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Rocky Mountain Research Station

Science You Can Use *(in 5 minutes)*

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The Alchemy of Addition: Cutting and burning together most effective in reducing fuels and improving forest resilience

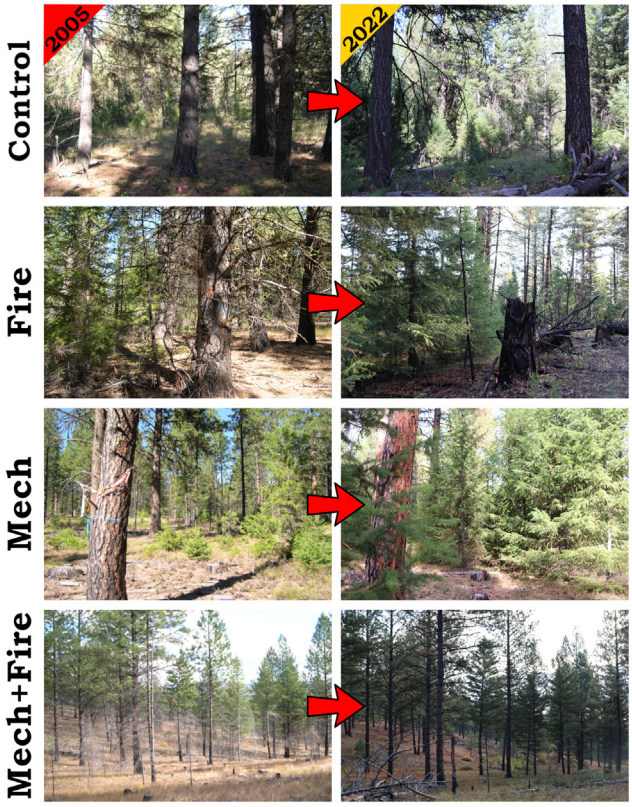
Scientists have spent decades trying to understand how to best promote resilient forests and reduce fuels. A golden endeavor certainly. Is the best approach using a series of prescribed burns? Or is it mechanically cutting trees? Or does the additive effect of both cutting and burning provide the best alchemy?

Low-elevation, ponderosa pine forests historically were very resilient to frequent, low-intensity fires. These types of fires killed many of the smaller trees, especially of shade-tolerant species, but most of the larger trees would survive. Forest conditions are much more susceptible to wildfires than in the past across vast areas of the western United States. Now when fires occur, they are likely to kill many more trees and be more difficult to manage.

The National Fire & Fire Surrogate (FFS) study, initiated in 1998, was a pioneering network of 12 sites across the U.S. designed to test efficacy of fuel and restoration treatments in reducing fire severity (i.e., the number of trees killed in fire) and to quantify other restoration effects in forests with historically frequent, surface fire regimes. Each site included four treatments: an unmanipulated control, a prescribed fire only, a mechanical treatment only, and a mechanical treatment combined with prescribed fire. The Northern Rockies FFS study site is located on the University of Montana's Lubrecht Experimental Forest in a ponderosa pine dominated forest. The Lubrecht site primarily contains 80–90-year-old second-growth ponderosa pine and Douglas-fir trees, with small amounts of western larch and lodgepole pine.

Treatment of forest fuels was designed to reduce forest density and to support the dominance of larger trees of fire-resistant species. The ponderosa pine and western larch treatments were completed in 2002. Between 2005 and 2012 the study site was heavily impacted by a mountain pine beetle outbreak that allowed further testing of how the outbreak effects differed among treatments.

Sharon Hood and Justin Crotteau, scientists with the USDA Forest Service's Rocky Mountain Research Station, and Cory Cleveland from the University of Montana,



Treatment photographs demonstrating change over time from one of the established photo positions. The 2005 position shows 4 years postharvest and 3 years postburn; 2022 shows 20 years posttreatment. USDA Forest Service photos by Justin Crotteau.

worked together to address these important questions. They synthesized past publications from the Lubrecht FFS study and collected new data to assess the longevity of restoration and fuel reduction treatments commonly used in dry, low-elevation forests of the western United States. "This work was needed because there are so few examples of the long-term effects of these common forest treatment types in the region," says Crotteau.

Now equipped with a 20-year dataset from the Lubrecht FFS study, the team assessed the long-term efficacy of the three treatments compared to a control (no action) in mitigating high-severity wildfire and mountain pine beetle outbreaks. The research determined that the combination of mechanical treatment ("thinning") followed by prescribed burning had the lowest fire hazard throughout the 20 years of study compared to the control and individual thinning or burning treatments.

"The combined thinning and burning treatment gives you benefits that last much longer and minimizes fire hazard over the longest period of time. This study shows that proactive management can increase forest resilience to multiple disturbances," says Hood.

Thinning treatments had consistently lower forest density and higher tree growth, but effects were more pronounced when thinning was combined with prescribed fire. The thinning plus prescribed fire treatment had the added benefit of fostering more ponderosa pine regeneration, while maintaining the highest proportion of ponderosa pine overstory. If a wildfire were to occur now, 20 years posttreatment, the researchers estimated many more of the larger trees would survive in the treatments with thinning, which has the added benefit of creating higher stable carbon stores.

"It's important to use both cutting and burning together when possible. The mechanical- and process-based (i.e., prescribed fire) approaches work together to quickly and reliably produce good results for restoration and fire hazard reduction," says Crotteau.

A trade-off to these benefits, however, was that nonnative species richness was still higher 20 years posttreatment in the combined mechanical and prescribed fire treatment compared to the control. While nonnative cover and richness paled in comparison to native species, their presence is still a concern.

In addition to the Lubrecht FFS Montana site, three other sites of the original 12 in the National FFS study remain active in California, Ohio, and North Carolina. Findings from each of these sites and lessons learned about the National FFS study are part of a forthcoming special issue in the scientific journal *Ecological Applications*.

KEY MANAGEMENT CONSIDERATIONS

- The Lubrecht Fire & Fire Surrogate study shows that fuel and restoration treatments in ponderosa pine forests of the Northern Rockies can bolster resilience to multiple disturbances, while buffering risk of high carbon losses.
- The findings of this study support thinning and prescribed fire to increase ponderosa pine forest resilience to both wildfire and bark beetles for up to 20 years, but efficacy decreases over time and additional fuel treatments are needed to maintain forest resilience.
- However, these treatments can increase the number of nonnative species, which may require additional mitigation measures.
- As the site is re-treated, long-term monitoring is planned to document cumulative effects of multiple treatments to inform future management decisions.

PROJECT LEADS

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FURTHER READING

Hood, S.M.; Crotteau, J.S.; Cleveland, C.C. 2024. Long-term efficacy of fuel reduction and restoration treatments in Northern Rockies dry forests. *Ecological Applications*. e2940.