



## USDA Regional Climate Hubs: Southwest

Effects of Drought on Forests and Rangelands in the United States: A Comprehensive Science Synthesis

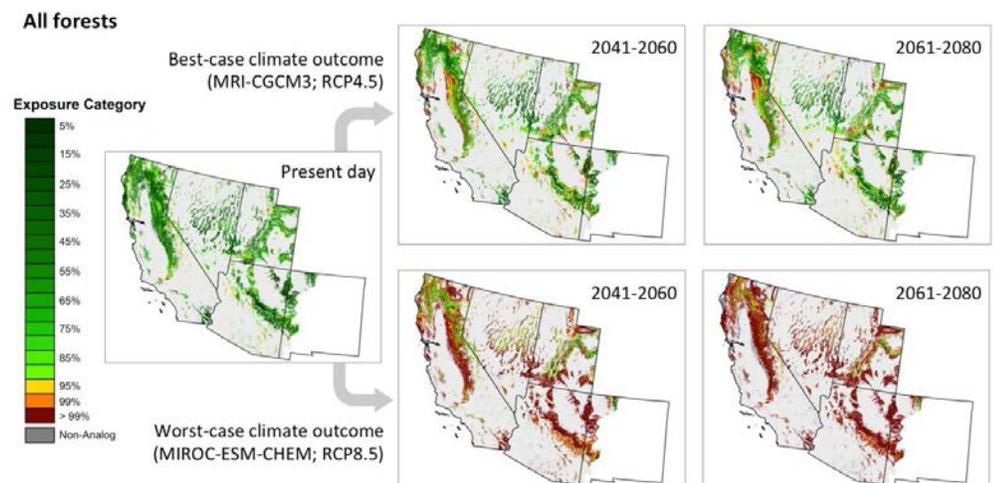


### Drought Impacts on Forests and Rangelands in the Southwest

#### Overview:

The Southwest is the most extensive dry region of the United States. Most of the region receives less than 15 inches of mean annual precipitation. High-elevation snowpack in the Sierra Nevada and Rocky Mountains supply much of the regional surface water. Average annual precipitation varies greatly for the Southwest region, from more than 60 inches on California's northwest coast to less than 5 inches in the lower Colorado River valley. However, with much of the region classified as arid or semiarid, the annual average rainfall region-wide is around 15 inches. The Southwest region experiences a wide range of weather and climate events including droughts, heat waves, and floods. Notable wet periods in the last 115 years include 1940–1941, and the 1980s and 1990s. Region-wide severe droughts occurred in 1900, the mid-1950s, and early 2000s; and in 2015 California and parts of Nevada experienced exceptional drought. The maximum number of consecutive dry days (precipitation < 0.04 inches) in a year is projected increase by 5-10 days in dry spell duration. The increases are expected to occur in summer months.

Temperatures are already warming in the Southwest and scientists agree that temperatures will continue to increase in coming decades. The freeze-free season (the time between the last occurrence of 32°F in spring and the first occurrence of 32°F in the fall) has lengthened and is now about 2 weeks longer on average now than it was in the 1960s and 1970s. Model projections of forest response to climate change suggest the forests in the Southwest will be less abundant. As the climate becomes warmer and drier, the areas suitable to support temperate and montane forests will shift northward and upward in elevation.



Climate change will increase stress on the region's rich diversity of plant and animal species. Widespread tree death and fires, have already caused billions of dollars in economic losses, are projected to increase, forcing wholesale changes to forest types, landscapes, and the communities that depend on them. In Arizona and New Mexico, high temperatures combined with droughts coincide with widespread mortality of diverse mesic montane tree species and patchy die-off of pinyon pine. Since 1996 about 20% of southwestern forest area has been affected by high levels of tree mortality from combinations of drought stress, bark beetle attacks, and fire.

## Drought Impacts on Forests:

- **High temperature will increase fire hazard** by affecting nearly all forest, rangeland, and grassland ecosystems.
- **Large wildfires will occur more frequently and cover larger areas.** Regeneration of some tree species may be difficult where fires are widespread and intense. Insect related tree mortality and other disturbances will contribute to fire hazard and fire severity on a local basis.
- **Droughts are predicted to accelerate the pace of non-native plant invasion into range and grasslands.** In rangelands, drought conditions as well as invasive annual weeds will exacerbate the risk of fire, especially in areas dominated by native shrubs such as big sagebrush. For example, drought increases the frequency of fires where cheatgrass, an exotic annual grass, has invaded the sagebrush biome. As a result, burned sites are more likely to be invaded by additional cheatgrass, which often displaces native grasses.
- **Reduced forage quantity and quality for livestock and wildlife** will occur as range productivity diminishes due to drought and non-native plant invasions.
- **Reduced water yield from forests and rangelands during extended droughts and lack of snowpack will reduce domestic and agricultural water supplies.**
- **Insect pests and fungal pathogens will increase or become more severe and damaging.** Warmer temperatures will help some invasive plant species and insect pests expand into new areas; climate-related stress and disturbances in forest ecosystems can create more opportunities for non-native plants and insects to invade. Examples include expansion of (native) mountain pine beetles in lodgepole and ponderosa pine forests.
- **Aquatic biota will be adversely impacted** as stream flows decrease and water temperatures increase.
- **Increased erosion** as drought-induced die back of native vegetation increases the exposure of bare ground to erosion.
- **Relocation of habitats:** If drought becomes more prevalent, habitats may shift in location at rates much faster than trees can move. **Adaptation to Drought in Forests and Rangelands:**

Management options to deal with additional stress resulting from drought include:

- Plant trees with genetic characteristics that confer tolerance to environmental stress now and in the future, considering both species and populations within species
- Manage forest stand density to ensure adequate soil water and other resources for the remaining trees.
- Improve resilience by managing for high spatial variability in the structure of forests to allow them to quickly return to a healthy and productive state after the stresses of drought and fire.
- Alter the composition of stands to accommodate changing conditions. This could entail planting different mixtures of species to reflect changing climates or planting genotypes from warmer and drier locations in order to adapt systems to warmer future conditions
- Use adaptive grazing; adjust livestock stocking rates so that habitat is not overgrazed and the land can regenerate quickly after grazing

## Conclusions:

- Climate change is already increasing the effects of drought in the Southwest.
- Prepare for increased severe fire occurrence,
- Invest in forest and shrubland fuels reduction, post-fire restoration efforts, and related research.
- Promote adaptation demonstrations, leveraging successful applications to advance climate change integration and adaptation in natural resource planning, particularly for owners and managers of livestock operations, woodlots, large forested areas, industrial lands, wildlife refuges, and watersheds.

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To learn more about USDA Climate Hubs visit: <http://climatehubs.ocs.usda.gov/southwest>

To read the full report *Effects of Drought on Forests and Rangelands in the United States: A Comprehensive Science Synthesis* visit: <http://go.usa.gov/cEtd9>