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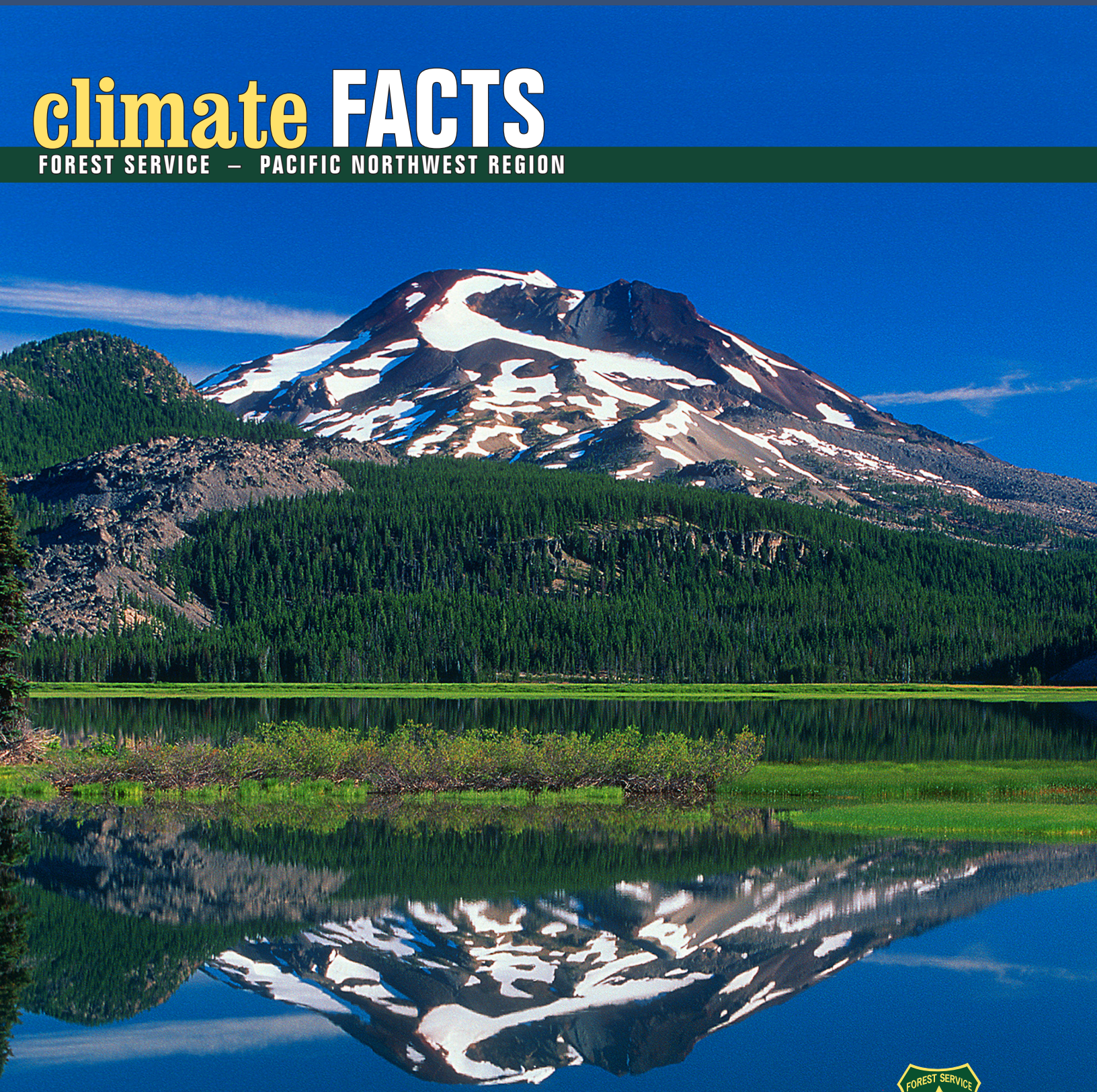
climate FACTS

FOREST SERVICE – PACIFIC NORTHWEST REGION



vulnerability & adaptation IN SOUTH CENTRAL OREGON

The South Central Oregon Adaptation Partnership (SCOAP)

The SCOAP is an initiative to identify and evaluate climate change issues relevant to resource management on federal lands that comprise over 5 million ac (2 million ha) in south central Oregon (Deschutes National Forest, Fremont-Winema National Forest, Ochoco National Forest, Crooked River National Grassland, Crater Lake National Park). This science-management partnership assessed the vulnerability of natural resources to climate change, and developed adaptation options to minimize negative impacts of climate change and facilitate transition of diverse ecosystems to a warmer climate. This summary reports some of the key findings for the resources areas included in the vulnerability assessment.

Projected Climate Change

- Since 1895, mean annual temperatures rose 0.1 °F per decade in the project area, with no discernible trend apparent for precipitation.
- Projections from a series of climate models were used to represent a range of possible outcomes under a no-mitigation "business-as-usual" emission scenario.
- Summary of climate findings for late century (2070-2099):
  - From a historical 43 °F, projections of annual average temperature range between 47.6 °F to 54 °F, with a model average of 51.4 °F.
  - There is no annual precipitation trend, with most uncertainty in the region's dominant mid-elevation areas.
  - Most models project greater seasonal precipitation amplitude – more falling in winter (December-March), less falling in spring and summer (April-October), but a few project the opposite.
  - Warming leads to longer growing seasons, but this will be offset by a near doubling of drought stress for most elevations (Figure 1).

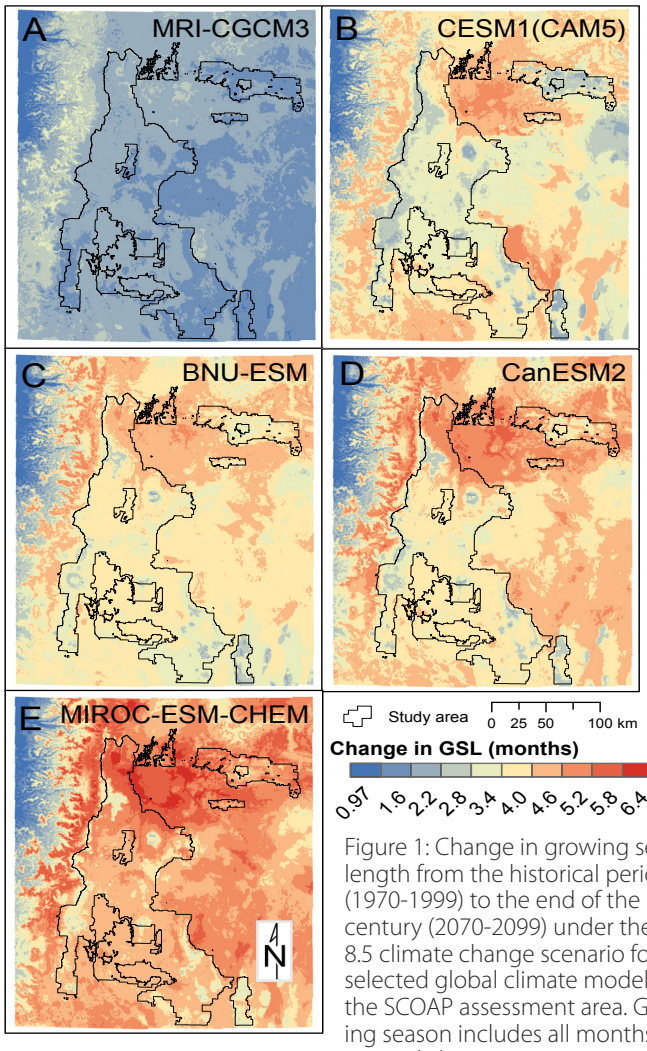


Figure 1: Change in growing season length from the historical period (1970-1999) to the end of the century (2070-2099) under the RCP 8.5 climate change scenario for five selected global climate models for the SCOAP assessment area. Growing season includes all months with mean daily minimum temperature greater than freezing (32 °F).

Water Resources and Infrastructure

- Decreasing snowpack and declining summer stream flows alters timing and availability of water supply, affecting human water users and ecosystems.
- Western Oregon High Cascades snowpack is more sensitive than in more eastern areas.
- Increased magnitude of peak stream flows in winter will potentially damage roads and other facilities near perennial streams, ranging from minor erosion to complete loss, affecting safety and access (Figure 2).

Adaptation and Strategies

- Increase water conservation, diversify sources, and facilitate open and honest dialogue about fair management, and reduced expectations with water users
- Use restoration techniques that slow water and increase water storage (e.g., beaver reintroduction)

Figure 2: Road (also used as a trail) adjacent to Cherry Creek (Fremont-Winema National Forest) inundated with flood-water during a rain-on-snow event, December 2014.

- Increase resilience of the roads and other infrastructure by:
    - Increasing size of drainage structures
    - Reducing hydrologic connectivity to stream system
    - Decommissioning and rerouting vulnerable roads

Fish and Aquatic Habitat

Fish will be affected by changing stream flows (higher peak flows in winter and lower low flows in summer) and increasing summer stream temperatures.

A large proportion of the habitat for fish species in the SCOAP area is found on Forest Service managed land —3100 mi (5000 km) out of 11800 mi (19000 km) of perennial streams.

Adaptation Strategies

- Store and slow the movement of water (benefits both aquatic life and infrastructure)
    - Specifically, add complexity to in-stream habitat, protect springs, increase shallow groundwater storage, and encourage beaver populations
    - Improve riparian habitat to increase soil water storage and shading
- Minimize the erosion impacts from roads, grazing, and wildfire that affect aquatic systems
- Increase water conservation

Vegetation and Disturbance

Higher air temperatures increase evapotranspiration and reduce soil moisture, thus affecting the abundance and distribution of plant species. Drought-tolerant species are likely to become more competitive with increasing moisture stress.

Disturbances like wildfire and insect outbreaks are the primary facilitator of vegetation change, potentially shifting forests to younger age classes and smaller trees.

Riparian and groundwater-dependent ecosystems (GDEs) will be especially vulnerable to higher temperatures, changing disturbance regimes, and reduced water availability.

Table 1: Summary of specific climate change effects on fish species selected for analysis

Species	Current Habitat	Projected Climate Change Sensitivities (2080s)
Redband Trout	3044 mi in 7 Species Management Units (SMUs)	• Juveniles sensitive to increased peak winter flows • 23% decrease in adequate summer flows • 27% decrease in thermally optimal habitat • Most sensitive SMUs – Goose Lk., Warner Lks., Malheur Lk., Upper Klamath, Chewaucan
Steelhead Trout	2121 mi in 2 Major Population Groups (MPGs)	• Juveniles sensitive to increased peak winter flows • Little decrease in adequate summer flows • 27% decrease in thermally optimal habitat • Has high adaptive capacity, and habitat restoration enhances resilience
Bull Trout	22 mi in 5 Core Populations	• Eggs and rearing juveniles vulnerable to increase peak winter flow • 18% loss in adequate summer flows • Most sensitive cores – Upper Sprague, Sycan, Upper Klamath • 52% decrease in thermally optimal habitat
Lost River and Shortnose Suckers	196 mi (25 mi on Fremont-Winema National Forest)	• Has complex life history -- uses streams, lakes, marshes, and shorelines • Nearly 80% of current habitat will have summer temperatures over 68 °F • Highly sensitive to declining water quality driven by decreased summer flows into lake habitats • Lost River Basin Recovery Unit particularly sensitive

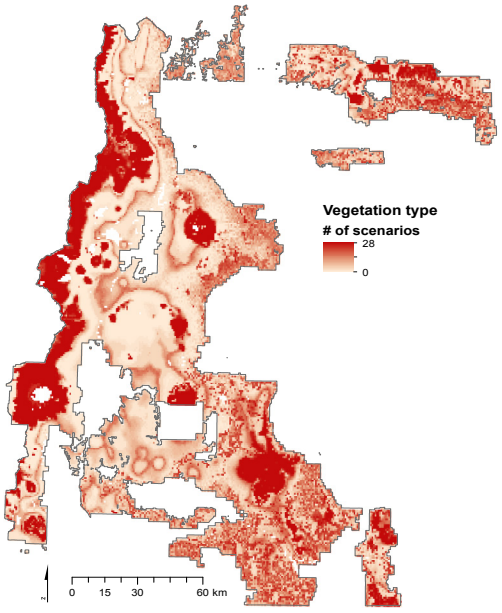


Figure 3: Model agreement map from the Dynamic Global Vegetation Model MAPSS-CENTURY 2 (MC2) for the end of the century (2070-2099) for simulated change in vegetation type for the SCOAP assessment area. Darker shading indicates more climate models agree that a shift in vegetation will occur. MC2 simulates the response of plant functional types to climate change, including plant physiology, biogeography, water relations, and interactions with fire.

Potential impacts to vegetation types:

- **Subalpine forests** are vulnerable to warming and snowpack loss, which leads to upward competitor migration, challenges for seedling establishment, and increased disturbance.
- Both **moist and mesic forest** structure and disturbance regimes will be determined by how productivity gains from warming interact with increasing drought stress.
- **Dry forests** are tolerant to warming which could allow for upward expansion. However these forests could see widespread mortality from compounding stresses. Increasing wildfire will tend to favor dominant species except in areas with high fuel loads.
- **Woodlands** could expand or contract depending on how temperature and soil moisture conditions interact with grazing and stressors like wildfire and nonnative annual grasses.
- **Shrublands and grasslands** are vulnerable to snowpack loss and wildfire, with compounding effects from land use conversion, grazing, and nonnative species.

Adaptation Strategies

- Increase resilience of forests by minimizing the incidence of high-severity, stand-replacing disturbance events. Tactics include:
  - Thinning and fuel treatments, especially in dry forests
  - Prescribed fire
  - Promoting drought- and insect-tolerant species
- Promote rangeland resiliency through:
  - Early detection and rapid response to invasive species
  - More collaborative weed management across agencies and with partners
  - Juniper expansion control, mechanical at lower elevations and prescribed fire at higher elevation
  - Increased post-fire monitoring, and implementation of appropriate post-fire actions (seed mixes)
  - Flexible grazing management plans
- Minimize impacts to riparian areas and GDEs by:
  - Planning ahead for more flood events
  - Increasing upland water storage
  - Manage water to maintain springs and wetlands; improve soil quality and stability.

Wildlife Species and Habitats

Climate change influences wildlife survival by altering the amount and distribution of basic needs (food, water, and shelter) as well as effects on competition and predator-prey dynamics.

Climate change effects interact with non-climate stressors to determine wildlife outcomes.

Despite the flexibility and adaptive capacity of many species, widespread shifts in animal ranges and local extirpations are possible.

Adaptation Strategies

- Limit non-climate stressors (manage roads, recreation, grazing, etc.)

Table 2: Summary of climate change effects on focal wildlife habitat types

Focal Habitat	Effects
Low-elevation grass/ shrub/woodland	• Heat/drought strains species physiological limits • Disturbance simplifies habitat, reduces food sources
Open, large ponderosa pine	• High-severity fire simplifies habitat by removing high-value components such as snags
Wetlands/riparian/ open water	• Habitat is sensitive to altered hydrology • There is higher potential for permanent and seasonal drying • Extreme flooding could damage habitat
Mid-elevation old forest	• Increased high-severity fire reduces structural and spatial heterogeneity • Habitat characteristics take a long time to develop
Mid-elevation early seral	• Lower-elevation areas are sensitive to drought stress • A post-disturbance transition to grass-shrub is possible
High-elevation habitats	• Transition to mid-elevation forest species is likely • Increased disturbance leads to loss in structural diversity

- Reduce the risk of high-severity fire
- Increase resilience of late-successional habitats (shrub and forest)
- Provide thermal refugia and opportunities for animal movement
- Maintain diverse, permeable landscapes that are resilient to disturbance
- Identify, retain, and restore riparian and wetland habitat
- Develop mitigation strategies to compensate for loss of snowpack location and duration

Recreation

Summer recreation in the area benefits from a longer period of suitable weather, especially during the spring and autumn shoulder seasons.

Water-based recreation is sensitive to lower water levels during drought years.

Snow-based recreation is negatively affected by smaller snowpacks and a shift to more transient snow regimes (Figure 4).

- In the SCOAP area, 224 mi (360 km) of snow trails are highly sensitive.
- Highly sensitive sno-parks in 2040s are Corbett, Lower Three Cr, Summit, Swampy Lks, and Upper Three Cr.

Current hunting seasons may not have optimal conditions, and shifting seasons may conflict with other recreation types.

Fishing will be sensitive to reduced summer stream flows and increasing temperatures, affecting target species.

Recreation infrastructure is sensitive to flooding.

- In the 2040s, there will be 18 mi (29 km) of trails within 300 ft (90 m) of a stream with high peak flow increase (>30%). This will increase to 128 mi (206 km) by the 2080s.
- Projected high risk in the 2040s - Pike Crossing, Corral Creek and Skyliner Lodge, increasing to 23 sites in the 2080s.

Adaptation Strategies

- Manage for increased recreational use in the shoulder seasons. For example, adjust openings and closings for roads, trails, and campgrounds
- Engineer transportation systems for wet weather movement (e.g., graveled trails) and couple with public education about safety issues
- Develop a sustainable recreation plan that includes monitoring use patterns and enlarge areas of high use while divesting in areas of declining use

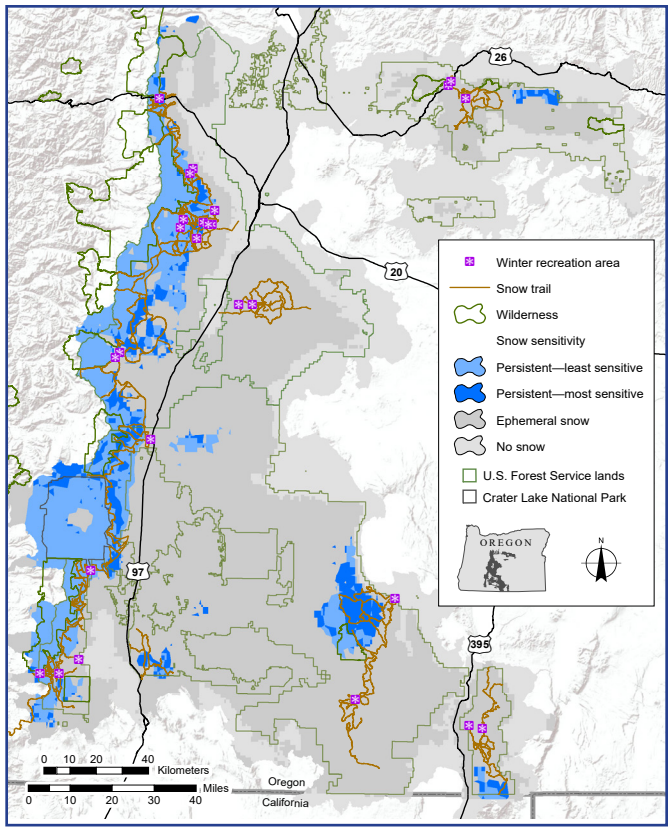


Figure 4: Winter recreation is sensitive to climate change in locations where the quality of recreation sites will be reduced by decreasing snowpack.

Ecosystem Services

Changes to timber supply and carbon sequestration are expected with lower productivity in low-elevation forests and increased productivity in mid-elevation forests, which could be offset by increased wildfire.

Livestock grazing is at risk from changes to amount, distribution, and productivity of rangelands and the further expansion of nonnative annual grasses. Issues surrounding access to water and pressure on riparian areas will likely be exacerbated.

Warming may cause a mismatch in the timing of flowering and pollinator presence. Pollinators may shift their ranges to find food.

Climate change may also affect biophysical structures, processes, and functions related to cultural resources, including first foods (e.g., huckleberries, salmon) valued by tribes and other users.

Adaptation Strategies

- Employ management options like thinning and surface fuel removal to reduce potential for high-severity wildfire in forests to create resilience in timber and carbon stocks
- Ensure continued productive livestock grazing by:
    - Promoting early-season species
    - Employing appropriate post-fire action (e.g., effective seed mixes)
    - Developing flexible livestock grazing management plans
- Protect pollinator habitat that has a diversity of plants with overlapping flowering phenology
- Promote sustainability of cultural resources by reducing non-climate stressors and reducing conflicts between commercial and recreational use versus tribal use
- Consider ecosystem services in vegetation management plans

Conclusion

The SCOAP is a large climate change vulnerability assessment and adaptation effort bringing together stakeholders interested in a broad range of resource areas. It provides new scientific context for future forest plan revisions, restoration and project level activities in south central Oregon. Many of the proposed adaptation strategies, some already part of current management practice, provide a pathway for slowing the rate of deleterious change in resource conditions. Climate-informed selection of priorities and rapid implementation of adaptation in resource planning and management will help maintain critical structure and function of aquatic and terrestrial ecosystems in south central Oregon. Long-term monitoring can help detect potential climate change effects, and evaluate the effectiveness of implemented adaptation options.

Looking for More?

Please refer to the original **vulnerability assessment** for more in-depth information about impacts and adaptation in south central Oregon.

Halofsky, J.E.; Peterson, D.L.; Ho, J.J., eds. 2019. Climate change vulnerability and adaptation in south central Oregon. Gen. Tech. Rep. PNW-GTR-974. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 473 p.

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