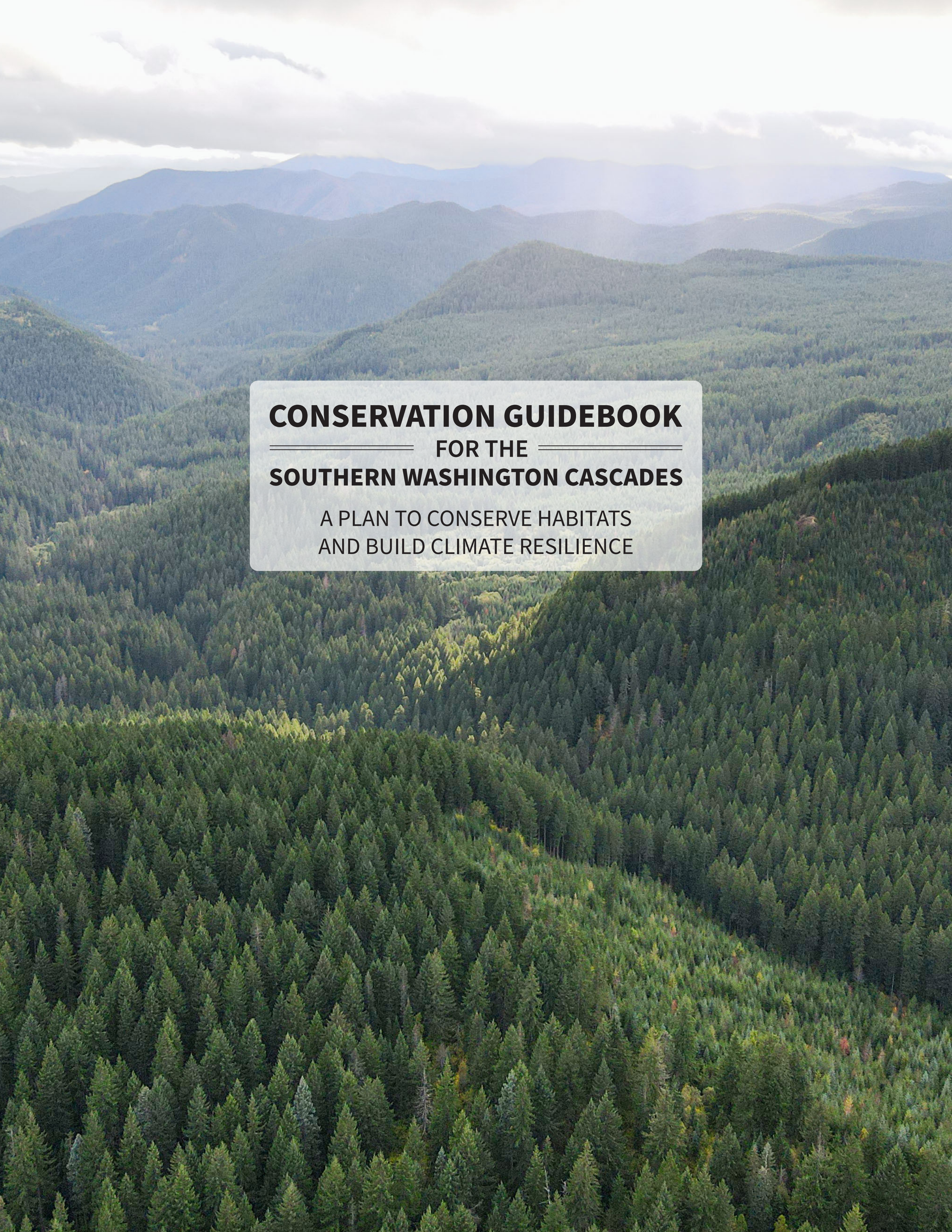


CONSERVATION GUIDEBOOK FOR THE SOUTHERN WASHINGTON CASCADES

A PLAN TO CONSERVE HABITATS AND BUILD CLIMATE RESILIENCE

Conservation Guidebook for the Southern Washington Cascades: A Plan to Conserve Habitats and Build Climate Resilience

Shiloh Halsey, Ashley Short, and Amanda Keasberry

Chapter reviewers: Joseph Vaile, Jessica Hudec, David Lindley, Andrea Ruchty, Brice Crayne, Stephen Zylstra, Susan Jane Brown, Don Lloyd, Nathaniel Reynolds, Bob Robison, Molly Whitney, Sean Roome, Bryn Harding, and Suzanne Whitney

Guidebook design by Bryn Harding and Shiloh Halsey

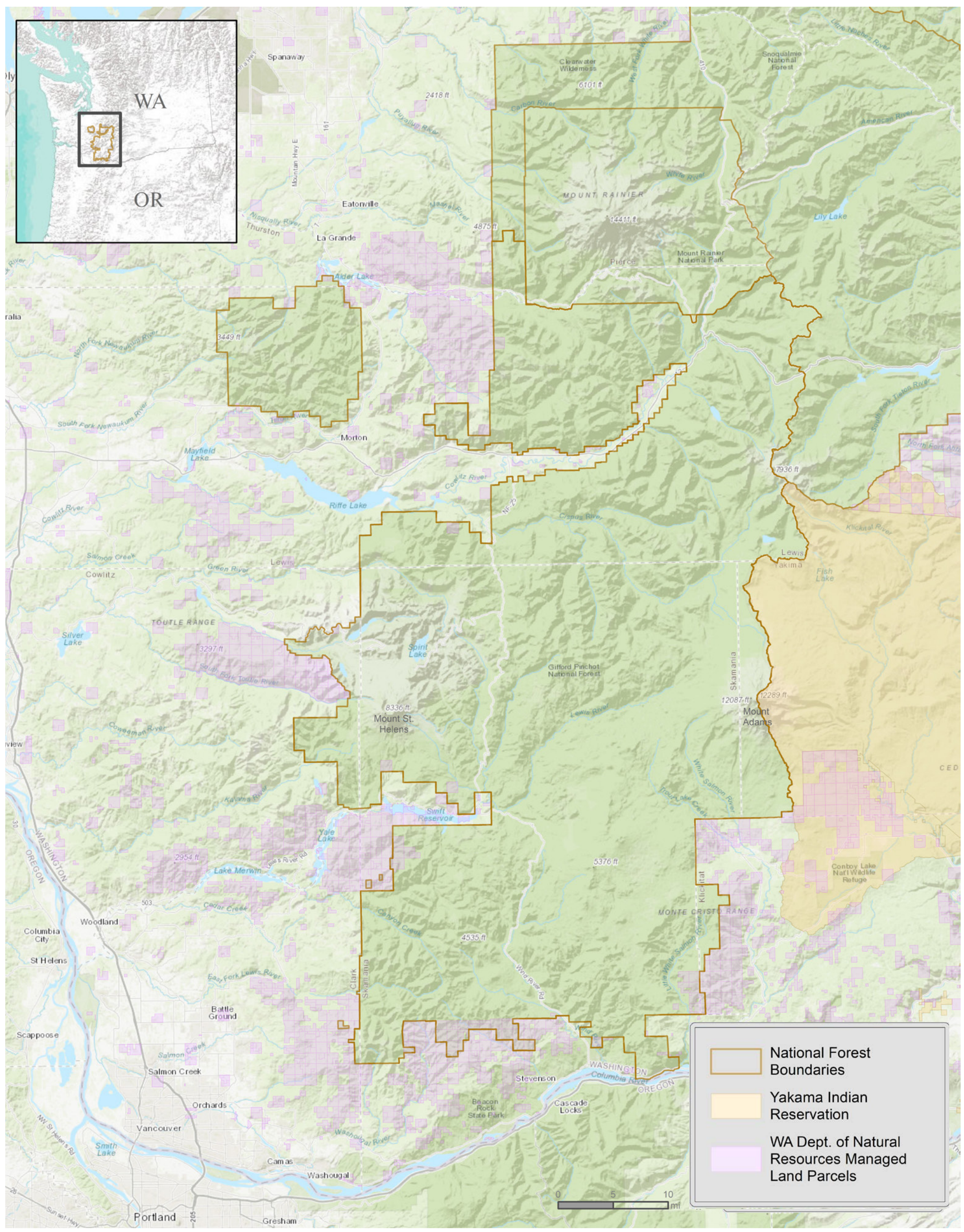
CHAPTER 1: CLIMATE CHANGE AND THE SOUTHERN WASHINGTON CASCADES

View of Mount St. Helens, Goat Mountain, and the Green River Valley from Strawberry Mountain

Climate Change and the Southern Washington Cascades

Our goal in creating this guidebook is to identify and assess the threats of climate change to species and ecosystems in the southern Washington Cascades and to offer a set of conservation and restoration strategies for improving climate resilience and enhancing the general health and vitality of habitats. We begin by outlining the setting and then briefly discuss recent climate projections and what they may mean for our region. The information provided in this introductory chapter is not meant to be an exhaustive investigation into any of these areas. Rather, we aim to set the scene for the recommendations and strategies that are the main focus of this guide.

We then turn to analyzing the ecological challenges and needs of our region within four different subject areas. Chapter 2 addresses forest habitats while Chapter 3 focuses on rivers and other aquatic habitats. These chapters highlight the climate impacts we expect to see in these different ecosystems and our recommendations for addressing these impacts. Chapter



The southern Washington Cascades focus area

The Muddy River floodplain

4 outlines recommendations specific to regional and local forest plans that guide management of our national forests, with particular focus on the Gifford Pinchot National Forest. Chapter 5 explores the dynamics of forests and carbon and outlines strategies to improve carbon storage.

Many of these strategies are replicable and can be applied in other forest landscapes. This guidebook offers a blueprint for conservation and restoration action that non-governmental organizations, land managers, community members, and other interested stakeholders can use when considering next steps for building ecosystem health and resilience. In addition, the strategies outlined within will be used to inform parts of Cascade Forest Conservancy's strategic plan.

The Setting

The southern Washington Cascade Range lies within the Pacific Northwest and encompasses Mount Adams, Mount St. Helens, Mount Rainier, and the Columbia River Gorge. The crest of the Cascade Range bisects this region, with dry forests extending eastward and moist forests sweeping westward toward the ocean. The Gifford Pinchot National Forest is the centerpiece of this landscape and is integral to the continued health and resilience of the region. This diverse landscape is home to a wide array of ecosystems and wildlife, including many threatened and rare species. Streams and rivers of the region provide critical habitat for threatened salmon, steelhead, and bull trout. The forests are home to species including northern spotted owls, fishers, mountain lions, black bears, flying squirrels, and others. Upland meadows sustain a striking diversity of plants and animals, and alpine areas contain unique habitats and glaciers that feed the rivers below.

Around 36 million years ago, the North American Plate drifted westward and collided with the Farallon Plate to create the volcanically active Cascade Arc.[1] By the early Plio-Pleistocene, more regional folding, uplift, and erosion in the Cascadia Subduction Zone increased the rate of local volcanism, resulting in basalt and andesite flows dominating the southern Washington Cascades.[1,2] Stratovolcanoes like Mount Rainier, Mount Adams, and Mount St. Helens hosted many alpine and valley glaciers during the time of regional glaciation over the past two million years; some of these remain today. Erosional processes (e.g., fluvial, glacial, and precipitation) also greatly affected the terrain. The geology of the region is ever-changing, but for now, it has settled into steep, dissected valleys separated by corresponding ridge crests.

Indigenous peoples have lived on and cared for the lands of the Pacific Northwest since time immemorial. The regions discussed in this guidebook are the traditional homelands of the Chinook, Chehalis, Cowlitz, Klickitat, Nisqually, Puyallup, and Yakama Peoples, as well as many other bands and groups. Over thousands of years, they

An Indigenous woman drying huckleberries in southwest Washington, 1937

have developed techniques to harvest salmon, lamprey, and wild game. They maintain habitats for camas and huckleberries, make fibers and containers from cedar, and are masterful canoe-builders. The various peoples of the region each developed complex systems of local specialization and far-reaching trade networks, which enabled them to thrive for thousands of years. Prior to contact with Europeans, parts of the region were among the most densely populated on the continent. From initial contact with Europeans in the late 18th century until the present, the Indigenous peoples of the Pacific Northwest have suffered from the impacts of novel diseases, war, and broken treaties, but they have also persevered against unfavorable odds and survived by adapting again and again—all while maintaining their unique identities and rich cultural heritages. In the subsequent chapters, we discuss the roles that Indigenous people have played and currently play in shaping and defending habitats and species of the southern Washington Cascades, such as their use of fire as a forest management tool and their past and current work improving habitat for salmon.

Many of the ecosystem degradations we seek to address are outcomes of Euro-American colonization and resource extraction, which dramatically altered the landscape during the 1800s and 1900s. This includes the near or full loss of wolves, grizzly bears, fishers, and beavers and the lasting impacts of rampant timber harvest, fire suppression, dams, and road building. We work in a landscape that has been heavily altered in a relatively short period of time.

A skid road for removing logged timber in western Washington

Addressing this degradation is often the first step for improving resilience.

Today, human communities in southwest Washington continue to rely on the resources provided by the landscape, but there is also an increased focus on restoring ecosystem health and establishing a more sustainable balance between ecosystems and human influence. The future of all people in the region is inextricably linked to the fates of our forests and rivers.

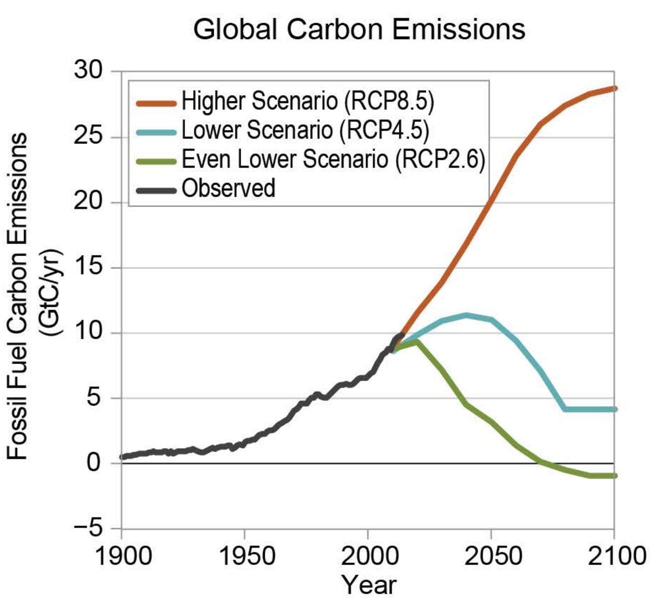
CLIMATE **PROJECTIONS**

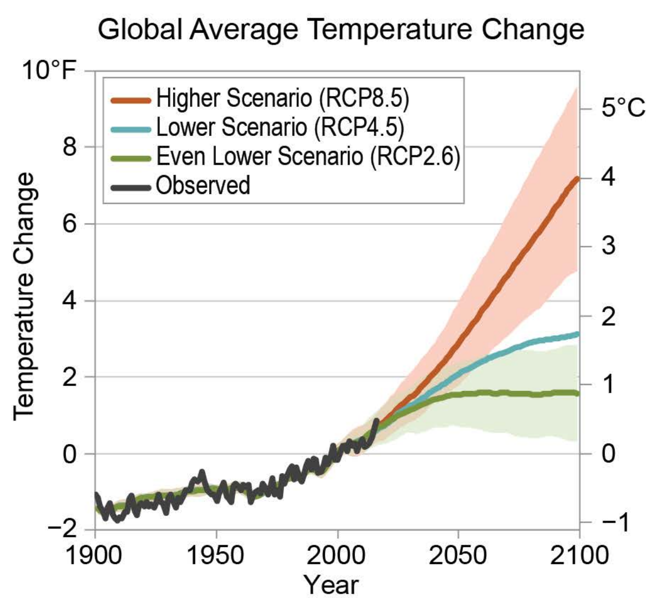
Global

According to the Intergovernmental Panel on Climate Change (IPCC) report published in 2023, average global surface temperatures have risen 1.98 °F (1.1 °C) since the late 1800s.[3] Temperature increase over land, with a rise of 2.86 °F (1.59 °C), has been more pronounced than that over water.[3] The rate of change has accelerated over the last several decades, and temperatures have increased more since 1970 than over any other 50-year period during the last 2,000 years.[3]

Relative to averages from a 1986–2015 timeframe, by the end of the century (2080–2099), we could expect temperature increases ranging from 0.4–2.7 °F (0.2–1.5 °C) under a very low emissions scenario (RCP2.6) to 4.2–8.5 °F (2.4–4.7 °C) under a high emissions scenario (RCP8.5).[4]

Pacific Northwest forests and timberlands covered in snow



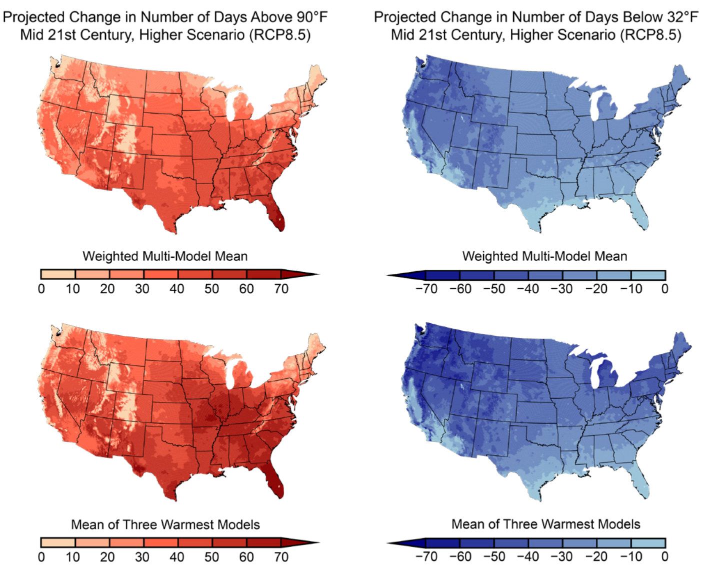


Graphic from Hayhoe et al. 2018 highlighting global dynamics of carbon and temperature. The authors explain the graphs in this way: "Observed and projected changes in global average temperature (right) depend on observed and projected emissions of carbon dioxide from fossil fuel combustion (left) and emissions of carbon dioxide and other heat-trapping gases from other human activities, including land use and land-use change. Under a pathway consistent with a higher scenario (RCP8.5), fossil fuel carbon emissions continue to increase throughout the century, and by 2080–2099, global average temperature is projected to increase by 4.2°–8.5°F (2.4°–4.7°C; shown by the burnt orange shaded area) relative to the 1986–2015 average. Under a lower scenario (RCP4.5), fossil fuel carbon emissions peak mid-century then decrease, and global average temperature is projected to increase by 1.7°–4.4°F (0.9°–2.4°C; range not shown on graph) relative to 1986–2015. Under an even lower scenario (RCP2.6), assuming carbon emissions from fossil fuels have already peaked, temperature increases could be limited to 0.4°–2.7°F (0.2°–1.5°C; shown by green shaded area) relative to 1986–2015. Thick lines within shaded areas represent the average of multiple climate models. The shaded ranges illustrate the 5% to 95% confidence intervals for the respective projections. In all RCP scenarios, carbon emissions from land use and land-use change amount to less than 1 GtC by 2020 and fall thereafter. Limiting the rise in global average temperature to less than 2.2°F (1.2°C) relative to 1986–2015 is approximately equivalent to 3.6°F (2°C) or less relative to preindustrial temperatures, consistent with the aim of the Paris Agreement (see Box 2.4). Source: adapted from Wuebbles et al. 2017."

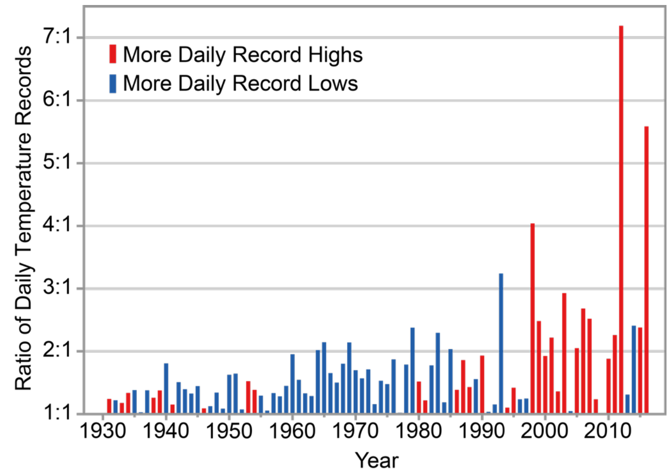
National

In both low and high emissions scenarios, over the coming decades, the United States will likely experience a 2.2 °F (1.2 °C) rise in annual average temperatures compared to the period of 1986–2015. Even more substantial temperature increases are projected for the late century, with increases in the ranges of 2.3–6.7 °F (1.3–3.7 °C) under a low emissions scenario (RCP4.5) and 5.4–11.0 °F (3.0–6.1 °C) under a higher scenario (RCP8.5).[4]

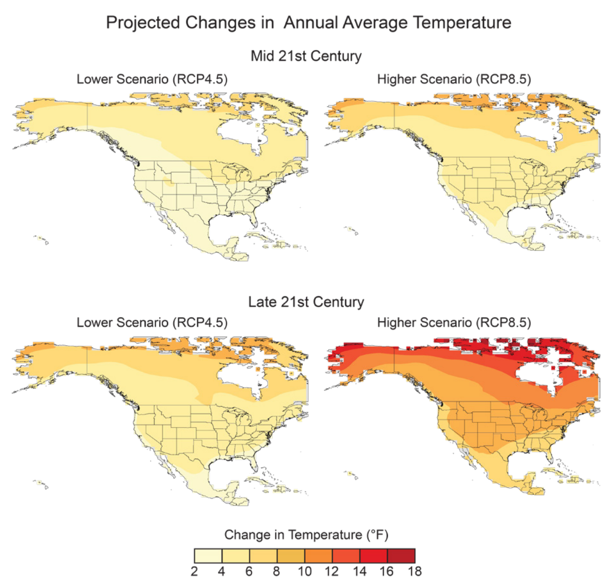
With these changes, heat waves are anticipated to become more severe, and the number of days with temperatures exceeding 90 °F is expected to rise.[4] Cold waves, on the other hand, are expected to decrease in intensity, with a similar decrease in the number of days below freezing.[4]



Vose et al. 2017, in "Climate Science Special Report: Fourth National Climate Assessment," highlight projected temperature changes in the contiguous United States. The authors explain the maps in this way: "Projected changes in the number of days per year with a maximum temperature above 90°F and a minimum temperature below 32°F in the contiguous United States. Changes are the difference between the average for mid-century (2036–2065) and the average for near-present (1976–2005) under the higher scenario (RCP8.5). Maps in the top row depict the weighted multimodel mean whereas maps on the bottom row depict the mean of the three warmest models (that is, the models with the largest temperature increase). Maps are derived from 32 climate model projections that were statistically downscaled using the Localized Constructed Analogs technique. Changes are statistically significant in all areas (that is, more than 50% of the models show a statistically significant change, and more than 67% agree on the sign of the change). (Figure source: CICS-NC and NOAA NCEI)."



Vose et al. 2017 outline historical observations of record-setting temperatures in the contiguous United States. The authors explain the graph in this way: "Observed changes in the occurrence of record-setting daily temperatures in the contiguous United States. Red bars indicate a year with more daily record highs than daily record lows, while blue bars indicate a year with more record lows than highs. The height of the bar indicates the ratio of record highs to lows (red) or of record lows to highs (blue). For example, a ratio of 2:1 for a blue bar means that there were twice as many record daily lows as daily record highs that year. Estimates are derived from long-term stations with minimal missing data in the Global Historical Climatology Network–Daily dataset." (Figure source: NOAA/NCEI).

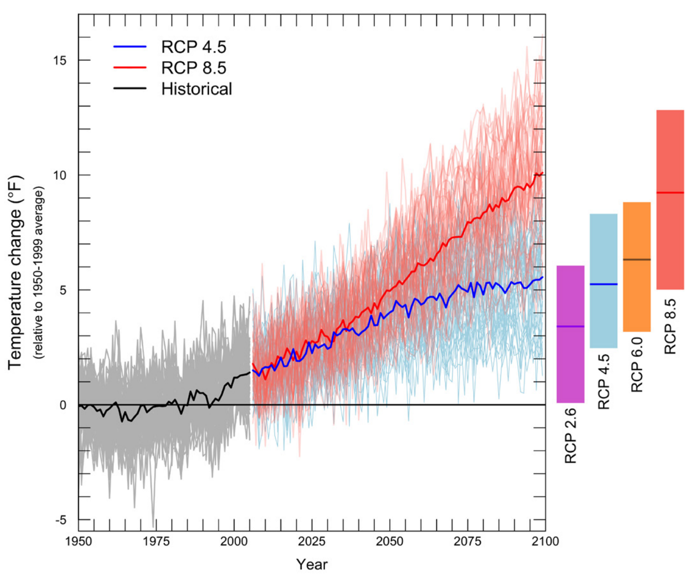


Vose et al. 2017 highlight projected averages in temperature change in the United States and Canada. The authors explain the maps in this way: "Projected changes in annual average temperatures (°F). Changes are the difference between the average for mid-century (2036–2065; top) or late-century (2070-2099, bottom) and the average for near-present (1976–2005). Each map depicts the weighted multimodel mean. Increases are statistically significant in all areas (that is, more than 50% of the models show a statistically significant change, and more than 67% agree on the sign of the change)." (Figure source: CICS-NC and NOAA NCEI).

Regional

Western Washington has already seen a 1.7 °F (0.94 °C) rise in average temperatures over the past 120 years, and by mid-century, average summer temperatures are expected to increase 3.3 to 3.5 °F (1.8–1.9 °C) relative to the 1950–1999 average.[5] Expected increases in average winter temperatures range from 2.5–3.0 °F (1.4–1.7 °C) for the same time period.[5]

Zooming in further, projections for the southern Washington Cascades highlight a trend toward warmer temperatures and more intense heat waves in summer.[6–8] Compared to average temperatures in the 1950–1979 range, temperatures in the southern Washington Cascades may increase 4.5 to 7.6 °F (2.5 to 4.2 °C) by mid-century and 7.7 to 11.5 °F (4.3 to 6.4 °C) by the latter part of the century.[9] The largest temperature increases will occur in summer, with increases in summer averages ranging from 10.3 to 12.2 °F (5.7 to 6.8 °C).[9]



Graph from the Climate Impacts Group showing a warming trend over time in the Pacific Northwest using climate projections from the 2013 IPCC report. The Climate Impacts Group used projections from the 2013 IPCC report and explains the graph as follows: "[A]verage yearly temperatures for the Pacific Northwest relative to the average for 1950-1999 (gray horizontal line). The black line shows the average simulated temperature for 1950–2011, while the grey lines show individual model results for the same time period. Thin colored lines show individual model projections for two emissions scenarios (low: RCP 4.5, and high: RCP 8.5), and thick colored lines show the average among models projections for each scenario. Bars to the right of the plot show the mean, minimum, and maximum change projected for each of the four emissions scenarios for 2081-2100, ranging from a very low (RCP 2.6) to a high (RCP 8.5) scenario. Note that the bars are lower than the endpoints from the graph, because they represent the average for the final two decades of the century, rather than the final value at 2100."

Projections for rain and snow patterns are less certain, but climate models tend to agree that summer rain will decrease, snowpack will decrease, extreme weather events will increase, and more winter precipitation will fall as rain rather than snow.[8,10–14] For instance, the summer rainfall average of 6.4 in. (162 mm) in the region is expected to fall to 3.4 to 4.8 in (87-121 mm) by the end of the century.[9] Sproles et al. (2013) suggests the western Cascade Mountains in Oregon, a similar landscape, will experience a 56% reduction in basin-wide volumetric snow water storage, with strongest reductions likely to occur in the 3,200 to 6,500-foot elevation range.[12]

Forests will be severely impacted by drought. Models suggest the greatest projected temperature increases will occur in summer, which will result in drier conditions, affecting a wide array of forest species.[9,15–17] For aquatic environments, warming waters are expected to significantly threaten a variety of species, especially anadromous fish. Decreases in spring and summer streamflows will be pronounced in many areas, and an increased frequency of high flow events in winter and spring will compound the aforementioned effects.[18,19]

Researchers expect we will see upward or poleward movements of some terrestrial species as well as phenological or life history changes.[20] There are already documented shifts in annual life-history events, such as earlier plant flowering and amphibian mating and altered timing in migratory patterns and egg laying of birds.[20] Some of these phenological alterations, in addition to impacts from temperature, drought, and hydrology changes, may cause species extinctions or extirpations of local populations. Variations in topography and aspect will create different patterns of risk. Temperature and solar influences on ridge tops and south slopes, for instance, may be more pronounced than impacts in moist valley bottoms or north-facing slopes.

It is important that we reflect on this climate data to underscore the urgency of addressing the threats faced by the species and ecosystems of our region. Our goal in this guide is to provide a targeted set of conservation and restoration strategies that can mitigate the severity of climate impacts, enhance resilience, and forge new opportunities for adaptation. These strategies should be employed by NGOs, land managers, community members, and any other stakeholders interested in taking part in advancing climate resilience.

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