CALIFORNIA FIRE SCIENCE CONSORTIUM

Research Brief for Resource Managers

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Influence of fuels management and fire weather on the Rim Fire

Lydersen, Jamie, Brandon Collins, Matthew Brooks, John Matchett, Kristen Shive, Nicholas Povak, Van Kane, and Douglas Smith. 2017. Evidence of fuels management and fire weather influencing fire severity in an extreme fire event. Ecological Applications 27(7): 2013-2030. DOI: 10.1002/eap.1586.
http://treesearch.fs.fed.us/pubs/55246

The incidence of high severity wildfire in forests adapted to a frequent, low- to moderate-severity fire regime has increased throughout much of the western United States. Given this increase, there is great interest in whether fuels treatments and previous wildfire can alter fire severity patterns in large wildfires. In this paper we analyzed fire severity in the 2013 Rim Fire, which had both a rich history of fuels management and previous fire history, and occurred during extreme burning conditions.

Despite the wealth of information demonstrating reduced wildfire severity within areas with completed fuel/restoration treatments, there is still uncertainty in the ability of these treatments to affect wildfire severity outside their footprint. This is particularly true under more extreme burning conditions (e.g., plume-dominated fire), where reduced fuels conditions can be "overridden" by the energy of the fire. Random forests models were used to examine how high severity fire varied with the proportion of the landscape previously treated or burned, fire weather, vegetation, and water balance at three different spatial scales (500, 2500 and 5000 acres). Fire and treatment history prior to the Rim Fire that was included in this analysis dated as far back as 1995.

Management Implications

- Both fuels treatments and previous low to moderate-severity wildfire reduced the prevalence of high-severity fire.
- Areas treated with prescribed fire, especially when combined with thinning, had the lowest proportions of high severity, while areas that previously burned at high severity had the greatest proportion of high-severity fire
- The proportion of the landscape burned at high severity was most strongly influenced by fire weather and proportional area previously treated for fuels or burned by low to moderate severity wildfire.

Both fuels treatments and previous low to moderate-severity wildfire reduced the prevalence of high-severity fire (Fig. 1). Areas treated with prescribed fire, especially when combined with thinning, had the lowest proportions of high severity. In contrast, areas without recent fuels treatments and areas that previously burned at high severity tended to have a greater proportion of high-severity fire in the Rim Fire. High severity reburns are particularly problematic in conifer-dominated areas historically characterized by a low- to moderate-severity fire regime. In these areas conifer establishment rates are very low, which favors conversion of the landscape to shrub- or grass-dominated vegetation.

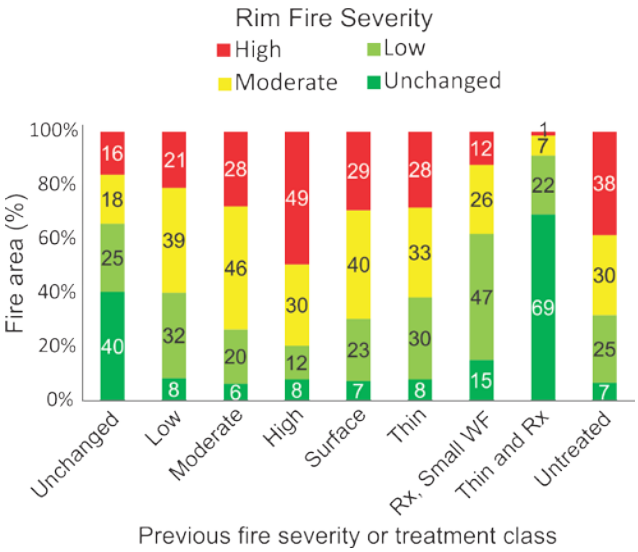

FIG. 1. Rim Fire severity by previous wildfire severity and fuel treatment class. Numbers over each portion of the bars show the percentage, rounded to the nearest whole number, within each fire-severity class.

The strongest drivers of high-severity fire at the landscape scale were proportion of area treated or previously burned and fire weather (as indicated by the burning index and the energy release component) (Fig. 2). These were the leading variables in random forest models across all three spatial scales tested.

At smaller spatial scales, the burning index had the greatest influence on proportion high severity fire, while at the largest scale the proportion treated had the greatest influence. In addition, a greater proportion treated was required to see an effect on fire severity at smaller scales. This may reflect that treatments need to be of a certain size to influence fire severity across a landscape.

Fire severity patterns along the general direction of fire spread were also examined using a mixed model ANOVA. When the Rim Fire was burning with moderate or high severity and encountered a previously burned or treated area, fire severity was reduced within the first 50 m of the treatment/previous fire boundary.

These results show that fuels treatments and low to moderate severity wildfire can reduce fire severity in a subsequent wildfire, even when burning under high- to extreme-fire growth conditions, and provide further evidence that both fuels treatments and lower severity wildfire can increase forest resilience. However, the occurrence of some high-severity fire within all treatment types (1–29%) emphasizes that under high to extreme burning conditions fuel/restoration treatments reduce, but likely cannot completely eliminate, high-severity fire effects.

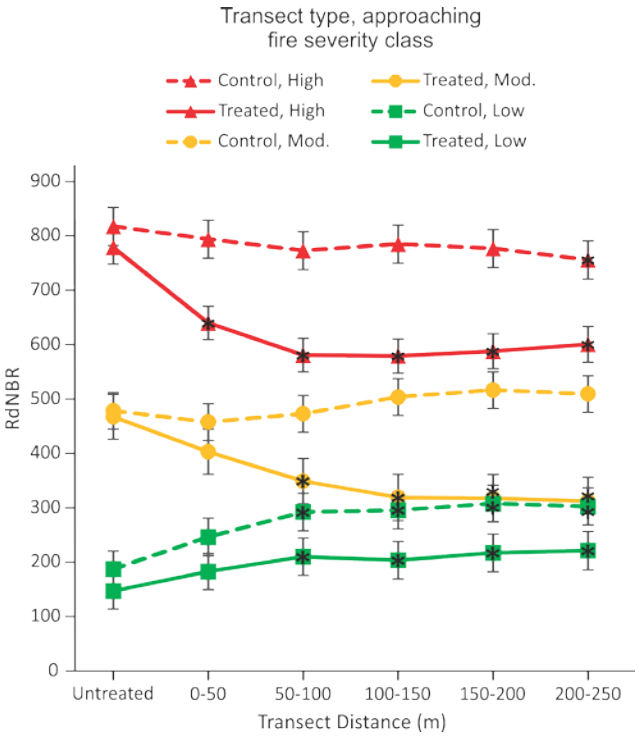

FIG. 2. Fire severity along 500-m transects roughly oriented in the direction of fire spread, classified by incoming fire severity. Treated transects include five points (250 m) outside a treatment or previous fire boundary and five points within. The control transects have no points within treatment or previous fire, and the Untreated point was calculated as the average of the first five points (250 m) of each transect. Asterisks denote significant difference ($P < 0.05$) from the Untreated point within each severity class.

Suggestions for further reading:

Lydersen, J. M., M. P. North, and B. M. Collins. 2014. Severity of an uncharacteristically large wildfire, the Rim Fire, in forests with relatively restored frequent fire regimes. Forest Ecology and Management 328: 326-334. https://doi.org/10.1016/j.foreco.2014.06.005