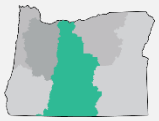
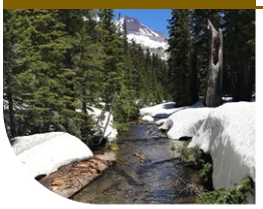


REGION 4 Observed & Projected Changes for Habitats & Fish Species

Habitats

Cold Forests / Subalpine


Credit: Linda Repplinger

- Likely that cold forests will be more sensitive to warming at their lower elevation limits as moist-forest species may expand into these places.
- As snowpack decreases, cold-forest species may be able to establish at treeline (assuming sufficient soil is available).
- Soil moisture stress will reduce overall vigor and growth of subalpine tree species.
- Increased frequency and extent of wildfire could not only kill subalpine species across large landscapes but make regeneration difficult.
- Increased frequency and extent of wildfire and insects would have a significant negative effect on most species, especially whitebark pine.

Woodlands


credit: Joan Amero

- Tree establishment and growth in woodlands are limited by precipitation and soil moisture; lower precipitation could decrease tree establishment and possibly increase tree mortality.
- Higher temperatures in spring and summer may increase mortality in some woodlands, particularly at lower elevations.
- Higher precipitation could facilitate further juniper expansion.
- Increased fire frequency could reduce conifer encroachment, favoring the development of open woodlands.
- In general, expansion of woodland types is likely with hotter and drier future conditions; expansion is likely at the expense of dry forest.

Mesic Forests


credit: OWEB

- Higher temperatures may increase growth and productivity in some locations, especially if precipitation increases; drought stress could limit the expansion of mesic forests and favor species that tolerate low soil moisture/adapted to drier conditions (e.g., ponderosa pine, lodgepole pine).
- Pumice soils could limit expansion in some areas.
- Severe wildfires are possible in areas with high fuel loading.

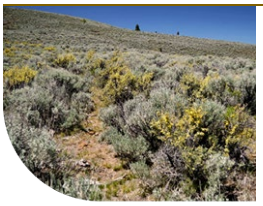
Dry Forests


credit: OWEB

- Dry forests are less sensitive to warming than other forest types; species may be able to expand into more suitable habitat (e.g., higher elevation).
- Dry forests are sensitive to the duration and severity of summer drought stress at lower elevations; shifts from dry forest to woodlands or shrublands may occur in the driest portions of the current dry forest range, especially if drought and frequent fire limit regeneration.
- Establishment and growth will be affected by water availability; growth of dry forest species is projected to decrease.
- Increased frequency and extent of wildfire will tend to favor dominant species in these forests except where fuel loads are high.

- Increasing the frequency of short-interval, high-severity reburns could result in conversion to shrubland.
- Increased precipitation could lead to the expansion of dry forest.
- Tree mortality may also increase in some locations because of interactions among drought, disturbance, and insects.
- Ponderosa pine may shift to higher elevations and become more dominant relative to Douglas-fir.

Shrub & Grasslands


credit: OWEB

- Shrublands are limited by snowpack, soil moisture, and winter temperatures; grassland composition and extent are controlled by soil moisture and winter temperatures.
- Continued loss of snowpack may accelerate the loss of some shrublands, especially big sagebrush; drought-tolerant species may replace big sagebrush in some locations.
- Shrublands are sensitive to altered wildfire frequency and severity; increased fire frequency and extent would reduce the distribution of sagebrush and some other shrub species.
- Decreased winter or spring precipitation may shift the composition and abundance of grasslands to more drought-tolerant or invasive species whereas increased winter or spring precipitation may increase woody vegetation in areas currently dominated by grasslands.
- Relatively little change projected for cool-season grasslands.

Wetlands, Riparian, & Groundwater-Dependent Ecosystems (GDE)


credit: OWEB

- Sensitive to drought, higher evapotranspiration, and lower summer streamflows, which can decrease habitat extent and alter plant community composition.
- In wetlands and GDEs, less water during summer would reduce the duration and depth of standing water and increase water temperature; this could affect local distribution and abundance of plant species and aquatic fauna.
- Some GDEs may decrease in size or completely dry out in summer due to reduced snowpack and resulting declines in the length of time that aquifer recharge can occur.
- Some ephemeral montane wetlands may disappear, and intermediate montane wetlands may become ephemeral.
- Drier conditions and more frequent fire in riparian areas may favor conifers over species typically associated with riparian areas (e.g., deciduous hardwoods).
- Increased flooding as a result of lower snowpack and increased intensity of winter precipitation events would affect erosion and sedimentation, resulting in changes to channel form and fluvial dynamics.

Fish Species

Steelhead Trout


credit: Greg Shields, cc

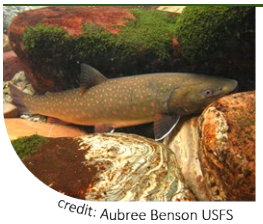
- Increased peak flows may affect rearing fish, particularly in streams that lack low-velocity habitat.
- Based on projections of stream temperature, steelhead streams with optimal mean August temperatures are projected to decrease from 58% (current) to 31% (2080).
- Lower flows and warmer temperatures place additional stress on steelhead, which could increase pre-spawn mortality rates, impair spawning ability, or reduce viability of eggs and embryos.
- Summer steelhead populations in the Middle Columbia are projected to experience warmer temperatures and lower flows while in freshwater, and consequently, find fewer cold-water refugia.

Redband Trout


credit: Jonny Armstrong OSU

- Headwater habitat loss during summer will be most pronounced in the Goose Lake, Chewaucan, and Upper Klamath basin species management units.
- Higher winter peak flows may affect rearing fish, particularly in streams that lack low-velocity habitat.
- Based on projections of stream temperature, redband streams with optimal mean August temperatures are projected to decrease from 67% (current) to 40% (2080).

Bull Trout


credit: Aubree Benson USFS

- Increasing water temperatures can affect spawning distribution and abundance and early rearing.
- Higher winter peak flows may affect bull trout redds and incubating eggs; rearing fish, especially in streams that lack low-velocity habitat may also be at risk.
- Bull trout streams within the optimal temperature range are projected to decrease 31% by the 2040s and 52% by the 2080s.
- The Columbia River-Hood core area retains a greater amount of streams within the optimal August temperature than the other Columbia River core areas.
- Populations exposed to high temperatures and frequent winter flooding may have lower genetic diversity.

Pacific Lamprey


credit: USFWS

- Increased risk of mortality for embryonic and newly-hatched Pacific lamprey due to water temperatures exceeding 20°C (68°F) in summer.
- Increases in water temperature can also affect the survival of larval rearing fishes and timing or number of individuals as they metamorphose into ocean-going life stage, or lead to premature migration of juvenile lamprey (which could expose them to saltwater before they have made necessary physiological changes).

Lost River & Shortnose Suckers


credit: USGS

- Nearly 80% of current stream habitats used by suckers will have summer temperatures higher than 20°C (68°F) by 2080.
- These species will also be affected by low summer flows and declining water quality (e.g., if declining flows in important spawning tributaries result in habitat fragmentation).

Coho Salmon


credit: USGS

- Areas inhabited by coho salmon from the Hood population are projected to have more stream length experiencing high-flow conditions.
- Warming water temperatures can accelerate egg incubation rates in winter or spring and potentially desynchronize the developmental phenology of juveniles from the temporal availability of seasonal habitats.

Chinook Salmon


Credit: Greg Morgan, BLM

- Highly variable flow and temperature regimes in April and May can affect smolt migration (e.g., high flows and water temperatures can narrow the migration window while cool temperatures and minimal flows can delay migration).
- Holding adults are vulnerable to higher summer water temperatures.
- Reduced availability of cold-water refuges in late summer and early fall.
- Altered behavior, physiology, and growth due to warmer water temperatures.

Information from the following references and the citations therein:

1. Halofsky, J.E., D.L. Peterson, and R.A. Gravenmier, eds. 2022. Climate change vulnerability and adaptation in the Columbia River Gorge National Scenic Area, Mount Hood National Forest, and Willamette National Forest. Gen. Tech. Rep. PNW-GTR-1001. U.S. Dept of Ag., Forest Service, Pacific Northwest Research Station. 469 p.
2. Halofsky, J.E., D.L. Peterson, and J.J. Ho, eds. 2019. Climate change vulnerability and adaptation in south-central Oregon. Gen. Tech. Rep. PNW-GTR-974. U.S. Dept of Ag., Forest Service, Pacific Northwest Research Station. 473 p.