USDA Forest Service
U.S. DEPARTMENT OF AGRICULTURE

FS-1189e | April 2022

Treating Hazardous Fuels at a Scale That Makes a Difference

Periodic fire is a natural disturbance that helps keep forests and grasslands healthy. For more than a century, fire has been excluded across U.S. forests and grasslands, leading to a buildup of fuels across landscapes and denser and more expansive forests than before European colonization. These factors, combined with increasingly warmer and drier weather due to climate change, have contributed to widespread tree death from drought, insects, disease, and fire. These conditions have resulted in longer and more severe wildfire seasons in the Western United States. High-severity wildfires can lead to postfire erosion and debris flows that threaten water resources and infrastructure. Additionally, the increasing number of homes built along the forest's edge places communities at risk to loss of life and property.

U.S. Department of Agriculture (USDA), Forest Service researchers and partners are working toward a proactive (rather than a reactive) approach to managing fire, with the goal of rapidly and substantially increasing the pace and scale of managing hazardous fuels. This work often has the added benefit of increasing tree resilience to drought, insects, and diseases. Equally important, Forest Service scientists are developing tools to help planners make informed decisions about community risks, the best ways to put prescribed fire on the landscape and reduce smoke exposure, and how to best manage landscapes for recovery and resilience after fires occur (see related "Postfire Stabilization and Recovery" factsheet, FS-1189a).

In many situations, treatments that reduce hazardous fuels make it easier to manage and contain wildfire and improve long-term forest health. By keeping fuel loads low, future fires burn at lower intensities. Furthermore, these actions restore fire-adapted ecosystems, helping to conserve native biodiversity and provide wildlife habitat.

Hazardous fuels are excess woody materials on the ground or in the forest understory or canopy that can increase the severity of fire. Once fire occurs, hazardous fuels can threaten any of the following:

- Communities
- Water resources
- Recreation areas
- Ecosystem health
- Timber

A Combination of Thinning and Prescribed Fire Is Best for Forest Health

Studies consistently find that thinning followed by prescribed fire has the most dramatic impact on fire behavior. However, this effect may be diminished when done at small scales or where high winds and landscape features can increase the spread and intensity of a fire regardless of local fuel conditions. Thinning followed by prescribed fire has positive impacts on other aspects of forest health as well, such as improving tree growth rates and enhancing resistance to disturbances such as drought, insects, and diseases. Where initial thinning is necessary to put fire on the ground safely, repeated use of fire to maintain those resilient conditions is a cost-effective pathway to sustaining healthy landscapes at the necessary scale.

Large trees survived after a wildfire in a forest that was treated with prescribed fire (left). By contrast, nearby untreated forests (right) had a thick, fuels-laden understory. Images are from research on the Tahoe National Forest, CA. USDA Forest Service photos by Jens Stevens.

Mechanical Treatments Can Target Specific Trees and Reduce Overall Tree Density

Mechanical treatments aimed at reducing the risk of wildfire include commercial timber harvesting, thinning of smaller trees, and manipulative processes that reduce ladder and surface fuels by redistributing, compacting, or burning them (such as chipping, mastication, and pile-and-burn). Mechanical treatments provide specific outcomes that help reduce overall forest density and increase the spacing between tree crowns, making it more targeted than prescribed fire in certain situations.

Prescribed Fire Is Useful for Sustaining Resilient Forests

Prescribed fire is most effective in reducing small stems and surface fuels to modify fire spread, especially over larger areas and on steeper slopes where mechanical treatments are more limited, though it can also be used near communities. Through prescribed fire, resource managers can reduce fuels in a controlled manner while mimicking the natural disturbance cycles of forests. Managers can plan the burn area and severity ahead of time, conduct the burn during safe weather conditions, and minimize the impacts of smoke. Important advances by Forest Service researchers on understanding prescribed fires, resultant smoke, and general fire behavior and effects include:

- QUIC-Fire—a new tool that integrates wind and fire spread models to rapidly predict complex prescribed fire behavior.
- The Fire and Smoke Model Evaluation Experiment (FASMEE)—a study of large-scale prescribed fires to better understand and predict fire behavior and smoke dynamics.
- The Missoula Fire Sciences Laboratory houses unique equipment essential for studies of fire behavior, soil heating, fire physics, smoke properties, and estimation of fire danger.

Determining the Most Cost-Effective Scale of Fuels Treatments

A knowledge of how the present landscape compares to historical ranges of vegetation, when fire was not excluded, is essential for a landscape-scale approach to forest management and fuels reduction. This knowledge is critical for planning and prioritizing treatments to maintain forested landscapes and protect communities from wildfires. Forest Service innovations in measuring fuels and mapping community risk to wildfire include:

- Wildfire Risk to Communities is a free, easy-to-use website with interactive maps, charts, and resources to help communities understand, explore, and reduce wildfire risk.
- The Fireshed Registry delineates geographic units that can be used to describe past, present, and future trends in forest and fuels management and wildfire exposure to communities.

Social Acceptability, Demographics, and Barriers to Fuels Reduction

In general, there is a high level of support for fuels reduction on lands with high wildfire risk. Forest Service research on social acceptability of and barriers to fuels reduction includes:

- A synthesis of over 200 social science studies found that social acceptability of mechanical thinning and prescribed fire is greatest when members of the public perceive high wildfire risk and poor forest health, are familiar with the proposed treatment types, perceive treatments as being cost-effective and successful at achieving desired outcomes, and trust the implementing agencies.
- A new method integrates U.S. Census Bureau demographic data with planned land management activities to ensure that minority populations benefit from fuels reduction treatments.
- In a survey of public land managers in 11 Western States, lack of adequate resource capacity and funding were the most common barriers to increasing use of prescribed fire, rather than air quality, which is often thought to be a key barrier.

Effects of Fuels Reduction Treatments on Carbon Dynamics

The impact of fuels treatments on landscape forest carbon stocks is an evolving field of study. It is highly variable because the carbon benefit only manifests when a fire ultimately occurs in the treated area. Overall, the impact of fuels treatments most likely results in short-term carbon loss from landscapes but will have long-term carbon benefits from improved fire resiliency.

About Forest Service Research and Development: The Research and Development (R&D) arm of the Forest Service works at the forefront of science to improve the health and use of our Nation's forests and grasslands. Research has been part of the Forest Service mission since the agency's inception in 1905. The organization consists of 7 research stations and 81 experimental forests and ranges. Forest Service R&D partners with other Federal agencies, States, Tribes, nongovernmental organizations, universities, and the private sector. Today, more than 400 Forest Service scientists work in a range of biological, physical, and social science fields to promote sustainable management of the Nation's diverse forests and rangelands.