CALIFORNIA FIRE SCIENCE CONSORTIUM

SMART PRACTICES AND ARCHITECTURE FOR PRESCRIBED FIRE

Research Brief for Resource Managers

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Insights from wildfire backburns for conducting hot prescribed burns in ponderosa pine plantations

Zhang JW, Finley KA, Knapp EE. 2019. Resilience of a ponderosa pine plantation to a backfiring operation during a mid-summer wildfire. International Journal of Wildland Fire 28(12) 981-992.
https://doi.org/10.1071/WF19033

Ponderosa pine-dominated plantations cover over 700,000 acres of forest land in California, and the area in even-aged plantations is likely to increase as a response to 2020 wildfires. Reintroducing fire in young stands dominated by ponderosa pine is likely to be of interest to managers, but research for guiding such management is limited. In this study, researchers examined the effects of backburning operations in a heavily stocked ponderosa pine plantation during the 2012 Mill Fire.

Management Implications

- Under certain conditions, prescribed fire may be an effective tool for thinning dense ponderosa pine plantations.
- Little impact to tree growth was observed from the backburn, implying that prescribed fire may be an appropriate tool for a variety of ownerships and management objectives.
- Pretreating shrubs in plantations to avoid undesirable fire behavior and effects might not always be necessary for prescribed burning.
- Prescribed burns can be conducted outside of traditional burn windows if weather and fuel moisture conditions are conducive to lower-severity effects – such as in the summer at night.

The area burned was part of a study designed to investigate how density impacted tree growth. In 1970, 15 study plots were installed and thinned to various densities, resulting in a range of tree spacings varying from 7 x 7' to 14 x 14'. By 1975, shrubs had established in abundance, and a shrub removal treatment was added to the study. Shrub treatments included: all shrubs top-killed, every other shrub top-killed, and no shrub treatment. The plots were last measured in 2005. While these measurements were not collected with the intent to gather pre-backburn information, the researchers took advantage of the fortuitous circumstances.

The backfire used to slow wildfire progression burned through the study on the night of July 12, 2012 and was completed by the afternoon of the 13th. Although it was hot and dry during the day, temperatures were much lower and Relative Humidity (RH) much higher overnight, dropping to 61˚F and 60% respectively. Overnight winds were relatively calm and fine dead fuel moisture was estimated between 4-5.5% (Fig. 1). Live and dead fuel moisture were also not likely at peak dryness at this time of year. The backfire burned through 14 of the 15 plots (Fig. 2). The plots were re-measured in 2016 for forest structure

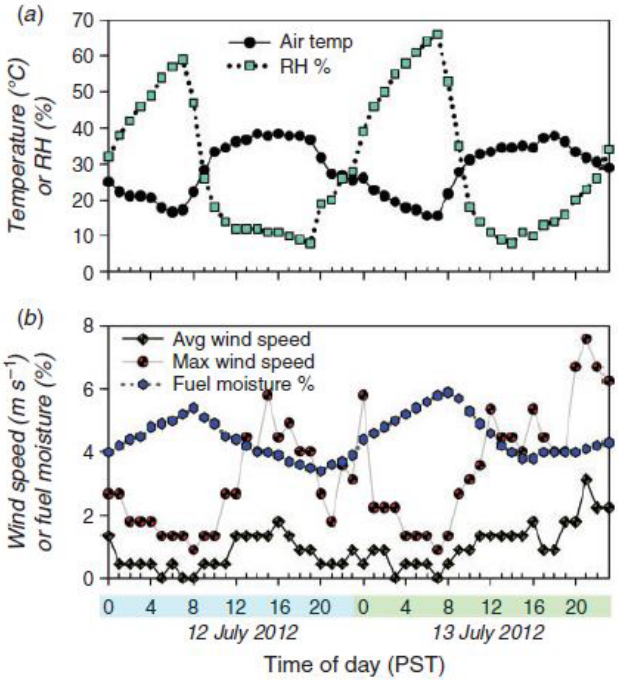

Figure 1. (a) Hourly air temperature and relative humidity, (b) moisture content, average wind speed, and maximum gust wind speed, which were recorded with a portable remote automatic weather station (RAWS) during the times when the backfire was conducted. Plots were burned between the night of 12 July, when backfiring in the area began, and the afternoon of 13 July.

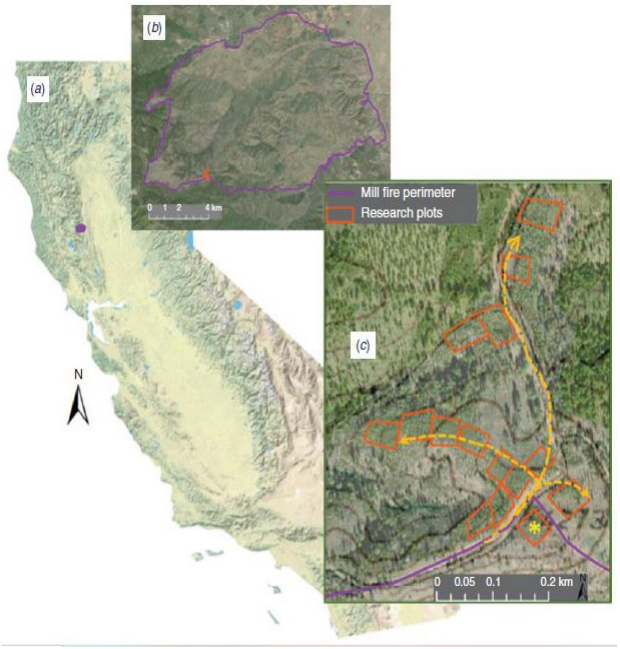

Figure 2. (a) The eastside of the North Coast Ranges of California, where (b) The Mill Fire burned in 2012. (c) It included 15 research plots located in the south-west portion of the fire. All research plots except for one with a yellow asterisk were burned during a backfiring operation. The orange dash lines show the approximate progression of ignition along primary and secondary ridgetops on both sides of the road (except where the road became the ultimate control line), starting somewhere close to the most southern plot.

including tree dbh, height, height to live crown and increment cores were collected at each subplot. Researchers also measured also for shrub above-ground biomass.

Results showed that across all treatments, tree mortality from the backfire resulted in an average basal area (BA) loss of ~3ft^2/acre or 14% of the measured 2005 BA; mortality was concentrated in smaller diameter classes. The study found no relationship between mortality and any of the pre-fire tree measurements recorded, including tree density, nor did it find a relationship between mortality and shrub treatment. Notably, it found no evidence of positive or negative impacts on post-fire tree growth, despite considerable crown scorch in several plots. This is likely because the release from competition outweighed any growth reduction caused by fire damage.

Rather than varying with tree density and shrub removal treatments, variation in mortality was best explained by bole char height. Bole char height also had an unexpected relationship with shrub treatment, as the *lowest* flame lengths were found in the plots with the *most* shrubs. This may suggest that the dominant shrub type in these stands, hoary manzanita, did not burn well under the weather and moisture conditions and may have shaded surface fuels, thereby increasing their moisture. This "heat sink" type of influence of shrubs has been observed anecdotally by others conducting prescribed burns.

Based on observational evidence, researchers suggested that mortality was influenced by unmeasured factors such as ignition pattern or fuel manipulations that preceded the backfire. For

example, areas of higher mortality ran in strips perpendicular to the slope, implying an association with a strip head fire during ignition, while another plot with very high mortality was adjacent to a pile of bulldozed shrubs. Observational evidence suggested that the fire primarily spread through surface litter, not shrub crowns.

This study highlights the fact that under the right weather conditions, prescribed fire can be a useful management tool at any time of year, even in forest structures that would seem to be incompatible with fire. Further, it demonstrates that prescribed fire may be possible without conducting expensive pre-fire treatments such as mastication or hand-thinning. (Although it should be noted that to realize full post-burn fuel reduction benefits, dead shrubs and small diameter trees may need to be removed if they are not fully consumed.) Even though the burn occurred during generally high fire hazard conditions, the burn was done at night and therefore was conducive to low-severity fire effects. Researchers suggested that burning when surface fuels are very dry might even help reduce shrubs and could be used as an alternative to herbicides or manual removal.

Further Reading:

Bellows, R. S., Thomson, A. C., Helmstedt, K. J., York, R. A., & Potts, M. D. (2016). Damage and mortality patterns in young mixed conifer plantations following prescribed fires in the Sierra Nevada, California. *Forest Ecology and Management*, *376*, 193-204.

Lyons-Tinsley, C., & Peterson, D. L. (2012). Surface fuel treatments in young, regenerating stands affect wildfire severity in a mixed conifer forest, eastside Cascade Range, Washington, USA. *Forest Ecology and Management*, 270, 117-125.

Noble, H. 2019. Age and Fuel Treatment Effects on Crown Scorch from Prescribed Fire in Young Sierra Mixed Conifer Forests. Master of Forestry Thesis. UC Berkeley.