CALIFORNIA FIRE SCIENCE CONSORTIUM

JOINT FIRE SCIENCE PROGRAM

Research Brief for Resource Managers

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Effects of thinning and prescribed fire on tree survival

Ritchie, M. W., Skinner, C.N., and T. A. Hamilton. 2007. Probability of tree survival after wildfire in an interior pine forest of northern California: Effects of thinning and prescribed fire. Forest Ecology and Management 247: 200-208
http://steps.ucdavis.edu/People/slyeh/syeh-resources/forest-biomass/RitchieetalConeFireMortality-2007.pdf

Across the western United States, fuels treatments are being used to reduce fuels and mitigate damage from wildfire. A number of options are available to land managers who wish to alter fuel structure and loading, yet opportunities to test the relative efficacy of treatments are limited, dependent on wildfire ignition and spread in previously treated areas.

A wildfire at Blacks Mountain Experimental Forest (BMEF) in northern California provided a rare opportunity to compare fire behavior and effects in treated and untreated ponderosa pine forests. BMEF maintains a patchwork of different stand densities, fuel structures, and treatment types, and the 2002 wildfire that burned through the area allowed the authors to (1) evaluate post-fire tree survival under different treatment scenarios and (2) ground-truth fire behavior outputs predicted by the modeling program NEXUS.

Methods

Nearly a year after the wildfire burned through BMEF, the authors installed plots along the boundaries of treated units. Plots were primarily located in the treatment area, but they also extended into adjacent untreated units.

Management Implications

- Reduction in fuels from thinning or thinning with prescribed fire can decrease fire intensity and severity in dry ponderosa pine forests. Thinning with prescribed fire is especially effective, reducing surface and ladder fuels and greatly improving tree survival rates.
- NEXUS predictions appear to give reasonable estimates of fire behavior and mortality under different fuels treatment scenarios.
- Though treatments can greatly improve survival rates, radiant and convective heat from wildfire in adjacent untreated stands may increase crown scorch and mortality just inside the treatment boundary. These edge effects may reduce the efficacy of narrow fuelbreaks and small treatment areas, and should be considered in treatment designs.

Plots were installed in 3 different treatment types: low structural diversity with prescribed fire; high structural diversity with prescribed fire; and low structural diversity without prescribed fire. In all cases, structural diversity categories resulted from different thinning prescriptions.

In all plots, distance from treatment boundary, scorch extent, mortality class, species, and size were recorded for each tree. The authors used these data to quantify relationships between specific tree characteristics (e.g., size and location) and likelihood of survival during wildfire.

Modeling fire behavior

NEXUS quantifies fire hazard by coupling existing models of surface and crown fire behavior to simulate overall fire spread and intensity. In this case, authors used NEXUS to compare predicted fire behavior across stand structures and treatment types.

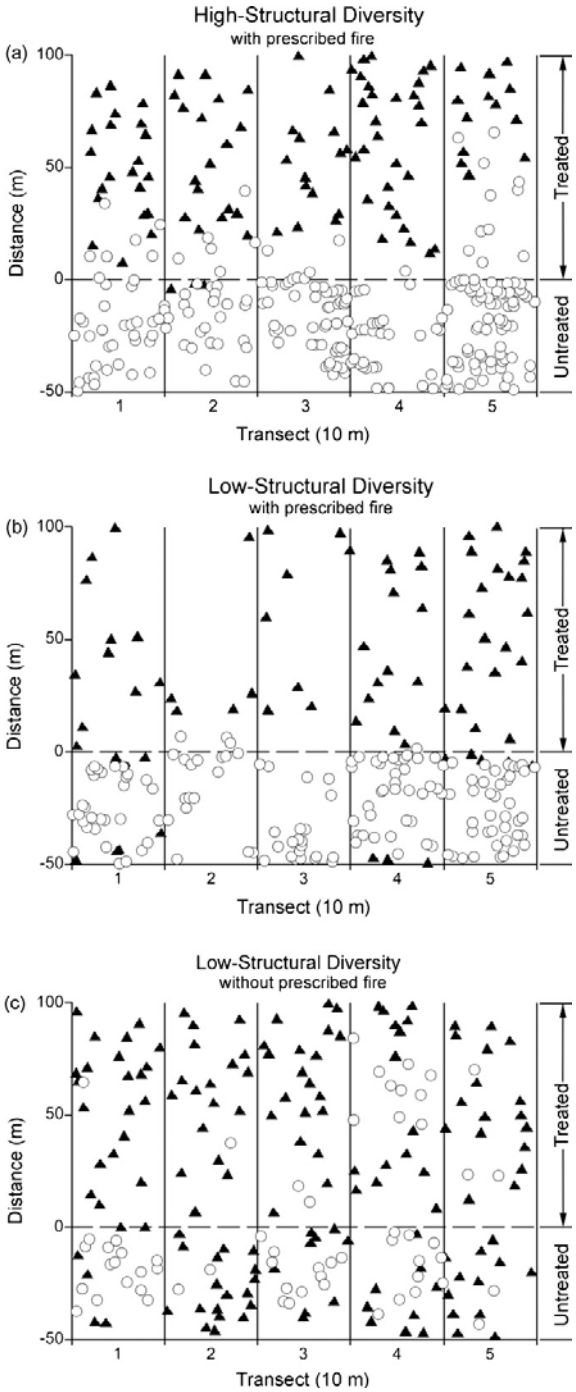

Figure 1*: Spatial distribution of tree mortality for each treatment type.*
Dead trees: ○ *Live trees:* ▲

Tree mortality across treatments

Clear patterns of tree mortality were observed in all plots. As shown in Figure 1, untreated stands suffered widespread mortality, while mortality in adjacent treated stands remained very limited. Survival was highest in stands where prescribed fire was incorporated into the prescription; in fact, stands that had been treated with prescribed fire could not carry flames during the wildfire. Within specific treatments, tree diameter and distance from treatment boundary were the best predictors of survival.

NEXUS predictions of fire behavior generally matched the patterns on the ground, with high fire intensity in untreated areas, low fire intensity in areas treated with prescribed fire, and moderate fire intensity in areas that were thinned but not burned.

Though fire severity was much lower in treated stands, the authors observed edge effects within treatment areas. Trees that were closer to the treatment boundary suffered higher rates of mortality (see Figure 1), likely due to radiant and convective heat from intense wildfire in adjacent untreated stands.

Conclusions

This study demonstrates the importance of fuels treatments in reducing fire intensity and limiting tree mortality from wildfire. More specifically, it highlights the unique effectiveness of prescribed fire in dry ponderosa pine ecosystems, which historically maintained frequent, low-intensity fire regimes. However, the study also shows that edge effects can be a concern in treated areas; the mortality gradient near the treatment boundary could have important implications for narrow fuelbreaks and small treatment areas, and is an important consideration in the development of treatment plans.

Suggestions for further reading

Finney, M.A., McHugh, C.W., & I.C. Grenfell. 2005. Stand- and landscape-level effects of prescribed burning on two Arizona wildfires. Can. J. For. Res. 35: 1714-1722.

Pollet, J. & P.N. Omi. 2002. Effect of thinning and prescribed burning on crown fire severity in ponderosa pine forests. Int. J. Wild. Fire. 11: 1-10.