



United States Department of Agriculture
Forest Service
Pacific Southwest Research Station

Research Brief: Impacts of Extreme Fires in the Sierra Nevada

The Rise of Extreme Fires

Fire is so important in the Sierra Nevada that it can be seen as medicine for ailing forests; however, as with most medicines, taking too large a dose can be very harmful. Wildfires that are unusually large, complex, and resistant to control, such as the Rim Fire (fig. 1), have been described as extreme fires or “mega-fires.” The size and unpredictability of these fires impacts societal well-being, and their tendency to burn extraordinarily large and severe patches threatens important ecological values. This kind of wildfire is likely to become more common as the regional climate warms and as fuels continue to build up due to decades of fire exclusion.

Scientists from PSW considered the effects of severe wildfire in the Sierra Nevada and southern Cascade Range in a recent synthesis* intended to inform strategies to promote forests and the societies connected to them. Fire is indispensable to maintaining the health and productivity of most forests in the Sierra Nevada. Fires rejuvenate both terrestrial and aquatic systems by restructuring habitats and increasing the availability of light, water, and nutrients in ways that benefit many herbs, shrubs, and animals. Recurring fires also reduce forest fuels and help grow large iconic trees including giant sequoia, sugar pines, yellow pines, and California black oak. However, extreme fires burn so intensely that they leave fewer unburned or moderately burned areas that provide source material for regenerating forests. As a result, the oversized effects of extreme fires compound the existing vulnerability of forests and communities and threaten their resilience, even though plants, wildlife, and people do re-inhabit the burned areas.



Fig. 1. In September 2013, the Rim Fire became the premier example of an extreme fire in the Sierra Nevada, causing evacuations, property losses, poor air quality, and impacts to infrastructure that harmed both local communities and people far beyond the burned area.

The oversized effects of extreme fires compound the existing vulnerability of forests and communities and threaten their resilience, even though plants, wildlife, and people do re-inhabit burned areas.

Management Implications

- Extreme fires cause societal problems due to their large size and unpredictability. The abnormally large size of high-severity patches accounts for most negative impacts of such fires to ecological values.
- Encouraging less intense, more manageable fires through combinations of thinning, prescribed burns and managed wildfire under moderate conditions (fig. 2) would help to restore the vital role of fire while reducing potential for more dangerous extreme fires.
- Promoting more moderate and frequent fire and reducing high fuel loads would yield a more sustained flow of ecological services, including high-quality water, wildlife habitat, forest products, and tourism and recreation opportunities.



Fig. 2. Wildfires that are intentionally managed for resource benefits can promote landscape diversity, which includes relatively small high-severity patches.

* Long, J.; Quinn-Davidson, L.; and Skinner, C., tech. eds. [In press]. Science Synthesis to Support Socioecological Resilience in the Sierra Nevada and Southern Cascade Range. Gen. Tech. Rep. Albany, CA: USDA Forest Service, Pacific Southwest Research Station.



Fig. 3. The negative effects of stand-replacing burn patches become greater and last longer where they extend over thousands of acres.

For Further Information, Contact:

Jonathan Long

Ecologist

1731 Research Park Dr.

Davis, CA 95618

(530) 759-1744

jwlong@fs.fed.us

www.fs.fed.us/psw



Impacts of Extreme Fires on Forests

Extreme fires like the Rim Fire become giant by spreading rapidly under extreme weather conditions. This extreme fire behavior kills large swaths of trees, including large, old-growth trees that historically survived many lower intensity fires. The resulting patches of dead trees and severely burned soils are larger than what these landscapes typically experienced in recent centuries. Patches of fire-killed trees (fig. 3) can become a short-term haven for many wildlife species, including deer, woodpeckers and other birds, as well as fire-following grasses, forbs, shrubs, and young trees. However, gains for fire-following species may come at the expense of many old-forest species, such as California spotted owls and fishers, that have to find new nest and den sites. Many burned oaks may resprout from their roots soon after a fire, but it will take decades for these top-killed trees to regrow to the size where they produce acorns and provide valuable structural habitat for wildlife. Patches of dead trees may be so large that it takes long periods for seeds of coniferous trees to reach the expanses of burned areas and reestablish forests. During that period, shrubs may become dominant, and high-intensity fires may recur before trees have grown enough to survive fire. Such repeated fires may be more likely in areas that have flammable shrubs and heavy fuels resulting from fire-killed trees. As a result, extreme fires can transform large areas of forest into fields of shrubs and small trees that persist for decades or even centuries. Within large patches of dead trees, reestablishing mature forest, understory diversity, and habitat structures within decades may be infeasible.

Impacts of Extreme Fires on People

Extreme fires result in very costly suppression, property damage, threats to infrastructure, stress, and other short-term health and safety risks for people in affected communities and the firefighters assigned to defend them. Wildfires can have major negative impacts on people and businesses tied to tourism, recreation, grazing, logging, and other uses of national forests. In addition, as fires grow larger and more damaging, it becomes more difficult to redirect such activities into unimpacted areas. Some people or businesses may benefit from the influx of firefighters during the event or the salvage harvest of burned trees immediately following it, but it is difficult for businesses, agencies, and other institutions to scale up and down in response to such large and unpredictable events. Massive wildfires disperse smoke widely and for extended periods, affecting people who may already be vulnerable to poor air quality, especially in urban areas. Despite increasingly sophisticated suppression techniques, most forests in the Sierra Nevada will inevitably experience fires, so outcomes will depend on the conditions when and where they do.

Alternatives to Extreme Fires

Even uncontrolled extreme fires leave patches of unburned to moderately burned forests where they burned under less severe weather conditions or through areas with a history of past fires and/or treatments to reduce fuels. More moderate burns over time can reduce forest fuels and tree density to levels that leave the remaining forests less vulnerable to drought, climate warming, and other stressors. Promoting such diverse forest patches through combinations of thinning forest and managed fire provides an opportunity for inevitable wildfires to burn more safely and effectively across the landscape. When fires burn under managed conditions and favorable weather, residents can be warned and smoke can be dispersed away from communities. Adopting such a fire-centric strategy can help sustain forest values including high-quality water, wildlife habitat, carbon storage, forest products, and other benefits while avoiding the high costs of extreme fires.