Northwest Fire Science Consortium
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INFLUENCES ON WILDFIRE BURN SEVERITY
TREATMENT AND LANDSCAPE DRIVERS IN AN EXTREME FIRE EVENT

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Burn severity greatly influences the impacts of large wildfires on forested landscapes. Large, high-severity wildfire events have a lasting legacy. Through widespread tree mortality, they reset forest succession and can leave a landscape burn scar that persists for decades. As large and intense wildfires become more common under projected climate change, an understanding of the drivers of burn severity is increasingly important. High-severity fire events in a warming climate may be associated with changes in species composition and the type of vegetation that can regenerate after fires. Forest treatments with the potential to influence burn severity can help guide management that restores forest resilience, particularly if these influences persist in extreme fire events.

In this study, researchers analyzed how previous management efforts and other factors including weather and landform influenced burn severity during the 2006 Tripod Complex Fires, which at the time represented the largest wildfire event in over 50 years in the state of Washington. The Tripod Complex burned over 170,000 acres of mixed-conifer forests, including 387 past harvest and fuel-treatment units. By evaluating differences in burn severity in areas with and without harvest and fuel treatments, as well as between areas with different landform, vegetation, insect outbreak, and weather during burning, researchers evaluated the relative influence of these drivers on burn severity during the fire.

Map courtesy of Susan Prichard
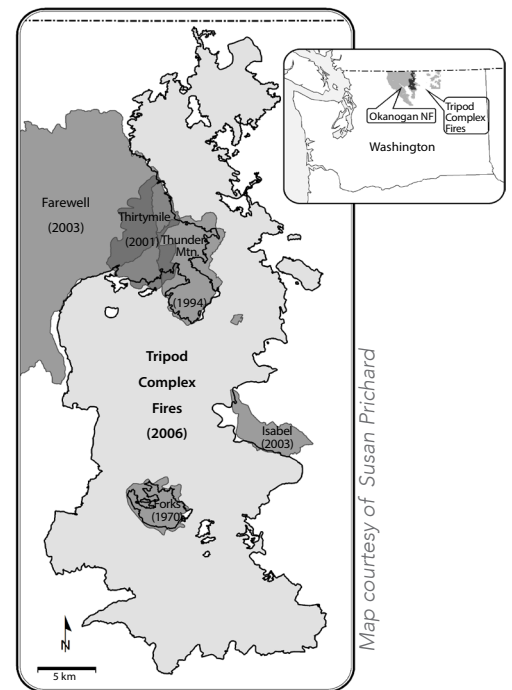
Tripod Complex study area.

MPB-affected lodgepole pine and fire damage in the Tripod Complex burn area. Photo: Susan Prichard.

KEY FINDINGS

- Even during extreme fire weather, harvest and fuel treatments influenced patterns of burn severity.

- Areas with prescribed burning of surface fuels were particularly effective at mitigating severity, even 20-30 years after treatments.

- Areas with mountain pine beetle outbreak burned at higher severity than unaffected areas.

- Elevation, vegetation type and structure, temperature, and relative humidity were also strong predictors of burn severity.

The Northwest Fire Science Consortium is a regional fire science delivery system for disseminating knowledge and tools, and a venue for increasing researcher understanding of the needs of practitioners.

RESULTS

Fuel treatment effects

Forest management practices appear to have significantly influenced burn severity in the Tripod Complex Fires, as areas with previous harvesting or fuel treatments consistently burned at less severity than areas with no treatments. Treatments that included prescribed fire were particularly effective at reducing severity. Areas that were clearcut and then broadcast burned had the lowest burn severity overall, followed by areas that were thinned and then broadcast burned, suggesting that surface fuel loads were important contributors to burn severity. Management units that were thinned or clearcut without prescribed burning also had lower burn severity than untreated areas, suggesting that treatments also modified fire behavior to reduce burn severity.

Treatment age was correlated with burn severity. Broadcast burn treatments that were 20 to 30 years old still appeared to be effective at mitigating burn severity, likely due to slow fuel succession in semiarid forests of this study area.

Mountain pine beetle status

Increased mountain pine beetle (MPB) populations and damage in western forests have led to a growing concern about how outbreaks affect wildfire behavior and severity. In the few years before the Tripod Complex fires, high elevation, lodgepole pine-dominated forests experienced a widespread MPB outbreak. This study showed a significant association between insect damage and burn severity. MPB attack areas with red-needle stage classification dominated by dead needles burned the most severely compared to unattacked areas of green vegetation, followed by areas with mixed attack. Although the association between affected areas and burn severity offers insight, it may also be partly biased given widespread MPB outbreak in the study area, and the tendency of lodgepole pine forests to both burn at higher severity and be more predisposed to MPB outbreaks than other forest types.

Other influences

Elevation, vegetation type and structure, and weather variables were significant predictors of burn severity. Burn severity was highest at elevations between 1,600 and 2,100 feet, with mid- to high-elevation vegetation type consisting of dense, mixed-conifer forests that are more susceptible to fire than fire-resilient species at lower elevations. Burn severity dropped off dramatically at elevations above 2,100 feet, which typically contained more sparse alpine or subalpine vegetation. Across the study area, burn severity increased with canopy cover and was greatest in mixed-conifer forests. Maximum temperature and minimum relative humidity during fire progression were also strong predictors of burn severity.

IMPLICATIONS

This research suggests that dry forest management and fuel reduction treatments in particular can significantly affect wildfire burn severity. Even during extreme fire seasons marked by high spring and summer temperatures, low precipitation, and frequent wildfires, fuel loads had an impact on burn severity. The influence of fuel treatments on reducing burn severity are compelling in the Tripod Complex Fire, as many treated areas burned completely undefended in the first few days of the fire with strong winds, low humidity, and high temperatures.

In different types of forest, similar treatments may not have had the same effect. Treatments that included broadcast burning to reduce surface fuel loads were particularly effective at reducing burn severity in the semiarid forests affected by the Tripod Complex Fire, and treatment effectiveness persisted for decades. Although the Tripod Complex was considered an extreme fire event, other studies have shown that fuel treatments have not remained effective. It is possible that in even more extreme fire weather (for example, hotter, drier weather leading up to the fires and stronger winds during event), that treatments would not have mitigated burn severity as well. Also, in more productive forests with flammable understory layers, thresholds to burning would be lower and more frequent treatments would likely be necessary to maintain effectiveness.

In dense mixed-conifer forests with mixed to high-severity fire regimes, thinning and broadcast burn treatments appear to be effecive at mitigating burn severity. They are also effective at retaining stand and landscape heterogeneity that promotes resilience to insects, pathogens, and wildfires. Across forest types, fuel treatments that consider vegetation type and historic wildfire regimes can be an effective approach to increasing forest landscape resilience under a changing climate.

Photo: Stacy Davis.

MORE INFORMATION

This brief is based on the following article :
Prichard, S.J., and M.C. Kennedy. 2014. Fuel treatments and landform modify landscape patterns of burn severity in an extreme fire event. Ecological Applications 24(3): 571-590.

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