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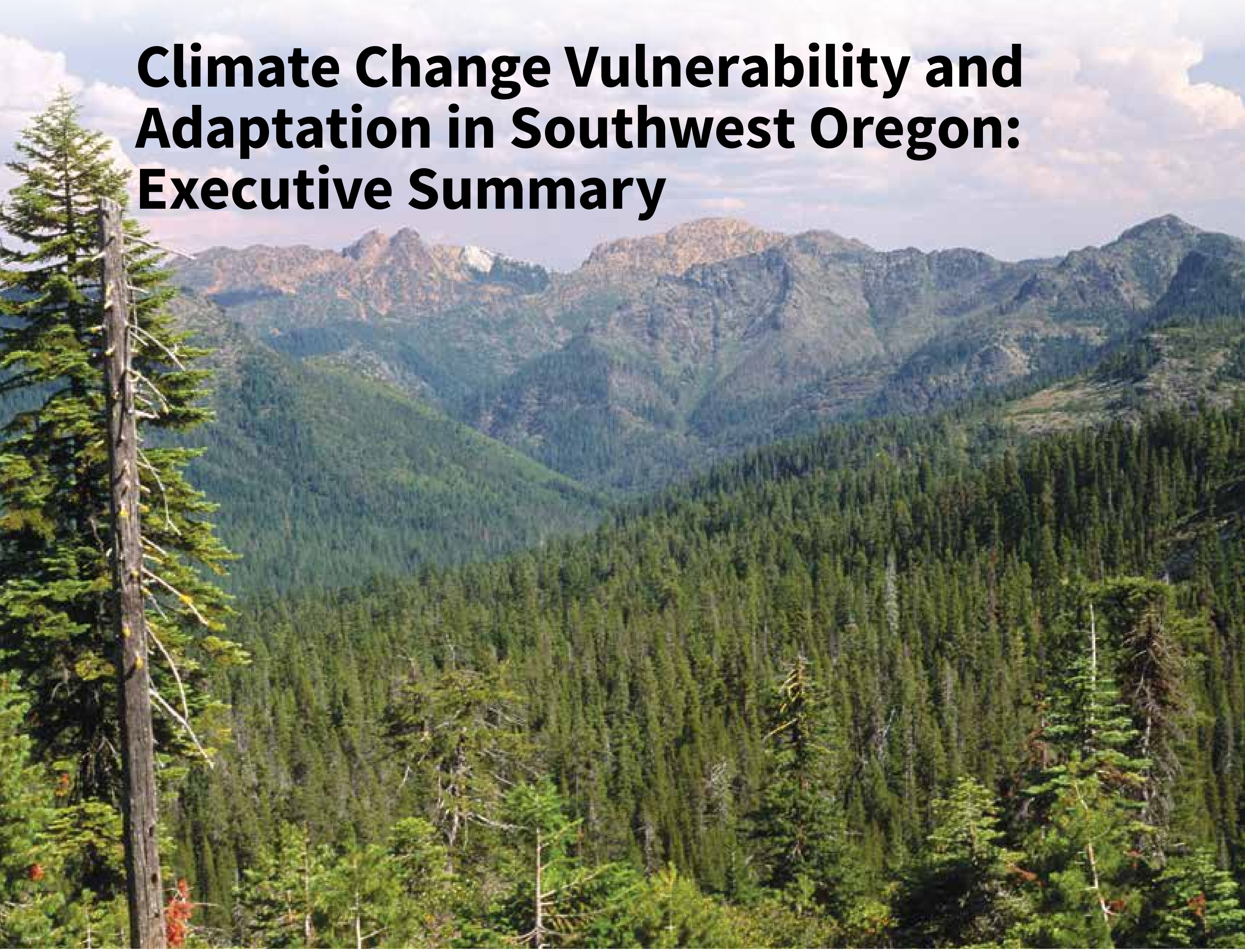
Climate Change Vulnerability and Adaptation in Southwest Oregon: Executive Summary



A Partnership Between Scientists and Land Managers

The Southwest Oregon Adaptation Partnership (SWOAP) is a science-management partnership with the U.S. Department of Agriculture, Forest Service—Rogue River-Siskiyou and Umpqua National Forests, Pacific Northwest and Rocky Mountain Research Stations, and Pacific Northwest Region; the U.S. Department of the Interior—Bureau of Land Management Medford and Roseburg Districts, and National Park Service Oregon Caves National Monument and Preserve; and the University of Washington.

This science-management partnership assessed the vulnerability of natural resources in southwest Oregon to climate change. The vulnerability assessment focused on water resources, fisheries, vegetation, wildlife, recreation, and ecosystem services. SWOAP resource managers then developed adaptation options in response to the vulnerabilities of each resource, including both high-level strategies and on-the-ground tactics. Following are key points from the full report, *Climate Change Vulnerability and Adaptation in Southwest Oregon*, by Halofsky et al. (2022).

Projected Climate Change

- A Mediterranean precipitation pattern characterized by wet winters and very dry summers prevails in southwest Oregon.
- The average annual temperature within the SWOAP assessment area has increased by 0.6 to 1.5 °C since 1895.
- Compared to observed historical temperature, average warming is projected to increase 2.4 to 5.6 °C by the end of the 21st century (2070–2099) under the high greenhouse gas emissions RCP 8.5 scenario[1] (fig. 1).
- Projections indicate that precipitation may increase slightly in the winter, although the magnitude is uncertain.
- Projections suggest that climatic water deficit will double compared to historical values, suggesting substantial increases in drought stress for plants.

Water Resources and Infrastructure

- Decreasing snowpack and declining summer flows will alter timing and availability of water supply, particularly in late summer. The effect in the SWOAP area will be moderate compared to areas in the Pacific Northwest with more mountainous landscapes.
- Greater peak streamflows in winter in the northeastern portion of the assessment area will potentially damage roads near perennial streams.

Adaptation Options

- Climate-informed streamflow projections can aid decisions on structure type and sizing at stream crossings, as well as decisions about travel management and restoration.
- Instream restoration techniques (e.g., adding wood to streams) will improve hydrologic connectivity in floodplains and increase water storage capacity.
- Reintroducing or supporting populations of American beaver (*Castor canadensis*) may also help to slow water movement and increase water storage.

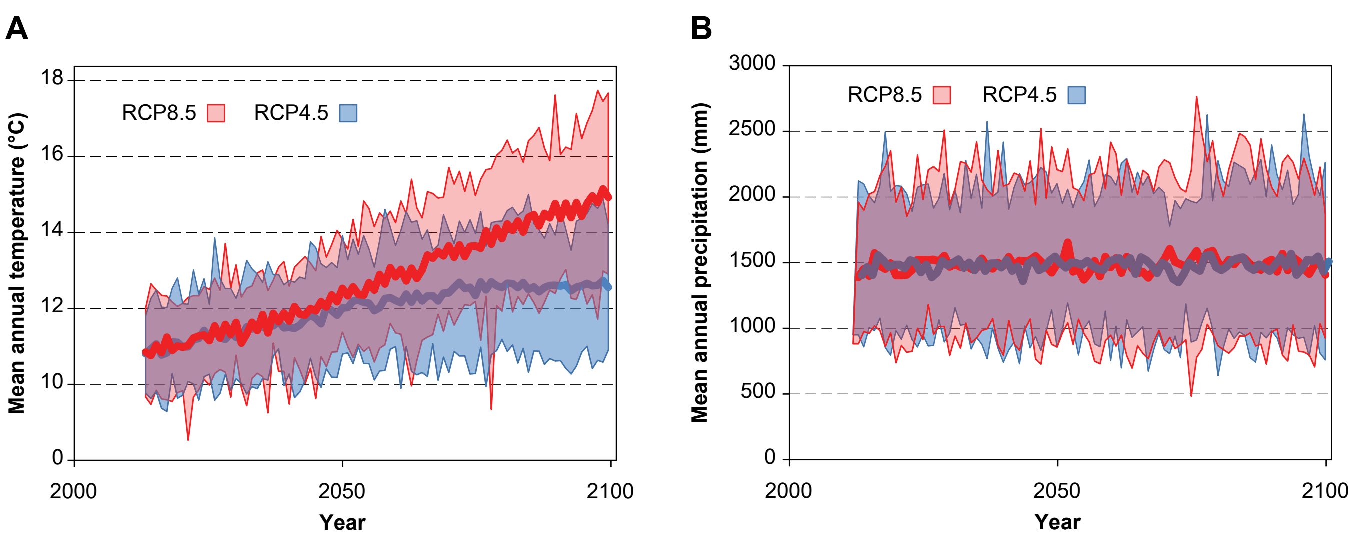


Figure 1—Comparison of RCP 4.5 and 8.5 climate change scenarios for the Southwest Oregon Adaptation Partnership assessment area through the end of the next century for projected (A) annual temperature and (B) precipitation. The model averages (red and blue lines) suggest warmer temperatures regardless of scenario through at least mid-century, whereas there is no discernible trend for precipitation.

[1] RCP = representative concentration pathway. Different RCP scenarios are used in climate modeling to project the trajectory of greenhouse gas emissions and their combined effect with other factors that influence the amount of heat that enters and leaves the Earth's atmosphere. RCP 4.5 represents a future with significant reduction in global greenhouse gas emissions and climate stabilization by 2100. RCP 8.5 represents a future with no climate change mitigation, high population growth, and continued increase in greenhouse gas emissions through 2100.

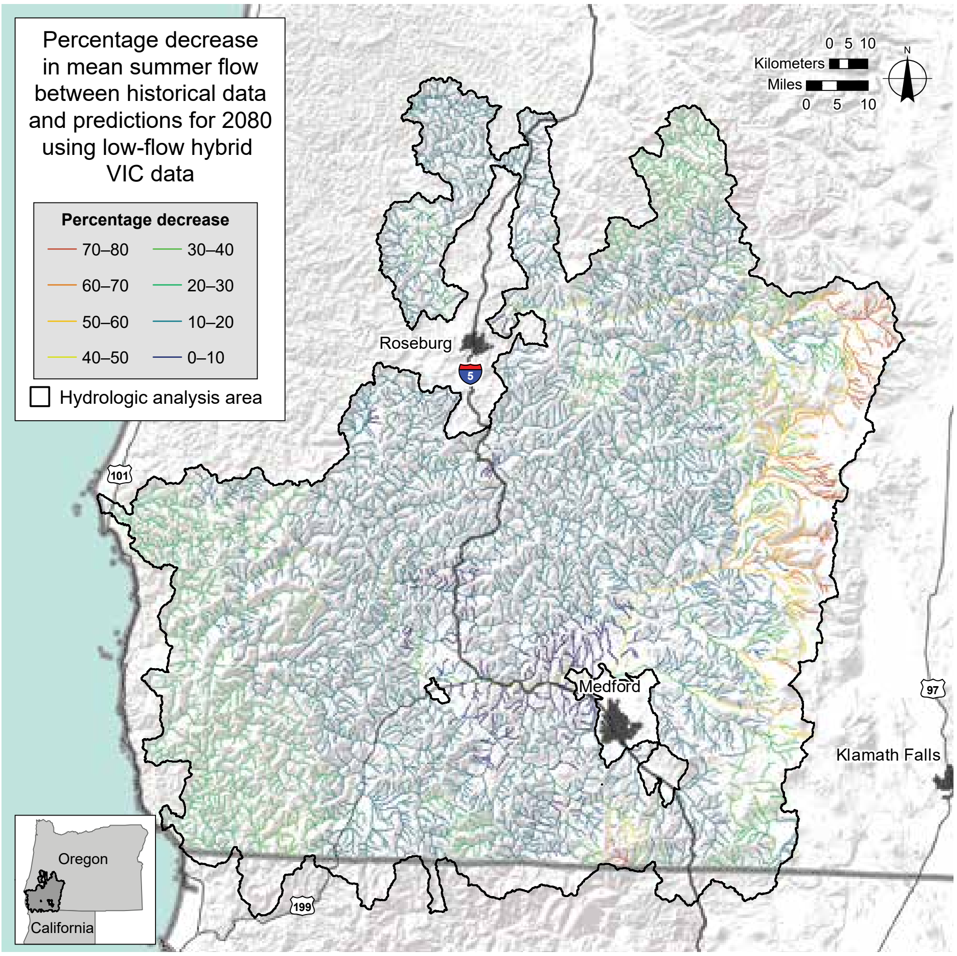


Figure 2—Projected percentage decrease in low flows between a historical period (1970–1999) and 2080s under the A1B greenhouse gas emissions scenario (moderate scenario similar to RCP 4.5). Projections are based on Variable Infiltration Capacity (VIC) model projections of surface water input changes filtered by geologically based unit hydrograph.

Fisheries and Aquatic Habitat

- Decreased summer streamflows and warmer water temperature will reduce habitat quality for coldwater fish species, especially at lower elevations (table 1).

Adaptation Options

- Adaptation strategies focus on maintaining and diversifying monitoring programs; restoring natural thermal, hydrologic, and wood regimes; restoring and maintaining habitat connectivity; and detecting and removing nonnative species.
- Specific adaptation tactics include removing barriers to fish movement, increasing instream flow, increasing retention of cold water across the landscape, restoring stream structure and function, enhancing and protecting hyporheic zones, and protecting refugial habitats.

Table 1—Projected change in the proportion of streams with mean temperatures less than 17 °C in August for focal fish species habitats

Species	Historical (2000s)	Future (2080s)
Coho salmon (*Oncorhynchus kisutch*): Oregon coast[a]	56%	17%
Coho salmon: southern Oregon-northern California coast	36%	13%
Spring chinook salmon (*O. tshawytscha*)	34%	16%
Fall chinook salmon	34%	12%
Summer steelhead (*O. mykiss*)	56%	22%
Winter steelhead	67%	25%
Cutthroat trout (*O. clarkii*)	77%	52%
Pacific lamprey (*Entosphenus tridentatus*)	36%	12%

[a] Coho salmon habitat is divided into two evolutionarily significant units. These species are populations considered unique for conservation purposes.

Vegetation

- Higher air temperature, through its influence on soil moisture, is expected to cause gradual changes in the abundance and distribution of vegetation species. Drought-tolerant species will likely have the competitive edge (table 2).
- Ecological disturbance, mostly through increased occurrence of wildfire, will be the primary facilitator of vegetation change. Future forest landscapes may be dominated by younger age classes and smaller trees.

Adaptation Options

- Minimizing high-severity disturbance events and maintaining spatial diversity will help increase resilience to fire, drought, and insects, thus supporting functional ecosystems.
- Reducing stand density in dry forests can decrease inter-tree competition and drought stress, thus increasing tree growth and vigor.
- Expanding fuel treatments in appropriate locations can help prevent stand-replacement fire over large areas.
- Favoring drought-tolerant genotypes and species may help increase survival following disturbances.
- Increasing upland water storage may help minimize the negative effects of more frequent winter flooding, while managing water to maintain springs and wetlands in the drier summer months may benefit riparian areas and groundwater-dependent ecosystems.

Table 2—Summary of key vulnerabilities by forests type in the southwest Oregon assessment area

Forest type	Key vulnerabilities
Moist forests	• Higher temperature may increase growth in some locations, although drought-tolerant species could be favored. • Increased wildfire may lead to a more fragmented landscape, with most areas continuing to be dominated by Douglas-fir (*Pseudotsuga menziesii*) and other early-seral species.
Mesic forests	• Higher temperatures, more area burned, and increasing drought may cause a mesic to xeric forest transition. • Douglas-fir will likely continue to dominate most stands, and incense cedar (*Calocedrus* sp.) and sugar pine (*Pinus lambertiana* Douglas) will increase in abundance. • Increasing summer drought stress will decrease growth and reduce vigor for many species in mesic forests.
Ultramafic forest and woodlands	• More drought stress may cause some declines, although many of the species adapted to ultramafic soils have relatively high drought tolerance. • As fire frequency increases, shrub species will have an advantage over conifers that are not drought and fire tolerant. • Increased abundance of invasive annuals, especially grasses, could promote more frequent fire as the grasses increase fuel continuity.
Dry forests	• Douglas-fir may be limited by drought on drier sites, but drought-tolerant species such as ponderosa pine (*P. ponderosa*), incense cedar, and oaks (*Quercus* sp.) may become more dominant. • Drought stress and higher fire frequency may cause a transition to woodlands or shrublands in the driest locations. • Growth of most tree species will decrease, and tree mortality may increase in some locations because of interactions among drought, fire, and insects.
Woodlands	• Expansion of woodland types is likely with hotter, drier conditions; habitat for Oregon white oak (*Quercus garryana* Douglas ex Hook.) and California black oak (*Q. kelloggii* Newberry) will persist, but sudden oak death could affect black oak. • With more frequent fire, conifer encroachment could be reduced, favoring development of open oak woodlands. • Nonnative annual grass species can establish following wildfire and thinning treatments and may limit the capacity of oak woodlands to adapt.
Shrubland	• With increasing fire frequency and summer water deficit, shrublands will likely expand in drier portions of southwest Oregon, including conversion of dry forest to dominance by shrub species following fire. • Repeated fire could facilitate dominance of chaparral species where short intervals between severe fires combine with drought to limit forest establishment.
Special habitats	• Wetlands, riparian areas, and groundwater-dependent ecosystems will be especially vulnerable to higher air temperature and altered hydrology; less water during summer will potentially reduce the duration and depth of standing water, thus increasing water temperature. • Drying in riparian areas is likely to alter plant community composition. • Some ephemeral montane wetlands may disappear, and some intermediate wetlands may become ephemeral.

Wildlife

- Ecosystem responses to climate change will affect animal species through altered food availability, competition, predator-prey dynamics, and availability of key habitat features (table 3).
- Despite the flexibility and adaptive capacity of many species, widespread shifts in animal ranges and local extirpation of some species may result from climate change, in combination with other stressors.

Adaptation Options

- Refugia will facilitate species persistence with climate change, and increasing spatial variability in stand structures can increase the extent of refugia.
- Increasing habitat connectivity is critical for mobile species.
- Fuel reduction and strategic placement of fuel breaks can help to lower fire severity and protect valued habitats, including late-successional forest habitat.
- Minimizing new stressors to high-elevation habitats will increase resilience to climate change in these vulnerable areas.

The northern spotted owl was listed as threatened under the U.S. Endangered Species Act in 1990. Loss of old-forest habitat and competition with barred owls (*Strix varia*) have contributed to a long-term decline in its population. Climate change could exacerbate these existing stressors through altered fire frequency, weather, and prey availability. Photo by Alan Dyck.

Table 3—Summary of climate change effects on focal wildlife habitat types

Focal habitat	Effects
Conifer forests	High-severity fire can reduce spatial and structural heterogeneity and may increase fragmentation and isolation of old-forest patches critical for northern spotted owls (*Strix occidentalis caurina*) and marbled murrelets (*Brachyramphus marmoratus*). Reductions in available thermal microrefugia will increase vulnerability to thermal stress for salamanders, small mammals, and mesocarnivores.
Early-seral forest and brushfields	Animals associated with early-seral, postfire habitats tend to be good dispersers with high reproductive rates, which may facilitate survival in a warmer climate. Species dependent on herbaceous vegetation may be sensitive to altered timing of forage availability and plant development.
Oak woodlands, savannahs, and grassland	Increased fire frequency may favor oaks and maintain open woodland habitat if large oak trees are able to survive initial fires. Invasive annual grasses could reduce fire resilience and overall biodiversity. Increased susceptibility to sudden oak death in warmer, wetter conditions is another potential stressor.
Wetland, riparian, and open water	Altered seasonal water availability and water temperature will affect aquatic insect populations that provide prey for wildlife. Increased vulnerability to drying may affect amphibian species. Loss of riparian vegetation caused by increases in wildfire or winter flooding could contribute to increased stream temperatures and loss of nesting and resting structures for wildlife.
Subalpine forest, woodlands, and meadows	Loss of snowpack will be highly negative for species adapted to cold, snowy environments. Longer duration of warmer weather may affect forage availability and migration timing. Phenological mismatches between vegetation and pollinators may be a particular concern for high-elevation herbaceous communities.

Recreation

- Summer recreation will benefit from a longer period of suitable weather without snow, especially during the spring and autumn shoulder seasons.
- Snow-based recreation will be negatively affected by less and more transient snow, especially at lower elevations (fig. 3).
- Hunting may be sensitive to temperature and timing of snow, while fishing will be sensitive to changes in streamflows and stream temperatures.
- Water-based recreation will be sensitive to lower water levels during drought years.
- Forest product gathering may also be somewhat sensitive due to changes in the distribution and abundance of items.

Adaptation Options

- Organizational flexibility will help adapt recreation management to climate change.
- Managers can adjust capacity and availability of sites based on variable weather conditions from year to year.
- Flexibility in the seasonality of staffing, permitting, and concessionaire contracts will help adjust to altered demands and opportunities in the future.

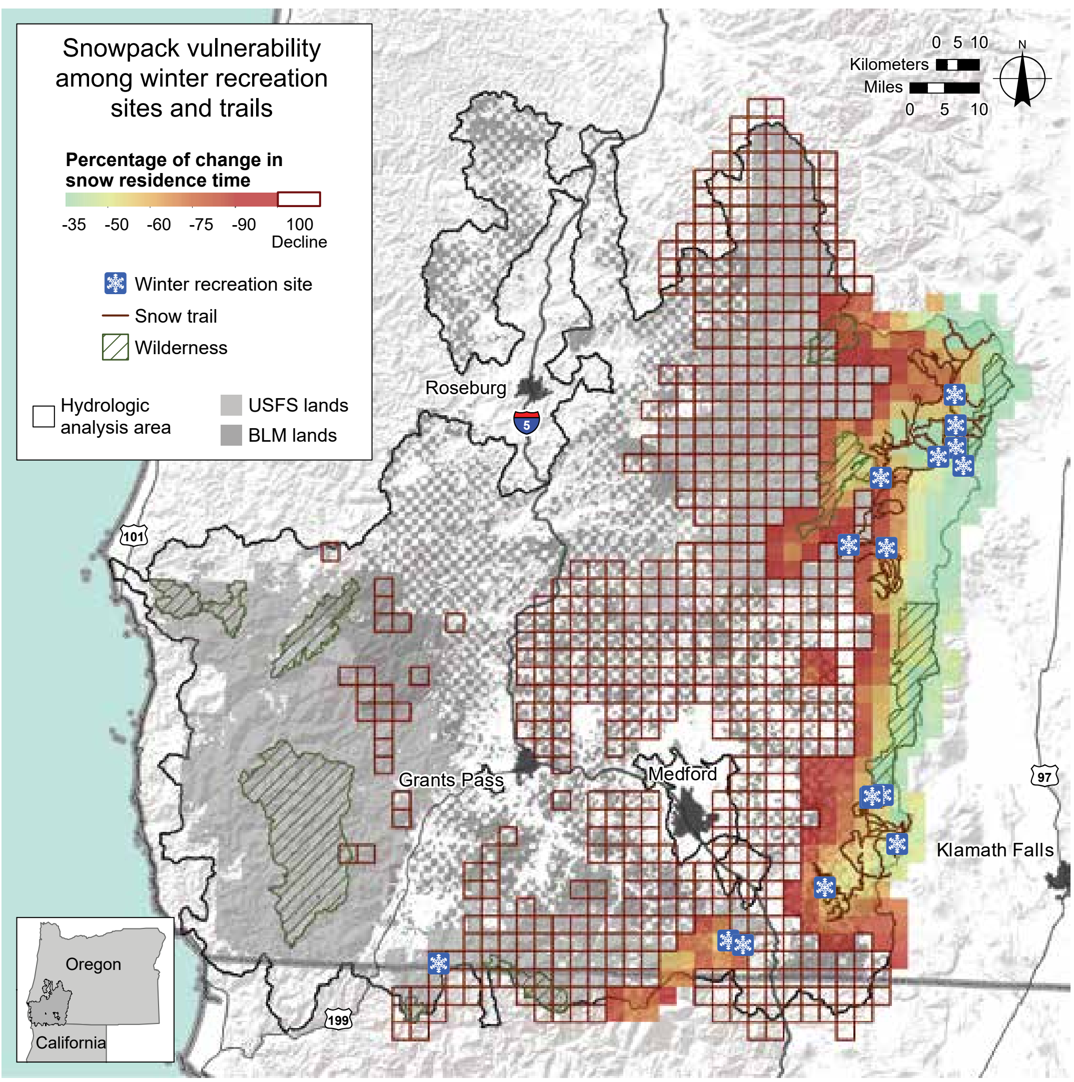


Figure 3—Locations where snow residence time is expected to decrease by more than 35 percent, thus affecting snow-related activities on land managed by the U.S. Forest Service (USFS) and Bureau of Land Management (BLM). Change in snow residence time is based on a 3 °C increase in December through March average temperature at snow telemetry stations in the Southwest Oregon Adaptation Partnership assessment area.

Ecosystem Services

- Climate change may also affect cultural resources, including “first foods” such as huckleberries (*Vaccinium* spp.) and salmon that are valued by American Indian tribes.
- Impacts of higher temperatures and disturbances on forest structure and growth will affect timber supply, carbon sequestration, and special forest product availability (table 4).
- Changes in plant species composition and productivity will affect livestock forage (table 4).
- The ability of forests to sequester carbon will likely decrease if a warmer climate increases physiological stress in trees and increases the frequency and extent of disturbances.

Adaptation Options

- Thinning dry forests helps to create resilience and ensure long-term stability of carbon sequestration in these forests.
- Adaptive grazing strategies help adjust to impacts of climate change.
- Sustainability of cultural resources can be improved by directly involving indigenous people and governments in applying traditional ecological knowledge where appropriate, reducing nonclimate stressors, and encouraging pre- and postdisturbance strategies to protect high-value resources.

Table 4—Summary of metrics describing selected ecosystem services in the four largest Southwest Oregon Adaptation Partnership units

	Ecosystem service								
			Forest products permits sold						
Unit area × 1000	Grazing	Timber volume	Christmas trees	Mushrooms	Specialty wood/ firewood	Other (foliage, cones, berries, etc.)	Carbon stock	Recreation	Water supply
	Animal unit months	*Million board feet sold*	*Number*				*Metric tons per hectare*	*Thousand visits*	*Million cubic meters*
RRS 696	14,944	32.5	6,543	1,192	1,094	308	47	1,174	11,551
UMP 399	1,249	34.5	1,807	811	804	377	61	1,239	4,037
MED 355	9,197	39.8	1,123	88	419	208	49	984	NA
ROSE 172	None	23.9	212	401	309	565	63	988	NA

[a] For data sources, see full report (Halofsky et al. 2022: 426).
RRS = Rogue River-Siskiyou National Forest; UMP = Umpqua National Forest; MED = Bureau of Land Management (BLM) Medford District; ROSE = BLM Roseburg District.
NA = data unavailable.

For More Information

Halofsky, J.E.; Peterson, D.L.; Gravenmier, R.A., eds. 2022. Climate change vulnerability and adaptation in southwest Oregon. Gen. Tech. Rep. PNW-GTR-995. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 445 p. https://doi.org/10.2737/PNW-GTR-995.

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Cover photo: Red Buttes, Rogue River-Siskiyou National Forest. USDA Forest Service photo.

Abstract

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This is the executive summary for the report *Climate Change Vulnerability and Adaptation in Southwest Oregon,* by Halofsky et al. (2022, PNW-GTR-995). The vulnerability and adaptation assessment was conducted by the Southwest Oregon Adaptation Partnership, a science-management partnership. The partnership assessed the vulnerability of natural resources to climate change and developed adaptation options that minimize its negative impacts and facilitate ecosystem transition to a warmer climate.

Keywords: Adaptation, aquatic ecosystems, climate change, climate-smart management, ecosystem services, fisheries, hydrology, infrastructure, recreation, science-management partnership, southwest Oregon, terrestrial ecosystems, vegetation, wildfire, wildlife.

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