Union of Concerned Scientists
Citizens and Scientists for Environmental Solutions

backgrounder

All information in this summary is entirely based on "Global Climate Change Impacts in the United States" (USGCRP, 2009). To enhance clarity, slight modifications were made that maintain the intended meaning of the report.

Northwest

Idaho, Oregon, Washington, and Western Montana

CLIMATE

- Regionally-averaged temperature rose about 1.5ºF over the past century (with some areas experiencing increases up to 4ºF) and is projected to increase another 3 to 10ºF during this century. Higher emissions scenarios would result in warming in the upper end of the projected range.
- Increases in winter precipitation and decreases in summer precipitation are projected by many climate models, though these projections are less certain than those for temperature.

WATER AVAILABILITY

Declining springtime snowpack leads to reduced summer streamflows, straining water supplies.
The Northwest is highly dependent on temperature sensitive springtime snowpack to meet growing, and often competing, water demands such as municipal and industrial uses, agricultural irrigation, hydropower production, navigation, recreation, and in-stream flows that protect aquatic ecosystems including threatened and endangered species.

Higher cool season (October through March) temperatures cause more precipitation to fall as rain rather than snow and contribute to earlier snowmelt.

- April 1 snowpack, a key indicator of natural water storage available for the warm season, has already declined substantially throughout the region.
- The average decline in the Cascade Mountains, for example, was about 25 percent over the past 40 to 70 years, with most of this due to the 2.5ºF increase in cool season temperatures over that period.
- Further declines in Northwest snowpack are projected to result from additional warming over this century, varying with latitude, elevation, and proximity to the coast.
- April 1 snowpack is projected to decline as much as 40 percent in the Cascades by the 2040s.

Throughout the region, earlier snowmelt will cause a reduction in the amount of water available during the warm season.
In areas where it snows, a warmer climate means major changes in the timing of runoff: streamflow increases in winter and early spring, and then decreases in late spring, summer, and fall.

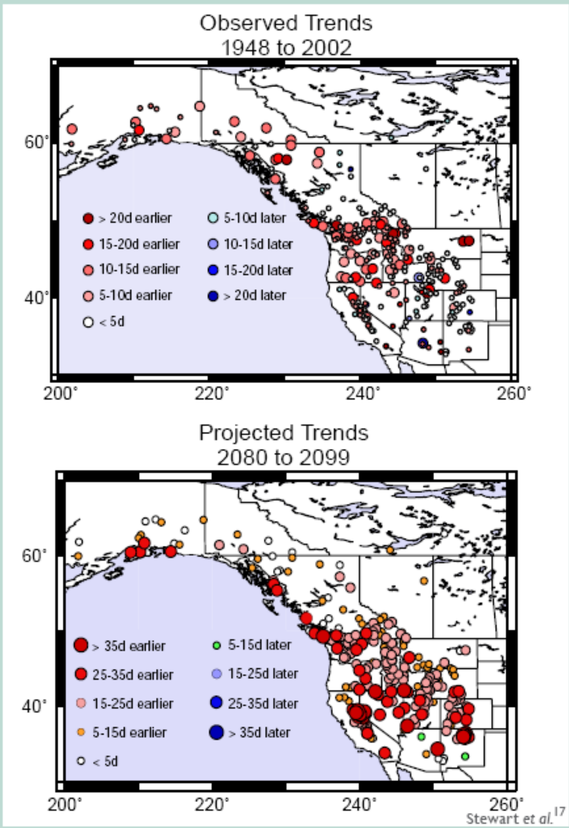
- This shift in streamflow timing has already been observed over the past 50 years, with the peak of spring runoff shifting from a few days earlier in some places to as much as 25 to 30 days earlier in others.This trend is projected to continue, with runoff shifting 20 to 40 days earlier within this century. Reductions in summer water availability will vary with the temperatures experienced in different parts of the region.

In relatively warm areas on the western slopes of the Cascade Mountains, for example, reductions in warm season (April through September) runoff of 30 percent or more are projected by mid-century, whereas colder areas in the Rocky Mountains are expected to see reductions on the order of 10 percent. Areas dominated by rain rather than snow are not expected to see major shifts in the timing of runoff.

Extreme high and low streamflows also are expected to change with warming.
Increasing winter rainfall (as opposed to snowfall) is expected to increase winter flooding in relatively warm watersheds on the west side of the Cascades. The already low flows of late summer are projected to decrease further due to both earlier snowmelt and increased evaporation and water loss from vegetation. Projected decreases in summer precipitation would exacerbate these effects. Some sensitive watersheds are projected to experience both increased flood risk in winter and increased drought risk in summer due to warming.

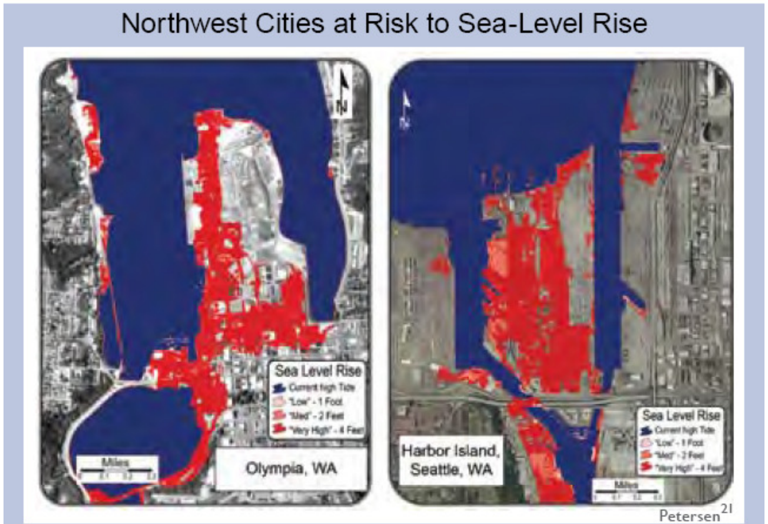
Earlier flows would place more of the year's runoff into the category of hazard rather than resource.
The region's water supply infrastructure was built based on the assumption that most of the water needed for summer uses would be stored naturally in snowpack. For example, the storage capacity in Columbia Basin reservoirs is only 30 percent of the annual runoff, and many small urban water supply systems on the west side of the Cascades store less than 10 percent of their annual flow. Besides providing water supply and managing flows for hydropower, the region's reservoirs are operated for flood-protection purposes and, as such, might have to release (rather than store) large amounts of runoff during the winter and early spring to maintain enough space for flood protection.

Trends in Peak Streamflow Timing



Top map shows changes in runoff timing in snowmelt-driven streams during 1948-2002 with red circles indicating earlier runoff, and blue circles indicating later runoff. Bottom map shows projected changes in snowmelt-driven streams by 2080-2099, compared to 1951-1980, under a higher emissions scenario.[†]

SEA LEVEL RISE AND COASTAL CITIES



Highly populated coastal areas throughout Puget Sound, Washington, are vulnerable to sea-level rise. The maps show regions of Olympia and Harbor Island (both located in Puget Sound) that are likely to be lost to sea-level rise by the end of this century based on moderate and high estimates.

Sea-level rise along vulnerable coastlines will result in increased erosion and the loss of land.
Climate change is projected to exacerbate many of the stresses and hazards currently facing the coastal zone. Sea-level rise will increase erosion of the Northwest coast and cause the loss of beaches and significant coastal land areas. Among the most vulnerable parts of the coast are the heavily populated south Puget Sound region, which includes the cities of Olympia, Tacoma, and Seattle, Washington.

- A midrange estimate of relative sea-level rise for the Puget Sound basin is about 13 inches by 2100.
- However, higher levels of up to 50 inches by 2100 in more rapidly subsiding portions of the basin are also possible given the large uncertainties about accelerating rates of ice melt from Greenland and Antarctica in recent years.
- A two foot rise in global seal level by the end of this century would result in a relative sea-level rise of 1 foot at Neah Bay, WA.

Some climate models project changes in atmospheric pressure patterns that suggest a more southwesterly direction of future winter winds. Combined with higher sea levels, this would accelerate coastal erosion all along the Pacific Coast. Sea-level rise in the Northwest (as elsewhere) is determined by global rates of sea-level rise, changes in coastal elevation associated with local vertical movement of the land, and atmospheric circulation patterns that influence wind-driven “pile-up” of water along the coast.

The projected heavier winter rainfall suggests an increase in saturated soils and, therefore, an increased number of landslides.
Increased frequency and / or severity of landslides is expected to be especially problematic in areas where there has been intensive development on unstable slopes. Within Puget Sound, the cycle of beach erosion and bluff landslides will be exacerbated by sea-level rise, increasing beach erosion, and decreasing slope stability.

HYDRO POWER PRODUCTION

There is a high likelihood that water shortages will limit power plant electricity production in many regions, projecting future water constraints on electricity production in thermal power plants for Arizona, Utah, Texas, Louisiana, Georgia, Alabama, Florida, California, Oregon, and Washington State by 2025.

One of the largest demands on water resources in the region is hydroelectric power production. About 70 percent of the Northwest's energy needs are provided by hydropower, a far greater percentage than in any other region.

- Warmer summers will increase electricity demands for air conditioning and refrigeration at the same time of year that lower streamflows will lead to reduced hydropower generation.
- Hydroelectric generation is very sensitive to changes in precipitation and river discharge. For example, every 1 percent decrease in precipitation results in a 2 to 3 percent drop in streamflow; every 1 percent decrease in streamflow in the Colorado River Basin results in a 3 percent drop in power generation. Such magnifying sensitivities occur because water flows through multiple power plants in a river basin.

FORESTS

Higher summer temperatures and earlier spring snowmelt are expected to increase the risk of forest fires in the Northwest by increasing summer moisture deficits; this pattern has already been observed in recent decades. Drought stress and higher temperatures will decrease tree growth in most low and mid-elevation forests and also will increase the frequency and intensity of mountain pine beetle and other insect attacks, further increasing fire risk and reducing timber production, an important part of the regional economy.

The mountain pine beetle outbreak in British Columbia has destroyed 33 million acres of trees so far, about 40 percent of the marketable pine trees in the province. By 2018, it is projected that the infestation will have run its course and over 78 percent of the mature pines will have been killed; this will affect more than one-third of the total area of British Columbia's forests. Idaho's Sawtooth Mountains are also now threatened by pine beetle infestation.

The extent and species composition of forests also are expected to change as tree species respond to climatic changes. In the short term, high elevation forests on the west side of the Cascade Mountains are expected to see increased growth. In the longer term, forest growth is expected to decrease as summertime soil moisture deficits limit forest productivity, with low-elevation forests experiencing these changes first. There is also the potential for extinction of local populations and loss of biological diversity if environmental changes outpace species' ability to shift their ranges and form successful new ecosystems.

AGRICULTURE

Agriculture, especially production of tree fruit such as apples, is also an important part of the regional economy. Decreasing irrigation supplies, increasing pests and disease, and increased competition from weeds are likely to have negative effects on agricultural production.

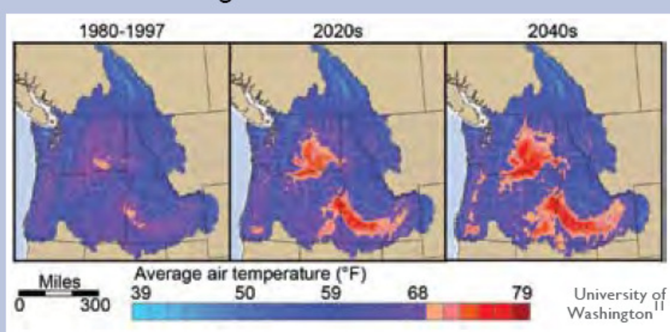
SALMON AND FRESHWATER FISH
Salmon and other coldwater species will experience additional stresses as a result of rising water temperatures and declining summer streamflows.

- Northwest salmon populations are at historically low levels due to stresses imposed by a variety of human activities including dam building, logging, pollution, and over-fishing.
- Warming of the climate has negative effects on salmon throughout their life cycle and poses an additional stress.
- As more winter precipitation falls as rain rather than snow, higher winter streamflows scour streambeds, damaging spawning nests and washing away incubating eggs.

Earlier peak streamflows flush young salmon from rivers to estuaries before they are physically mature enough for the transition, increasing a variety of stresses including the risk of being eaten by predators. Lower summer streamflows and warmer water temperatures create less favorable summer stream conditions for salmon and other cold-water fish species in many parts of the Northwest. In addition, diseases and parasites that infect salmon tend to flourish in warmer water. Climate change also impacts the ocean environment, where salmon spend several years of their lives. Historically, warm periods in the coastal ocean have coincided with relatively low abundances of salmon, while cooler ocean periods have coincided with relatively high salmon numbers.

Most wild Pacific salmon populations are extinct or imperiled in 56 percent of their historical range in the Northwest (except Alaska) and California, and populations are down more than 90 percent in the Columbia River system. Many species are listed as either threatened or endangered under the Federal Endangered Species Act. Studies suggest that about one-third of the current habitat for the Northwest's salmon and other cold-water fish will no longer be suitable for them by the end of this century as key temperature thresholds are exceeded. Because climate change impacts on their habitat are projected to be negative, climate change is expected to hamper efforts to restore depleted salmon populations.

Decreasing Habitat for Cold-Water Fish



Salmon can be found where average air temperature is less than about 70°F (shown in blue). Projected average August surface air temperatures in the Columbia Basin suggest that salmon are likely to be threatened by rising temperatures across much of their current habitat, based on a higher emission scenario.[†3,19]