

NORTHWEST

KEY MESSAGES

Changes in the timing of streamflow related to changing snowmelt are already observed and will continue, reducing the supply of water for many competing demands and causing far-reaching ecological and socioeconomic consequences.

In the coastal zone, the effects of sea level rise, erosion, inundation, threats to infrastructure and habitat, and increasing ocean acidity collectively pose a major threat to the region.

The combined impacts of increasing wildfire, insect outbreaks, and tree diseases are already causing widespread tree die-off and are virtually certain to cause additional forest mortality by the 2040s and long-term transformation of forest landscapes. Under higher emissions scenarios, extensive conversion of subalpine forests to other forest types is projected by the 2080s.

While the agriculture sector's technical ability to adapt to changing conditions can offset some adverse impacts of a changing climate, there remain critical concerns for agriculture with respect to costs of adaptation, development of more climate resilient technologies and management, and availability and timing of water.



Rising summer temperatures and changing water flows threaten salmon and other fish species.

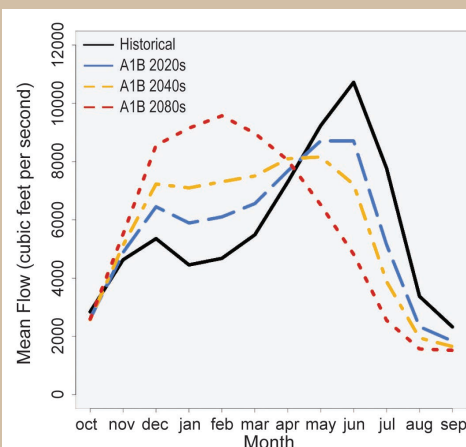
The Northwest's economy, infrastructure, natural systems, public health, and agriculture sectors all face important climate change related risks. Impacts on infrastructure, natural systems, human health, and economic sectors, combined with issues of social and ecological vulnerability, will unfold quite differently in largely natural areas, like the Cascade Range, than in urban areas like Seattle and Portland,¹ or among the region's many Native American tribes.²

Seasonal water patterns shape the life cycles of the region's flora and fauna, including iconic salmon and steelhead, and forested ecosystems.³

Adding to the human influences on climate, human activities have altered natural habitats, threatened species, and extracted so much water that there are already conflicts among multiple users in dry years. As conflicts and trade-offs increase, the region's population continues to grow. Particularly in the face of climate change, the need to seek solutions to these conflicts is becoming increasingly urgent.

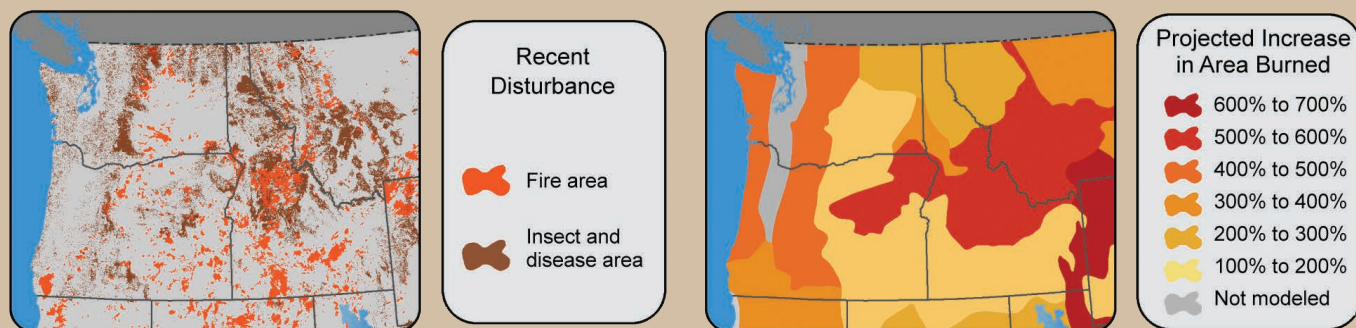
Observed regional warming has been linked to changes in the timing and amount of water availability in basins with significant snowmelt contributions to streamflow. By 2050, snowmelt is projected to shift three to four weeks earlier than the last century's average, and summer flows are projected to be substantially lower, even for a scenario that assumes emissions reductions (B1).⁴ These reduced flows will require trade-offs among reservoir system objectives,⁵ especially with the added challenges of summer increases in electric power demand for cooling and additional water consumption by crops and forests.

Future Shift in Timing of Streamflows



Mixed rain-snow watersheds, such as the Yakima River basin, an important agricultural area in eastern Washington, will see increased winter flows, earlier spring peak flows, and decreased summer flows in a warming climate, causing widespread impacts. Natural surface water availability during the already dry late summer period is projected to decrease across most of the Northwest.⁶ Projections are based on the A1B emissions scenario, which assumes continued increases in emissions through mid century and gradual declines thereafter. (Figure source: adapted from Elsner et al. 2010⁴).

Insects and Fire in Northwest Forests



(Left) Insects and fire have cumulatively affected large areas of the Northwest and are projected to be the dominant drivers of forest change in the near future. Map shows areas recently burned (1984 to 2008)⁷ or affected by insects or disease (1997 to 2008).⁸ (Right) Map indicates the increases in area burned that would result from the regional temperature and precipitation changes associated with a 2.2°F global warming⁹ across areas that share broad climatic and vegetation characteristics.¹⁰ Local impacts will vary greatly within these broad areas with sensitivity of fuels to climate.¹¹

Climate change will alter Northwest forests by increasing wildfire risk, insect and disease outbreaks, and by forcing longer-term shifts in forest types and species. Many impacts will be driven by water deficits, which increase tree stress and mortality, tree vulnerability to insects, and fuel flammability. By the 2080s, the median annual area burned in the Northwest would quadruple relative to the 1916-2007 period to 2 million acres (range 0.2 to 9.8 million acres) under a scenario that assumes continued increases in emissions through mid century and gradual declines thereafter (A1B).¹¹



Oyster harvest in Coos Bay, Oregon. Ocean acidification poses threats to the region's important shellfish industry.



SELECTED ADAPTATION EFFORTS



In Washington's Nisqually River Delta, large-scale estuary restoration to assist salmon and wildlife recovery provides an example of adaptation to climate change and sea level rise. After a century of isolation behind dikes, much of the Nisqually National Wildlife Refuge was reconnected with tidal flow in 2009 by removal of a major dike and restoration of 762 acres, with the assistance of Ducks Unlimited and the Nisqually Indian Tribe. This reconnected more than 21 miles of historical tidal channels and floodplains with Puget Sound.¹² A new exterior dike was constructed to protect freshwater wetland habitat for migratory birds from tidal inundation, future sea level rise, and increasing river floods.

