CALIFORNIA FIRE SCIENCE CONSORTIUM

JOINT FIRE SCIENCE PROGRAM

## Research Brief for Resource Managers

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# Seasonal variations in fuel moisture from thinning

*Estes, B.L., Knapp, E.E., Skinner, C.N., and Uzoh, F.C.C. 2012. Seasonal variation in surface fuel moisture between unthinned and thinned mixed conifer forest, northern California. International Journal of Wildland Fire, Online Early.*

### Management Implications

- In areas with Mediterranean climates, surface woody fuel moistures are likely to be similar in thinned and unthinned stands during the height of the wildfire season, when fuel moisture values are at seasonal lows
- Fuel moistures collected at RAWS stations and used in National Fire Danger Rating System (NFDRS) predictions may be lower than real-world fuel moisture levels, due to standard fuel moisture monitoring procedures that elevate fuels above the forest floor
- Thinning may result in lower woody fuel moistures during the spring, better enabling use of prescribed fire in treated stands

Mechanical thinning treatments are widely used to modify stand structure and reduce wildfire risk in western forests. Thinning treatments can reduce surface and ladder fuel, increase the height to live crown, and decrease canopy bulk density and crown connectivity, hindering fire spread and moderating fire intensity.

However, opening up the canopy can make stands more vulnerable to solar radiation and wind, and some researchers have hypothesized that this heightened exposure can increase evaporation, accelerating drying of fuels and increasing ignition potential in thinned stands.

The objective of this study was to investigate the influence of thinning treatments on fuel moisture and determine whether or not moisture patterns differ by treatment in mixed conifer stands in northern California.

***Site Description***

The study took place in the Goosenest Adaptive Management Area in the Klamath National Forest. The elevation in the study area ranges from 4850 to 5840 ft, and the vegetation is dominated by ponderosa pine-mixed conifer forest. It is important to note that the climate of the area is montane Mediterranean, with cool, wet winters and warm, dry summers. Most of the precipitation in this area falls between November and April, resulting in a long, dry summer season common throughout much of California.

The forest structure treatments used in the study were previously installed as part of the South Cascades Fire and Fire Surrogates Study, and they included 3 untreated control units and 3 units that had been thinned and burned.

Stand density and canopy cover differed significantly between thinned and unthinned stands; unthinned units had an average stand density of 822 trees/acre and an average canopy cover of 56%, whereas thinned stands had an average post-treatment stand density of 49 trees/acre and an average canopy cover of 29%. Thus, the two treatments offered clear, distinctive examples of thinned and unthinned areas.

### Methods

To compare fuel moistures by treatment, researchers established 12 fuel moisture monitoring stations in each of six study units. In each monitoring station, they installed 3 different size classes of woody fuels, including 10-hour (0.25 – 1 inches), 1,000-hour (3 – 9 inches), and 10,000-hour (> 9 inches) fuels.

Large diameter fuels (1,000- and 10,000-hour) were placed in the research plots before the first snow, and 10-hour fuels were put out after spring snowmelt, at the beginning of the sampling period. Unlike many fuel moisture monitoring efforts, where fuels are supported on metal stands, fuels in this study were placed in direct contact with the forest floor; this method more accurately mimicked natural fuel arrangements.

*3 different size classes of woody fuels were randomly arranged in each research plot*

Fuels were weighed and fuel moistures were calculated every 7 days from May to July, and every 14 days from July through the end of October, when the wet season began. Fuel moistures were compared across treatments (and leaf area index) to determine the influence of thinning on fuel moisture throughout the summer season.

### Results and discussion

There were significant differences in fuel moisture between the 3 size classes of fuels included in the study. 10-hour fuels, which were the smallest in diameter of the 3 fuel classes, responded most to short-term weather fluctuations, whereas moisture fluctuations in 10,000-hour fuels were more long-term. These observations are consistent with the timelag categorizations, which are based on the amount of time (in hours) that it takes for fuels to respond to ambient conditions.

Fuel moisture values collected in this study were consistently higher than values taken at RAWS stations or predicted by the National Fire Danger Rating System (NFDRS). This is likely due to the fact that fuels included in the study were in direct contact with the ground, whereas fuels monitored at RAWS stations and used in NFDRS predictions are elevated above the ground.

Stand densities and leaf area index were much greater in unthinned stands than in thinned stands. However, 10-hour and 1,000-hour fuel moistures did not differ significantly between treatments at any sampling time, and differences in 10,000-hour fuel moisture were observed only in the beginning of the season (with fuels being drier in thinned stands). No differences were observed between treatments during the height of the fire season (July – September).

It is likely that the extended dry season at the study site – typical for a Mediterranean climate – provided ample time for fuel moistures to equilibrate, even among sites with highly variable stand densities and canopy covers. In areas like these, thinning does not appear to result in relatively lower fuel moistures or increased risk of ignition during the height of the fire season. However, these results may not extend outside the geographic and climatic range of the study, and differences in fuel moisture observed in the early summer season – when large diameter fuels were drier in thinned stands – may better represent conditions in areas with shorter periods between precipitation events.

### Suggestions for further reading

*Bigelow, SW and MP North. 2012. Microclimate effects of fuels-reduction and group-selection silviculture: Implications for fire behavior in Sierran mixed-conifer forests. Forest Ecology and Management, 264: 51-59.*

*Stephens, SL, Fry, DL, Franco-Vizcaino, E, Collins, CM, and JJ Moghaddas. 2007. Coarse woody debris and canopy cover in an old-growth Jeffrey pine-mixed conifer forest from the Sierra San Pedro Martir, Mexico. Forest Ecology and Management, 240: 87-95.*

*Agee, JK and CN Skinner. 2005. Basic principles of forest fuel reduction treatments. Forest Ecology and Management, 211(1-2): 83-96.*