4

Water quality degradation caused by human activities or natural causes may impact nearshore species and habitats. Water quality within the nearshore ocean is affected by coastal and inland development, either from increased runoff of contaminated water or increased water temperature resulting from altered hydrology or depth (e.g., dredging, filling). Boating activity in nearshore waters or adjacent estuaries may lead to accumulation of oil in surface waters from poorly maintained or failing equipment. Pollution due to other toxic chemicals from both point sources and non-point sources can degrade water quality. Contamination by fecal indicator bacteria degrades water quality. Water quality may be further degraded if conditions support significant blooms of harmful algae, which can lead to highly concentrated marine biotoxins. Ocean acidification and

hypoxia both degrade water quality in the nearshore. Runoff from pavement, agricultural lands, and forests can all degrade water quality.

Recommended Approach

Coordinate with the multiple state and federal agencies involved in water quality issues to update and improve signage at marinas and public beaches to inform boaters and beach users about water quality issues and methods for reporting problems. Develop incentive programs to encourage boaters to use environmentally friendly gear or equipment. Prevent contamination and enforce laws regarding pollution and water quality issues. Monitor for harmful algal blooms to diagnose potential indications of domoic acid or paralytic shellfish poisoning. Work with the Department of Environment Quality (DEQ) in their monitoring efforts to continue and expand their assessments of water quality in the marine environment and their annual integrated reports which now include ocean acidification and hypoxia. Work with cities, counties, Oregon Department of Transportation (ODOT), and coastal industries to address rainwater runoff and sedimentation. Additional activities are needed to map and monitor the spatial distribution and extent of native eelgrass in both the intertidal and subtidal zones of Oregon estuaries.

Limiting Factor: Harvesting Aquatic Resources

CMP Direct Threats 5.4, 9.4

Accurate accounting of abundance and harvest impacts is an important component of sustainable resource management. However, abundance estimates, and complete life history information needed to model abundance remains unknown for many nearshore species. Yet many nearshore species are targeted by fisheries. Populations of nearshore species may be impacted and limited by commercial or recreational overharvest at local or at broader scales, as well as through bycatch and discard of non-targeted species. Entanglement of whales and sea turtles is one form of bycatch, defined as incidentally affected species that are not retained, that people often do not think about. These interactions can cause death as well as non-lethal effects that can limit populations of these species.

Recommended Approach

Provide opportunities for protecting and enhancing nearshore fisheries stocks. Develop and implement fish release methods designed to minimize discard mortality. Increase the ODFW representation at sportsmen shows, festivals, and other venues, encourage fishers to avoid vulnerable species, and make information about proper discard techniques widely

available. Develop monitoring, conservation, resource analyses, and harvest management plans for commercially and recreationally harvested shellfish. Evaluate immediate and long-term conservation and harvest management needs for Oregon's recreational and commercial nearshore fisheries. Develop stock assessment and/or stock status indicator strategies for priority nearshore groundfish and shellfish species, designed to accommodate the unique circumstances and habitats of nearshore species with the greatest management need. Develop fishery-independent survey methodologies and gather baseline information for all key nearshore species. Review the SGCN list to identify priority species in need of conservation plans under Oregon's Native Fish Conservation Policy. Collaborate with sport and commercial fishermen, university researchers, and others to gather imperative information for exploited nearshore stocks. Sponsor socioeconomic analysis of coastal communities to determine the relationship between stock status and direct (e.g., fishing) or indirect (e.g., tourism) impacts from various industries.

Limiting Factor: Monitoring and Research Needs

Monitoring species and habitat changes will help evaluate resource status and trends over the long-term. Although some monitoring is done at present, more is needed to examine changes and trends within Oregon's nearshore ecosystem. More data are needed to understand local and regional ecological changes due to predator-prey population dynamics, the introduction of non-native species, algae blooms, climate change, ocean acidification and hypoxia effects, and other changes. Many aspects of Oregon's **Nearshore Habitats** and nearshore species are poorly understood. For many marine species, substantial data gaps exist with regards to population abundance and trends, population structure, life history parameters, responses to environmental changes, and species-habitat associations. Similarly, while significant strides have been made toward describing and mapping nearshore habitats, gaps remain for parts of the nearshore area. In addition, researchers are still accumulating data to describe the physical properties and biological components of certain habitat types, and to provide long-term information on the physical response of nearshore systems to climate change. More information is needed to assess and understand the complexity of the nearshore ecosystem and the effects of human interactions.

Recommended Approach

Encourage and assist in monitoring the population dynamics and habitat usage of rocky reef-associated species. Research the movement, behavior, and predator-prey relationships of adult and juvenile stages of nearshore species. Identify and evaluate conflicts between marine mammals and fisheries. Inventory and monitor non-native

species. Public users should inspect boats, clothing, and equipment for non-native species before and after use of natural areas or waterbodies and should report sightings to support ongoing monitoring of species distribution. Assess and gather baseline information on levels of human use and disturbances to intertidal habitats, animals, and plants. Review coastal development plans and regulations to identify opportunities to address areas with consequent negative impacts to nearshore resources. Improve and expand the capabilities of research and monitoring programs to meet the requirements of the Native Fish Conservation Policy and other nearshore resource management programs. Investigate the effects of environmental changes on nearshore species and nearshore habitats. Continue to study, evaluate, and monitor harmful algal blooms to provide an early warning system for blooms. Continue to develop non-lethal habitat surveys of nearshore species and collaborate with interested stakeholders to increase survey coverage.

NEARSHORE RECOMMENDATIONS

The following set of recommendations, intended to facilitate voluntary, collaborative actions to improve understanding and stewardship of Oregon's nearshore resources, is the core of the information provided for the Nearshore ecoregion. These recommendations reflect the input received from the ODFW's staff, outside experts who served as technical advisors and reviewers, and members of the public. Twelve recommendations are outlined below, categorized into three main themes: 1)Education and Outreach, 2)Research and Monitoring, and 3)Management and Policy. These are all important and not listed in a prioritized manner. Each recommendation was chosen because it addresses priority nearshore issues in need of immediate or timely attention, is feasible, has received public support, and is beyond the capability of any single institution to achieve. The recommendations rely on partners to differing degrees and are intended to help guide collaboration rather than act as an action plan for ODFW alone.

The description of each recommendation includes:

Recommendation: A brief statement of the recommended action.

Rationale: Conservation and/or management need(s) addressed by this recommended action, and strategies to achieve results. Recommendations are based on the known and/or potential factors affecting nearshore resources and resource sensitivity, as identified by public input, scientific information, technical advisors, and the ODFW staff.

Potential Partners: Who should—or could—be involved? A general list (not necessarily comprehensive) of potential partners for collaboration on implementation.

Category: Education and Outreach

A well-informed public helps drive policy and management decisions that support a heathy ecosystem and the many benefits it offers. The following recommendations are designed to enhance public awareness of nearshore species and habitats and foster public engagement in nearshore conservation issues.

(1) General Public, Constituent and Advisory Group Engagement

Recommendation: Develop and expand creative avenues to engage a diverse array of constituents, including the broader general public, on nearshore resource issues. Explore technologies that support alternative methods of communication and participation, in addition to continuing to support traditional paths such as issue-specific advisory groups.

Rationale: Input from informed and engaged partners is essential to successfully developing and implementing research, management/policy, and outreach on all natural resource issues. The exchange of information between ODFW and constituents improves understanding and support on both sides and aligns management with public priorities. Advisory committees can provide focused, in-depth engagement in selected aspects of nearshore management and research. In addition, there is a growing need to augment traditional methods of public input to reach an increasingly dispersed and diverse population of constituents interested in nearshore issues. ODFW has begun using new options for engaging the public and exchanging information, e.g., opportunities for online participation in public meetings and online surveys, and these have shown promise as effective tools for enhancing traditional methods.

Potential Partners: ODFW, existing advisory bodies, the general public, sport and commercial fishing interests, non-governmental organizations, tribes, Oregon Sea Grant, and various other communities of interested parties with a broad and diverse representation.

(2) Nearshore Resources Outreach Information, Access and Awareness

Recommendation: Broaden outreach materials and information available electronically, to deepen public appreciation of Oregon's nearshore environment. Increase the quantity, quality, and timeliness of information available on ODFW's website on nearshore fisheries, regulations, conservation and ecosystem management.

Rationale: Oregon's nearshore is one of the richest ecological systems in the world, home to thousands of species in a multitude of habitat types. While there is much to learn about this incredible ecoregion, there is a wealth of existing information that could be used more effectively to fuel public interest in natural resource issues, and stewardship of those resources. Populating educational exhibits, websites, social media, and other media outlets with information about Oregon's nearshore will deepen Oregonian's connection to the outdoors and to wildlife. Photographs, videos, and stories, provided through a variety of sources and outlets will engage the public in the short-term, and build partnership and stewardship in the long-term.

Potential Partners: State and federal natural resource agencies, universities, Oregon Sea Grant, public aquaria and museums, non-governmental organizations, tribes, news outlets, and others.

(3) Communications Partnerships

Recommendation: Develop and expand existing partnerships for communication, education, and outreach on nearshore topics and issues. Work with partners to create new ways of developing and sharing information, and use these partnerships to reach new audiences. This includes developing best conservation and management practices where possible, sharing information about existing rules, and encouraging voluntary compliance through targeted outreach efforts.

Rationale: Conservation and management actions are better trusted and publicly supported when they are developed with stakeholders who understand nearshore issues. Partnering with groups that have a rich history of developing science-based education and outreach programs effectively and efficiently amplifies the quality and scope of nearshore resource communication and builds relationships and capacity outside of ODFW

on nearshore resource issues. Through these partnerships, Oregon's understanding of nearshore issues – and clarity on what members of the public can do to contribute to a healthy nearshore ecosystem – would facilitate a renewed spirit of engagement and commitment to nearshore resource stewardship.

Potential Partners: State and federal natural resource agencies, universities, Oregon Sea Grant, public aquaria and museums, non-governmental organizations, tribes, and others.

Category: Research and Monitoring

Expanded research and monitoring activities are required to generate data and information to meet the needs of resource managers. This is especially true in the nearshore area where human activity is intense and information on many species and their habitats is sparse. The **Appendix – Nearshore Research and Monitoring** lists some key data elements and examples of projects that would help support resource management. The following recommendations address research and monitoring program priorities for collaborative, multi-institutional issues. The broad objectives in this category are far beyond the capability of any one institution to fully achieve and therefore require partnerships to realize meaningful results.

(4) Ecosystem Response to Climate Change

Recommendation: Develop and implement research and monitoring efforts to understand, track, and work toward predicting effects of climate change and increased carbon dioxide on Oregon's nearshore species and ecosystems. Focus research on species and ecosystems most at risk, and foster collaboration between scientists and managers to optimize research outcomes for use in management and conservation.

Rationale: Oregon's ocean is already experiencing effects of climate change and increased carbon dioxide, including ocean acidification, hypoxia, other changes in water chemistry, warming ocean temperature, and changes in upwelling and other characteristics of the nearshore ocean and estuaries. These changes will continue to grow and intensify in the future. Oregon's upwelling ecosystem is experiencing many of these changes sooner and in greater magnitude than other parts of the nation, increasing the urgency for collecting the needed information and formulating the necessary management response. This is a global

problem that requires rigorous scientific information to solve, and partnership between scientists inside and outside of agencies to both understand the phenomena and try to mitigate its effects. Desired outcomes are to increase ecosystem and community resilience and the sustainability of Oregon's nearshore resource.

Potential Partners: State and federal natural resource agencies, universities, local governments, non-governmental organizations, shellfish and fishing interests, tribes and others.

(5) Ecosystem Characterization – Species and Habitats

Recommendation: Continue and expand research and monitoring efforts on nearshore species and habitats. Gather scientific information on the abundance and distribution of species and habitats, the interactions among species and between species and their physical environment, and changes in those resources and interactions over time. The SGCN species information and **Appendix - Nearshore Research and Monitoring** needs provide guidance for setting research and monitoring priorities.

Rationale: Management of nearshore resources is most effective when based on a sound scientific understanding of the nearshore ecosystem. While there has been a great deal of research on Oregon's nearshore ocean and natural resources, there remain significant data gaps that, once filled, will reduce uncertainty in resource management. ODFW gathers information on nearshore fish, invertebrates, marine mammals and habitats. In addition, ODFW monitors changes in marine reserves and nearby comparison areas, providing a unique opportunity to examine changes that occur to nearshore species in areas that are closed to fishing compared with similar areas where fishing occurs. These ODFW programs, along with numerous efforts undertaken by universities, resource agencies, and other partners need to be continued and expanding to produce information necessary to meet resource management challenges.

Potential Partners: State and federal natural resource agencies, universities, non-governmental organizations, fishing interests, tribes, and the general public.

(6) Fishery Independent Surveys

Recommendation: Develop methods for surveying fishery species in the nearshore environment with the goal of collecting fish and shellfish abundance data useful in assessing the status of harvested fish and shellfish stocks. Once methods are developed, conduct periodic fishery-independent surveys in the nearshore environment to produce data useful in stock assessments and develop long-term datasets that can indicate trends in abundance over time.

Rationale: The status of fishery stocks needs to be assessed periodically to ensure that fishery managers set appropriate catch limits and to provide sustainable harvest into the future. Stock assessments are often based on a combination of data collected from fishery landings and fishery-independent surveys of fish populations. Fishery-independent data are crucial to fine-tune and ground truth stock assessment models, helping to ensure assessment results most accurately reflect real-world fish abundance. These more accurate results allow managers and fishermen to have more certainty with management decisions and reduce the risk of deviating from conservation targets.

There are currently no fishery-independent surveys for most fish species targeted by nearshore fisheries. Many of these species are caught on nearshore rocky reefs, an environment that presents challenges to conventional fish survey methodology (e.g., trawl surveys). Methods need to be developed for conducting fish surveys in nearshore rocky reef areas that will produce consistent and reliable results useful in assessing stocks. Surveys then need to be conducted on a periodic basis and continued over a long time period to be useful in supporting stock assessments. The initial focus should be on nearshore rocky reef fish species, including black, blue, deacon, China, copper, quillback, and other rockfish species, as well as kelp greenling and cabezon.

Potential Partners: Fishery managers, stock assessment scientists, commercial and sport fishing interests, tribes, non-governmental organizations and university scientists.

(7) Nearshore Species Stock Assessments

Recommendation: Improve stock assessments and/or stock status indicators for priority data-limited nearshore fish and shellfish species to improve confidence in population estimates and management strategies. Develop and improve data collection programs needed to support nearshore species stock assessments including developing fishery-independent surveys (see Recommendation 6) and evaluate and improve existing fishery monitoring programs that record fishery catch/landings, estimate fishery effort, and collect biological data on landed catch.

Rationale: There is limited information about nearshore fish and shellfish populations available for use in population assessments. Data and monitoring have not been adequate to confidently assess stock status on many nearshore species, and there is currently no mechanism for indicating a population decline for many species. Developing stock assessment and/or indicator strategies, along with collecting the data necessary to implement the strategies, is essential to maintain confidence in management decisions and ensure sustainable harvest.

Potential Partners: ODFW, NOAA stock assessment scientists, other state and federal fishery resource agencies, tribes, university scientists, and the fishing industry.

(8) Human Dimensions Research and Monitoring

Recommendation: Conduct and support studies of social and economic patterns and trends as they relate to nearshore resources, human use of the resources, and effects of resource management actions on individuals, user groups, or communities. Potential topics include coastal community demographic trends, economic and social contributions of industries that depend on nearshore resources directly (e.g., fishing) or indirectly (e.g., tourism), and the impacts of regulatory and other management changes, including those that address climate change effects on coastal communities. In some cases, new methods will need to be developed to study these topics and develop data useful for resource management.

Rationale: Human dimensions information is central to understanding the context of natural resource issues and how people, coastal communities, economies, and nearshore resources are interrelated and might be

affected by various management actions and policy choices. The social and economic benefits and consequences of resource management and policy actions including spatial planning need to be an integral part of the process. Gaining a better understanding of how to engage diverse communities and cultures to effectively participate in shaping policy is becoming increasingly important. There is a complex mix of conservation, sustainable harvest, land use practices, and social wellbeing that go into such decisions. One example is how to effectively and proactively address the impacts of climate change in a timely manner. Another example is ODFW's marine reserves program ongoing human dimensions work about Oregon's coastal communities evaluating marine reserves as a management tool that increases our general understanding Oregon's coastal communities and user groups.

Potential Partners: State and federal natural resource agencies, university scientists, non-governmental organizations, the fishing industry, tribes, and the general public.

(9) Marine Mammal-Human Interactions

Recommendation: Continue and expand efforts to gather necessary information to manage resource conflicts between marine mammals and people in Oregon's nearshore ocean, estuaries, and rivers. Information needed includes ongoing monitoring of population abundance, research on feeding habits and foraging behavior, research on predation impacts to fish populations, evaluation of conflicts with fisheries and methods to reduce them, and research on how to mitigate negative effects of human activities on marine mammals.

Rationale: Many marine mammal species in the Pacific Northwest, under the protection of the federal Marine Mammal Protection Act of 1972, have enjoyed a marked recovery of their populations. In some cases, the substantial increase in the number of pinnipeds along the coast and in the lower Columbia River has resulted in widespread negative impacts to fish species of conservation concern such as ESA-listed salmon and steelhead, white sturgeon and Pacific lamprey, as well as conflicts with sport and commercial fisheries. As an example, the eastern stock of Steller sea lions has experienced a successful recovery and was delisted under the Endangered Species Act. Similarly, some populations of cetaceans like gray whales and humpback whales have increased. While

these are conservation success stories, the increase has resulted in increased resource conflicts throughout their range. To address conflicts created by increasing marine mammal populations, it is essential to monitor these populations, examine food habits, foraging behavior, and predation effects on fish populations, and evaluate conflicts with fisheries and other human activities and how best to mitigate them.

Potential Partners: ODFW, National Oceanic and Atmospheric Administration, the Washington Department of Fish and Wildlife, U.S. Army Corps of Engineers, sport and commercial fishing interests, tribes, port districts, and other state and local government entities.

Category: Management and Policy

Good governance for natural resources is built from a transparent management framework, trust from stakeholders, and sound science. Resource sustainability and resilience to a changing environment is improved with good management, good policy, and good governance. The recommendations in this category address priority nearshore issues and species using a variety of non-regulatory tools.

(10) Management Response to Climate Change

Recommendation: Promote use of climate change information in management decision-making and policy development in statewide, regional and global arenas. Build climate resilience and climate change adaptation into decision-making to maximize the long-term benefits of today's public investment in natural resource management.

Rationale: Our understanding of climate change continues to broaden and deepen, as we discover the multitude of climate change symptoms and explore predictions of future impacts. Symptoms include those that have been in the public awareness for decades (e.g. warming temperatures) as well as newly identified phenomenon such as ocean acidification, which was first recognized in 2003. Many (or arguably most) natural resource management tools do not explicitly incorporate climate change information; at best, management tools include methods for addressing scientific uncertainty (e.g. harvest quota estimates), which may indirectly account for some degree of climate change uncertainty, but not all of it. Decisions made today on natural resource issues – made in a vacuum relative to climate change adaptation information – likely will not stand

the test of time. Poor decisions today, assuming a static environment, will likely lead to destabilization of businesses, and economies that rely on resource availability for harvest, tourism or other purposes.

Potential Partners: State and federal natural resource agencies, university scientists, non-governmental organizations, tribes, and the fishing industry.

(11) Marine Fishery Management Plans

Recommendation: Build the information/datasets and stakeholder support for state marine fishery management plans for appropriate nearshore SGCN and Watch List species (see **Appendix - Nearshore Species**).

Rationale: Transparent documentation of management strategies can lead to increased public engagement in management (particularly increased public input) and improved information for decision-making processes. Both lead to greater public confidence that Oregon's natural resources are healthy and well-managed. To facilitate transparency and improve information in decision-making, ODFW has developed the Marine Fishery Management Plan Framework (2015) – an approach to developing Fishery Management Plans (FMPs) for nearshore and other marine species, developed under the umbrella of the Native Fish Conservation Policy. The goal of the Framework is to create a common understanding of what can and/or should be part of state FMPs and lay out a publicly transparent road map for how to develop marine FMPs. The real heart of the Framework is in the building of individual FMPs, each of which will be adopted by the Fish and Wildlife Commission. Building each individual FMP will be time-consuming and labor-intensive, both for agency staff and for the public, whose input will be necessary for the FMPs to be rigorous and effective.

Potential Partners: State and federal natural resource agencies, sport and commercial fishing interests, non-governmental organizations, university scientists, tribes, and the general public.

(12) Marine Planning

Recommendation: Participate in marine planning processes to ensure Oregon's interests in marine natural resource conservation and use are fully represented in marine policy. Develop marine natural resource spatial information and

incorporate it into marine planning processes to ensure they use the best available science to formulate plans concerning Oregon's marine resources and uses (see **Land Use Changes** KCI). There are many processes underway that are specifically focused on the marine environment, both within the state and outside of state boundaries that may affect Oregon's nearshore waters, species and habitats.

Rationale: Growing demand for ocean resources and competing use of ocean space has increased the need to move beyond single-sector management and plan for ocean uses more holistically. Marine planning processes require comprehensive spatial information on location, abundance and distribution of marine resources and resource uses. Spatial data that meet these needs have not been developed for many marine resources and require collaborative efforts and funding to ensure full development. Marine planning efforts engage multiple users, governments, and management agencies to ensure continued sustainability of ocean resources, while providing for a diverse array of uses and public priorities. Alongside many collaborators and partners, ODFW participated in the state's development and modifications of the Territorial Sea Plan, which outlines state policy on its Territorial Sea including spatial planning that may affect marine life and their habitats. Several marine planning processes affecting Oregon are currently underway at the federal level. While these are in federal waters, they still affect Oregon's nearshore marine resources and Oregon's ocean users. ODFW will continue to play a key role in providing natural resource information to support these processes, as well as ensuring Oregon's nearshore resources and ocean user groups are represented in policy decisions. ODFW will also play an ongoing role in plan implementation and keeping marine resource data sets current, and relevant, as new information becomes available.

Potential Partners: State and federal natural resource agencies, sport and commercial fishing interests, local, state, regional, and federal governments, community groups, non-governmental organizations, tribes, and the general public.