1. INTRODUCTION

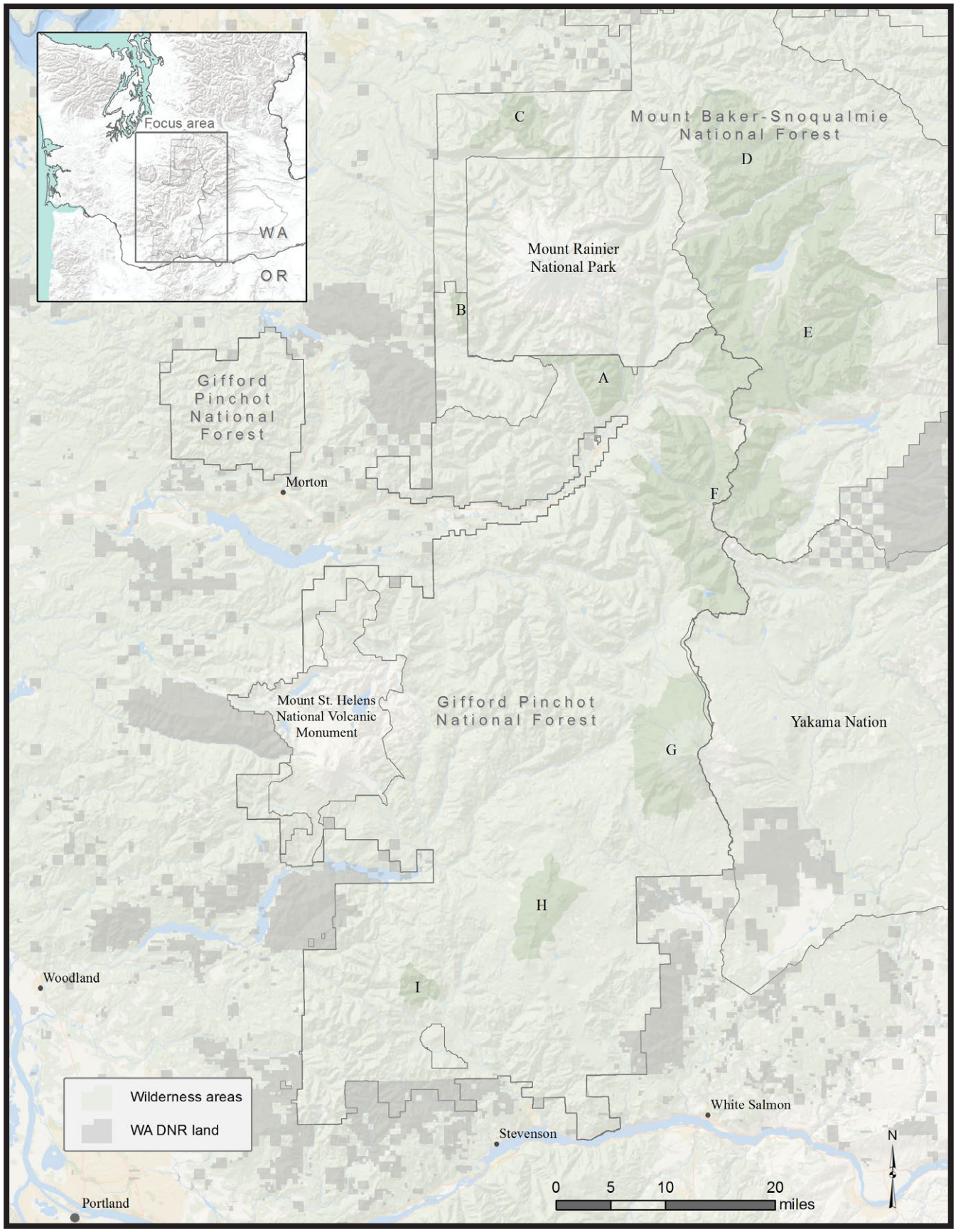
THE SOUTHERN WASHINGTON CASCADES

The southern Washington Cascades lie at the center of the Pacific Northwest and encompass Mount Adams, Mount St. Helens, Mount Rainier, and the lands between. Bordered on the south by the mighty Columbia River, this diverse and magnificent landscape is home to a wide array of ecosystems and wildlife as well as many threatened and rare species. The streams and rivers of this region are critical habitat for threatened salmon, steelhead, and bull trout. The forests are home to many iconic species including northern spotted owls, mountain goats, bears, martens, and mountain lions. The high elevation meadows sustain a striking diversity of plants and animals, and the alpine systems tower above and throughout the region.

We call this region the heart of the Cascades not only because of its placement within the broader biome, but also because this area serves as a vital transition zone and a stronghold of critical habitat. The Gifford Pinchot National Forest is the centerpiece of this landscape and is integral to the continued health and resilience of the region.

This guidebook will investigate climate projections and conservation opportunities throughout the southern Washington Cascades, although a large part of our focus, and especially that of our management discussions, will be on the Gifford Pinchot National Forest. We also address the surrounding and interconnected state, private, park, and tribal lands that constitute the southern Washington Cascades.

We have been working in the southern Washington Cascades for over thirty years. Our connection with this landscape extends back to 1985 when forest advocates banded together under the name Gifford Pinchot Task Force to stop the logging of old growth forests; we continue to advocate for protecting this important habitat. More recently we expanded our focus to include collaboration, restoration, aquatic conservation, citizen science, and youth and community involvement. We firmly believe that strong partnerships and community collaboration are keys to effective conservation.



The southern Washington Cascades with land designations outlined in gray and Wilderness areas labeled as follows: A – Tatoosh, B – Glacier View, C – Clearwater, D – Norse Peak, E – William O. Douglas, F – Goat Rocks, G – Mount Adams, H – Indian Heaven, I – Trapper Creek.

WHAT TO EXPECT IN THE GUIDEBOOK

This guidebook outlines a series of strategies for NGOs, state and federal agencies, and citizen volunteers for tackling the impacts that climate change is expected to have on the ecosystems and communities of the southern Washington Cascades. We identify vulnerable habitats and species, in addition to highlighting naturally resilient parts of the ecosystem. As climate change impacts our natural resources over the coming decades, agencies and conservation groups must consider how current and near-future actions will affect the long-term health of our forests, waterways, and wildlife. We consulted and summarized the relevant science and research to identify focus areas for restoration and conservation and to create specific recommendations that can improve the resilience of ecosystems in our region. We also identify surveying and monitoring needs that can improve our understanding of climate impacts. And, we highlight the role of partnerships and the value of building communities for conservation.

Long-term planning and new policies are necessary to address climate adaptation regionally. The 2012 Planning Rule of the U.S. Forest Service requires managers to integrate long-term or regional climate goals into forest management projects and decisions. Heller and Zavaleta (2009) identify important tools that can be deployed for climate change adaption, including reserve selection, ecosystem management, and land-use zoning schemes (1). Adaptation to climate change also requires an expanded spatial and temporal perspective, something district managers should consider in concert with managers of nearby lands. Evaluating and making small shifts to current conservation plans may often be the best plan of action for climate change. Due to the cross-boundary nature of climate change shifts and the need for long-term commitments, strong partnerships and communication of knowledge are central components to making lasting and meaningful improvements with these plans (2).

The Cascade Forest Conservancy is uniquely positioned to provide the guidance contained herein. We have a long history of working with local communities on restoration and conservation, and we can address climate change effectively at the local scale. A local blueprint of strategies will offer benefits in the short-term and the long-term, benefits that extend outward to all groups working to build resilience in the southern Washington Cascades.

"Due to the cross-boundary nature of climate impacts, strong partnerships are central to mitigation and adaptation efforts."

The inherent uncertainties of climate change require us to be nimble and adaptive to new developments and projections. We expect new research will uncover new opportunities for climate adaptation and therefore we expect our understanding of conservation and restoration approaches to be further refined as our projects are implemented and tested throughout the region. This guidebook will be updated as our knowledge grows.

In the strategies and recommendations sections of this guidebook, many of the plans outlined are site-specific, such as implementing prescribed burning in the mixed conifer forests of Mount Adams

WHAT YOU'LL FIND IN THIS GUIDEBOOK

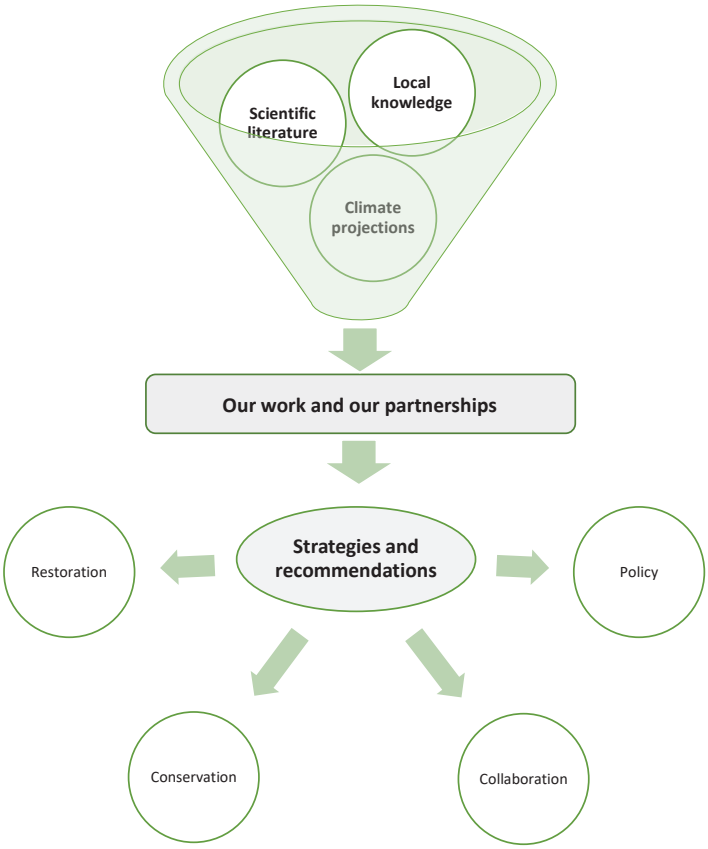
A detailed description of the ecosystems and wildlife of the southern Washington Cascades

A review and synthesis of climate change research and what it means for the region

or side-channel restoration in the tributaries of Trout Creek. Others are focused more directly on process, such as highlighting the need to reconnect floodplains for aquatic connectivity or the value of Research Natural Areas for expedited reserve designation.

"Managers should plan to implement a broad range of short-term and long-term measures, from precautionary to somewhat risky."

Heller and Zavaleta (2009) highlight the need to implement a broad range of short-term and long-term measures, from precautionary actions to innovative and somewhat risky actions. Monitoring is an essential step that must occur in conjunction with and after climate adaptive actions. Dunwiddie et al. (2009) recommend that those involved with climate change planning or restoration "document practices and results to permit continued assessment of success, reformulation of hypotheses, and further refinement of strategies"(3).



Resilience
The ability to survive a given change

Resilience at a regional scale
The capacity of an ecosystem to maintain function and biodiversity despite pressures brought on by climate change

Original maps and analysis completed by the Cascade Forest Conservancy

Policy recommendations and management strategies to build resilience

A description of ways in which you can get involved to help future conservation efforts

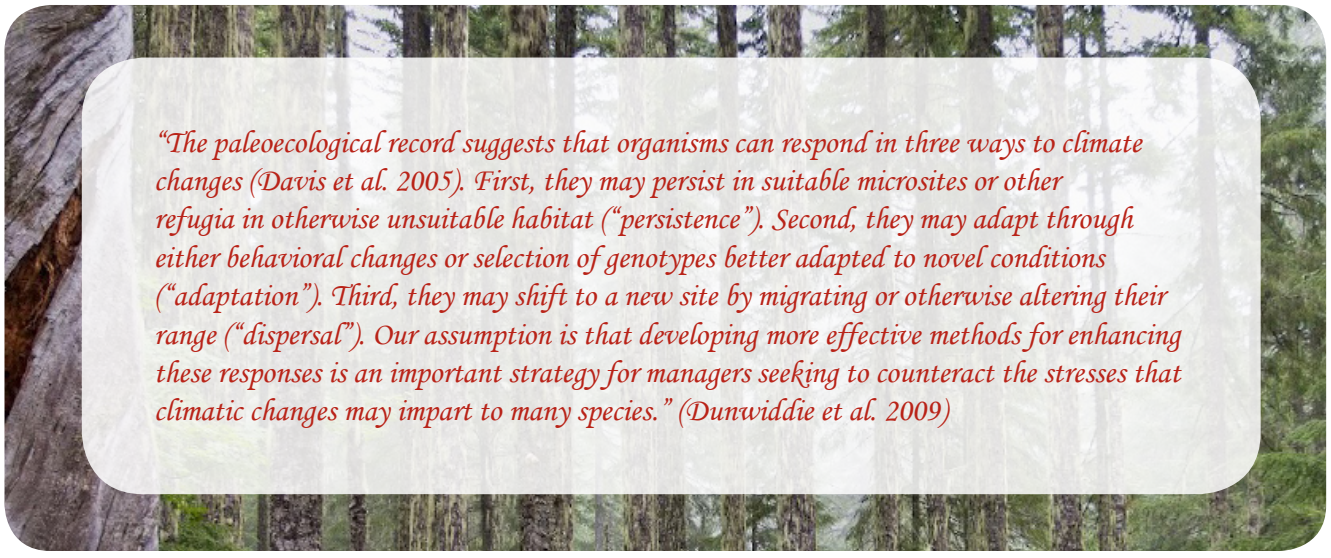
BACKGROUND INFORMATION

To create this guidebook, we reviewed and incorporated a broad set of information from various sources. Working from the scientific literature and climate models, consulting with local ecologists and climate scientists, and employing a wide array of ArcGIS tools and datasets, we summarized the large amount of information and results into a format that is applicable for planning on-the-ground projects and designing policy recommendations for the region.

The spatial layers from DataBasin (databasin.org), and in particular, those created by Conservation Biology Institute (consbio.org), were invaluable for designing and carrying out our forest ecosystem and connectivity analyses. The maps and spatial analysis tools published by the Washington Wildlife Habitat Connectivity Working Group (waconnected.org) formed the foundation of our connectivity analysis. The GIS data layers supplied by the U.S. Forest Service were valuable for many parts of the guidebook, from forest ecosystems to alpine habitats to aquatics. Maps and documents from the Lower Columbia Fish Recovery Board helped in identifying site-specific aquatic restoration needs. They maintain a comprehensive list of past, current, and planned projects, some of which are located in or near the project areas identified in this guidebook (lowercolumbiasalmonrecovery.org).

We were fortunate to receive valuable input from partners, including other conservation organizations, researchers from local universities, local stakeholders, and Forest Service specialists. Input from Forest Service specialists was essential for our fine-scale investigations and for outlining conservation and restoration strategies. These specialists work on-the-ground in these areas and have in-depth knowledge of local processes and place-based strategies. The work of the Southwest Washington Adaptation Partnership (adaptationpartners.org/swap) was also an integral part of our efforts to bring large-scale climate information into a context that is applicable at the scale of our focus area.

Chipping sparrow at Mount St. Helens. Photo by Michael Sulis

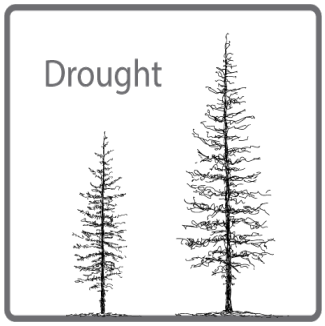


"The paleoecological record suggests that organisms can respond in three ways to climate changes (Davis et al. 2005). First, they may persist in suitable microsites or other refugia in otherwise unsuitable habitat ("persistence"). Second, they may adapt through either behavioral changes or selection of genotypes better adapted to novel conditions ("adaptation"). Third, they may shift to a new site by migrating or otherwise altering their range ("dispersal"). Our assumption is that developing more effective methods for enhancing these responses is an important strategy for managers seeking to counteract the stresses that climatic changes may impart to many species." (Dunwiddie et al. 2009)

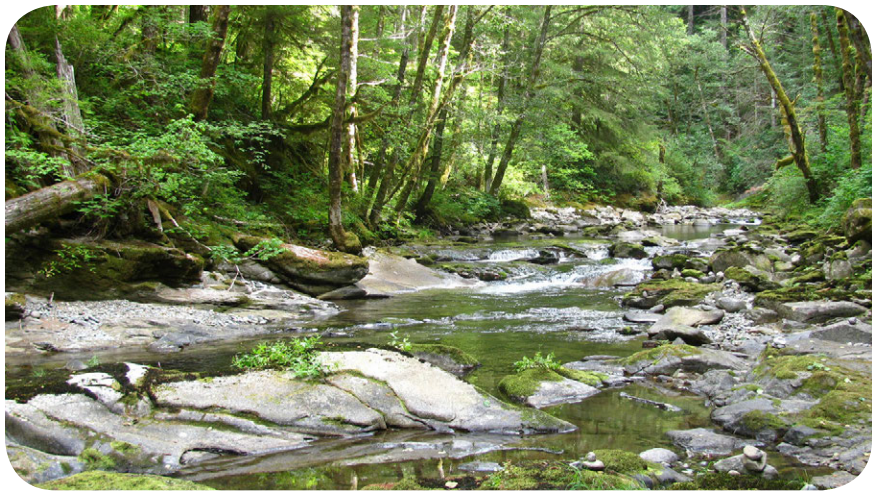
AN OVERVIEW OF WHAT TO EXPECT WITH CLIMATE CHANGE IN THE SOUTHERN WASHINGTON CASCADES

Projections of future shifts indicate that the southern Washington Cascades will experience changes in weather patterns, temperature, and rainfall, as well as resulting shifts in habitat locations, disturbance regimes, snow cover, and water availability. Climatic zones will, in general, shift to higher elevations and latitudes, but other and more varied shifts are expected as well (4, 5). Climate change is expected to cause more weather extremes and generally higher temperatures in both warm and cool seasons (6, 7). Extreme droughts and flooding are expected to occur with greater frequency and magnitude (8–10). By the later decades of this century, temperatures for the Columbia River basin are expected to rise anywhere from roughly 0.5° to 8°C (1° to 15°F) above 20th century averages (11).

Many of the climate impacts on **terrestrial ecosystems** will be due to the alteration of seasonal patterns (12–14). Although projections of precipitation are more varied and uncertain than projected shifts in temperature and snow, precipitation is expected to decline in the summer and increase during fall and winter (6, 15). An increase in the variability of winter precipitation will be a significant factor in habitat availability and hydrologic shifts. A significant decrease in snowpack is expected, and peak runoff from snowmelt will likely occur three to four weeks earlier than current averages (10, 16). More winter precipitation is expected to fall as rain, rather than snow, and habitats near the tree line are expected to move upward (10, 17, 18). A longer growing season in high elevation habitats may occur due to lower snowpacks (6, 16).



During recent decades, there has been an increase in the size and severity of fires and insect outbreaks throughout the western United States; further increases, up to 2- to 4-fold, are expected in the coming century (19–22). Drier summers and drought are expected to exacerbate this further, and plant mortality from disease is expected to increase accordingly.



Temperature increases of 0.5° to 8°C are expected to impact all ecosystems in the region

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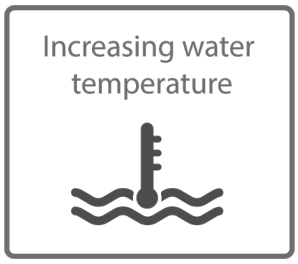
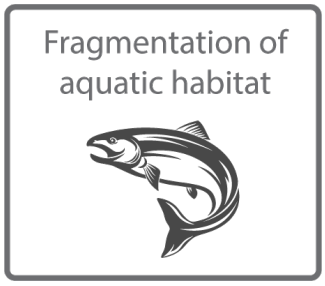
As the climate changes, we can expect to see more erratic patterns of low and high streamflow events.

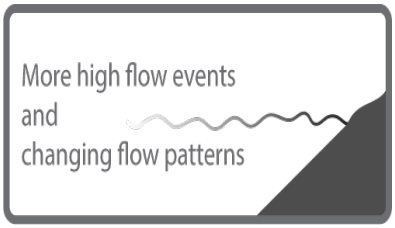
For **aquatic environments,** warming waters are expected to significantly threaten a variety of species, especially fish. Decreases in streamflow in spring and summer will be pronounced in many areas, and an increase in high flow events and the alteration of hydrologic regimes will often compound the aforementioned effects (15, 23).



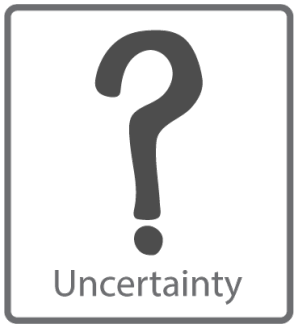
Snowmelt dominated watersheds are expected to shift to mixed rain-snow, which will likely increase winter flows and reduce late summer flows (6, 24–26). Similarly, mixed rain-snow watersheds are expected to become mostly rain-dominated, which will mean less snow and more rain during winter months (7, 10). Rain dominated watersheds may experience an increase in winter precipitation and higher winter streamflows (10). The shift from snowfall to rainfall will be most pronounced in mid-elevation areas (15).



Species distributions shifts, such as upward or poleward movement and phenological or life history changes have already been observed in the region and scientists expect these alterations to continue and increase (5, 27). Parmeson (2006) has documented current shifts in annual life-history events, such as earlier flowering of plants, egg laying and migratory patterns of birds, and mating of amphibians.



It is critical to keep in mind that these expected shifts in wildlife habitat will depend on the scale of investigation. Many of the projections that have been discussed in the scientific literature have concentrated on regional effects. We investigate how these broad shifts will be affecting the wildlife at localized scales and what practical actions can be taken to mitigate the worst climate effects while preserving regional biodiversity.



RESILIENT COMMUNITIES

In addition to the ecological impacts, climate change is expected to negatively affect local communities and infrastructure. Wildfires can reduce air quality or burn structures at the forest-residential interface, loss of snow can impact recreation tourism, drier summers can affect agriculture, warming waters can degrade fishing opportunities, and high flow events can wash out roads, reduce water quality, or flood croplands. There are, however, ways to mitigate and decrease the likelihood of some of these costly events. And through these mitigation efforts, there are economic opportunities for local communities in the form of restoration work and other jobs in the forest.

Road decommissioning in the national forest

Forests and rivers benefit local communities in many different ways, such as supplying drinking water, clean air, recreation opportunities, harvest opportunities for forest products, and various economic opportunities through maintenance, restoration, harvesting, and tourism. The forests of the southern Washington Cascades also offer future economic opportunities through carbon sequestration in future carbon markets.

Forest jobs are an integral part of the heritage of many communities that live within and around the forests of the Pacific Northwest. With the potential for significant job creation, resilience-building projects in the southern Washington Cascades should be prioritized for local community members, businesses, and contractors. Potential employment includes

Collaborative field trip to review a prescribed burning project

stewardship contracting, road maintenance and decommissioning, forest and river restoration, preparation steps for prescribed burning, and planting of diverse tree species in anticipation of climate change. Moreover, employment associated with the U.S. Forest Service and Bureau of Land Management contributes significantly to local economies (28).

"Forest jobs are an integral part of the heritage of many communities that live within and around the forests of the Pacific Northwest."

Collaboratives can help bridge the gap between local communities, stakeholders, and forest managers. Resilience-building projects for local workers can be designed by collaborative members and financially supported as retained receipts projects (see page 58). Restoration plans can also be integrated into timber management proposals and supported through the Knutson-Vandenberg program (K-V funds, see page 58). Also, county or city groups can partner with non-profits to obtain funds for restoration projects through grants and infrastructure-related programs, such as hydroelectric mitigation and drinking water improvement programs.

Fly fishing is a popular recreation activity in the southern Washington Cascades

Recreation and tourism also offer economic opportunity. If the groundwork is laid to support the influx of forest visitors that will likely result from population growth, local communities will reap the benefits of this market. In the 20-year report of the Northwest Forest Plan, visitor spending was found to be the largest source of economic activity associated with Bureau of Land Management and Forest Service lands in the region (28). Similar studies have found spending per visitor to range from $24 to $261 per day for visitors to state parks and natural areas, and the average local spending for mountain bikers to be $385 per trip (29, 30). Recreation dollars particularly boost economies associated with hotels, motels, cabins, campgrounds, breweries, coffee shops, gift shops, restaurants, guiding services, and firewood cutting.

"Climate change has the potential to significantly impact infrastructure and drinking water. Climate adaptation and restoration work offers opportunities to build resilience and bring jobs to local communities."

Citizen engagement is another important element in building resilient communities. Stewardship requires both a passion for protecting the area's natural resources and the opportunity to get involved in the on-the-ground work. Throughout this guidebook, we will outline citizen engagement opportunities so that local community members can support climate resilience directly and actively. Whether these efforts are aimed at protecting drinking water or improving forest health in the face of threats, the work of community members is an essential piece in ensuring a robust and resilient forest ecosystem.