CALIFORNIA FIRE SCIENCE CONSORTIUM

JOINT FIRE SCIENCE PROGRAM

Research Brief for Resource Managers

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Understanding Spatial Controls of Mixed-Severity Fire

Estes, B. L., E. E. Knapp, C. N. Skinner, J. D. Miller, and H. K. Preisler. 2017. Factors influencing fire severity under moderate burning conditions in the Klamath Mountains, northern California, USA. Ecosphere 8(5):e01794. http://onlinelibrary.wiley.com/doi/10.1002/ecs2.1794/epdf

Fire is an important ecological process, particularly in California forests. Fire patterns are complex and adding to the complexity is the warming climate and altered fuel structures following a century of fire exclusion. Outcomes from these fires influence ecosystem processes, forest structure and composition, and habitat for many species. Although the drivers of fire behavior on the landscape have been well studied, less is known how these same drivers affect fire severity.

Equally as important but even less well understood are weather conditions during a burn period. Often these metrics at the time of burning are difficult to estimate, but new technology has made this more plausible.

A unique phenomenon that has been documented in other fire climates where fire is pervasive are temperature inversions. Under these weather conditions, atmospheric lift is reduced and smoke is trapped near the surface. To date, little research has been done documenting how these conditions potentially affect fire severity.

The 2006 fire season in the Klamath Mountains provided an opportunity to evaluate the mechanisms driving severity during fires burning under moderate conditions in a landscape where large-scale temperature inversions are common.

Management Implications

- Lightning-ignited fires burning under moderate weather conditions may produce desirable ecological effects, and management of such fires, rather than immediate suppression, may increase the pace and scale of restoration;
- Understanding the relative importance of biological and environmental characteristics can help managers predict outcomes to better guide when and where fires can safely be managed;
- Although smoke trapped from temperature inversions in complex landscapes has impacts on air quality, resultant dampening of fire severity may provide valuable opportunities for managing fires for ecological benefits in complex landscapes.

Data on burn conditions, as well as biological and environmental conditions coupled with new analytical tools provided an opportunity to evaluate factors driving fire severity under moderate burn conditions.

Fire severity was estimated as the percent change in canopy cover (0–100%) based on the remotely

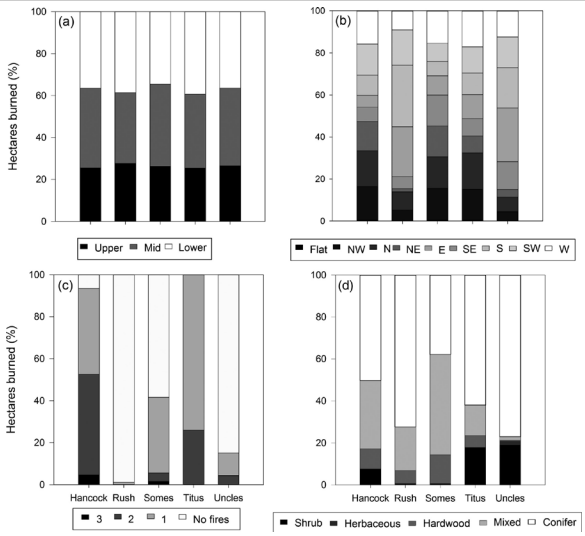

Figure1. Influence of slope position, aspect, number of fires and vegetation cover type on fire severity.

sensed Relativized differenced Normalized Burn Ratio (RdNBR). Spatial data measuring topography, weather, and fuels were compiled. Daily weather data were matched with fire progression maps to estimate weather and temperature inversion effects on a daily basis. A spatial model was utilized to quantify the relevant predictors of fire severity.

The 2006 fires were characterized by moderate burning conditions with a notable absence of extreme weather. Under these conditions, topographic complexity was the primary driver of fire severity patterns with upper and mid slopes and east and southeast facing aspects burning hotter than lower slopes and other aspects.

Vegetation and fire history also were drivers of fire severity, with shrub cover types burning most often at high severity as compared to other dominant vegetation types. The timing of the last fire had a somewhat different impact with a dampening effect in areas that just experienced a fire, followed by a gradual increase in fire severity that apeared to track with vegetation seral stage. As time since fire increased beyond 60 years, fire severity gradually decreased as vegetation became more mature and resilent to crown fire initiation.

The authors were also able to characterize the effects on fire severity of smoke trapped in temperature inversions. Overall, temperature inversions were shown to notably reduce fire severity in the 2006 fires, confirming anecdotal observations of fire managers.

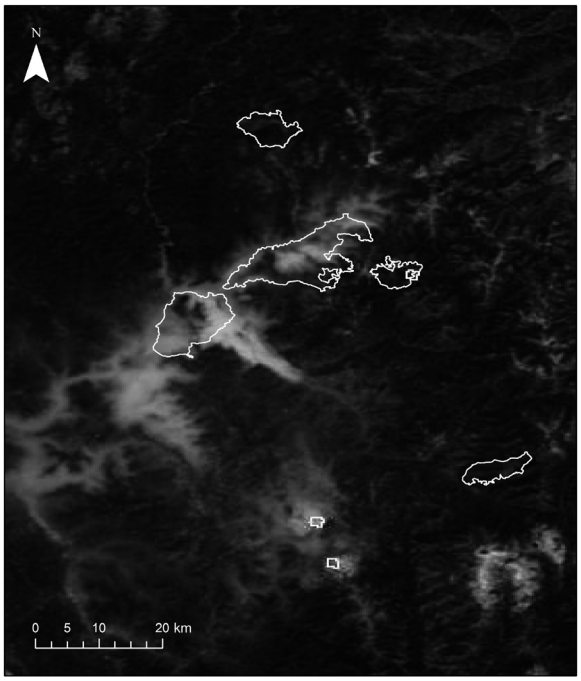

Figure 2. A temperature inversion during the 2006 fires that trapped smoke below 1300 meters.

Suggestions for further reading:

Oliveras, I., M. Gracia, G. More, and J. Retana. 2009. Factors influencing the pattern of fire severities in a large wildfire under extreme meteorological conditions in the Mediterranean basin. International Journal of Wildland Fire 18:755–764.

Perry, D., et al. 2011. The ecology of mixed fire severity regimes in Washington, Oregon, and Northern California. Forest Ecology and Management 262:703–717.