CALIFORNIA FIRE SCIENCE CONSORTIUM

Research Brief for Resource Managers

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Fire severity change with distance into fuel treatments

Kennedy, M. C., and M. C. Johnson. 2014. Fuel treatment prescriptions alter spatial patterns of fire severity around the wildland–urban interface during the Wallow Fire, Arizona, USA. Forest Ecology and Management 318:122–132. https://doi.org/10.1016/j.foreco.2014.01.014

Safford, H. D., J. T. Stevens, K. Merriam, M. D. Meyer, and A.M. Latimer. 2012. Fuel treatment effectiveness in California yellow pine and mixed conifer forests. Forest Ecology and Management 274:17–28. https://doi.org/10.1016/j.foreco.2012.02.013

Management Implications

- Fire severity and tree mortality were both reduced within fuel treatments, relative to nearby untreated areas, even at treatments where surface fuels had not been treated
- Based on evaluating spatial changes in fire severity metrics with distance into fuel treatments, 400-500 meters is a justifiable minimum width for fuel treatments

Fuel treatments are used to alleviate risks associated with unprecedented fuel loadings prevalent within dry forests across the western US. Fuel treatment zones are designed to lower fire severity and can act as strategic locations for firefighters to extinguish fires near homes or other resources. Given the limited funds available to land management agencies, fuel treatments need to be strategic in placement and size.

By measuring the spatial distribution of fire severity as fire moves into fuel treatments, we can quantify effective sizes of fuel treatments. Using a science-backed estimate for planning fuel treatments can help balance cost-effectiveness while ensuring treatments meet objectives. Two recent studies reviewed here, have addressed the question of what distance into fuel treatments fire needs to travel before fire severity is diminished. Both studies sampled along transects that crossed from untreated to treated areas to assess how fire severity changed as the fire moved into the fuel treatment (Fig. 1).

One such study was performed after the 2011 Wallow fire in Arizona. Researchers measured 14 transects across two different fuel treatment types on three different units. For both fuel treatment types, only ladder fuels had been removed. They found that while severity was reduced at all sites, the spatial distribution of fire severity within the treatment areas varied by treatment type and unit as well as which fire severity metric they were analyzing. They found fuel treatments reduced fire severity anywhere from -7 m to 533 m into the treatment area. Kennedy and Johnson (2014) caution that local site conditions, topography and vegetation type will be other sources of variation in fire severity.

Safford et al. (2012) also studied fuel treatments post-fire at 12 sites (37 transects) across California. Both ladder and surface fuels had been removed at all of the fuel treatments. In addition to measuring how fire severity characteristics changed with distance past treatment boundary, they also valuated post-fire tree mortality.

Measures of fire severity and tree mortality were significantly reduced within treatments at most sites. Other factors like tree size, slope (in treated units), fuel loading and 10 hour fuel moisture also influenced fire severity patterns. Fire severity was markedly decreased within 40-70 m of treatment boundaries (Fig. 2) while tree survivorship increased even in untreated areas adjacent to the treatment. Safford et al. (2012) recommended fuel treatments be at least 400 to 500 m in width, which they derived by considering additional variables like fire spread rates in extreme conditions and firefighter response times. Comparatively, in Kennedy and Johnson's (2014) study of treatments in which surface fuels had not yet been removed, fire severity metrics generally were reduced 500 m from the treatment boundary or beyond. Ultimately though, Safford et al. (2012) caution that treatment size should be guided by objectives, and the 400-500 m width treatment recommendation is not large enough to avoid ember-driven structure loss.

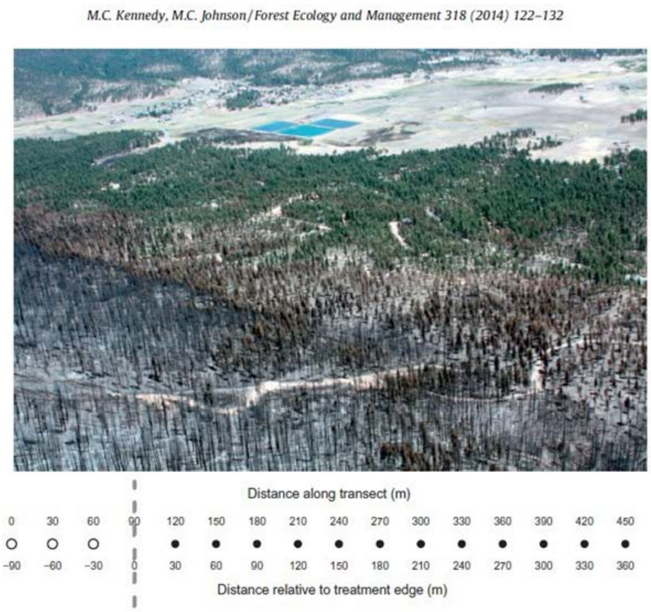

Figure 1. General sampling design along transects used by both Kennedy and Johnson (2014) and Safford et al. (2012). Dotted line indicates treatment boundary. Safford et al. (2012) plots were located about every 20 m and transects contained from 10 to 28 plots while Kennedy and Johnson (2014) plots were located every 30 m at transect lengths dependent on fuel treatment width. At each Safford et al. (2012) plot, fire severity and structural features of four nearest trees in each quadrant were measured along with fuel loading. In the Kennedy and Johnson (2014) plots, structural characteristics and fire severity were measured on trees within 8 m (untreated) and 11 m (treated) radii from plot center. Figure reproduced from Kennedy and Johnson (2014).

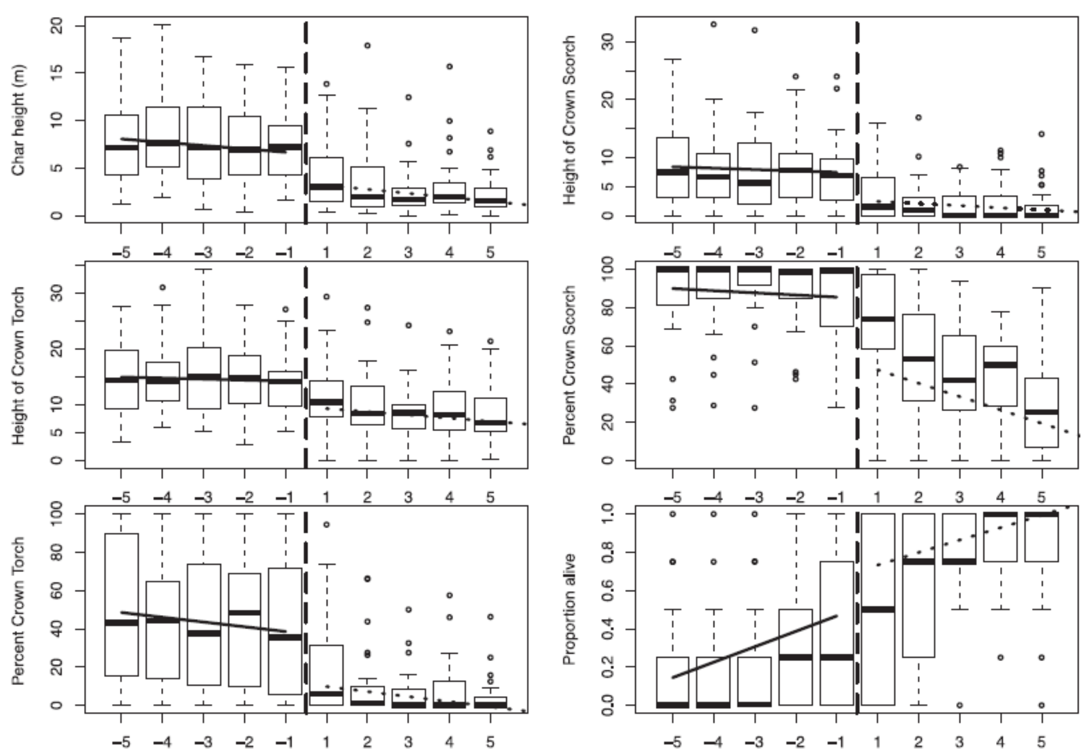

Figure 2. Change in fire severity with position relative to treatment boundaries across all 12 fires (Safford et al. 2012). Position refers to the order of plots away from the boundary, which is position 0. Negative numbers are untreated points, positive numbers are treated points, and the dashed vertical line indicates the treatment boundary. Plots were usually spaced 20 m apart. Figure reproduced from Safford et al. (2012).