CALIFORNIA FIRE SCIENCE CONSORTIUM

JOINT FIRE SCIENCE PROGRAM

Research Brief for Resource Managers

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Fuel treatment effectiveness in California yellow pine and mixed conifer forests

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.
http://www.sciencedirect.com/science/article/pii/S0378112712000898

Management Implications

- Fire severity and tree mortality were strongly reduced in treated forest compared to untreated forest at almost all sites.
- 70 meters of treatment was usually sufficient to reduce canopy fire to surface fire, but much wider fuel treatments are necessary where fire control is a management focus.
- Within treated areas, fire severity depended on fuel load, while in untreated areas it depended more on fuel moisture.
- In most cases, restoration efforts in drier yellow pine and mixed conifer forests in California will require some sort of fuel reduction before fire can be beneficially reintroduced.

Drier mixed conifer and yellow pine forests across the western US have experienced a notable increase in fire frequency and size since the 1980s, and data suggest that increasing trends in fire activity and severity are likely to continue in the future as both temperatures and fuel loads continue to increase. Management strategies to reduce fire spread and severity typically involve targeted reduction of forest fuels through some combination of mechanical, hand, and/or burning treatments. A 2012 study by Safford et al. evaluates the effectiveness of such forest fuel treatments in mixed conifer and yellow pine forests in the California National Forests.

Safford et al. monitored treated and untreated sites within 12 areas in eastern and southern California that burned between 2005 and 2011 to assess the effects of treatment on fire severity. They compared the following measures of fire severity between treated and untreated stands within each burned area: height of bole char; height of crown scorch; height of crown torch; percentage total crown scorched and torched; and percentage of canopy mortality. Treated sites included only those where forest fuel thinning projects explicitly removed surface and ladder fuels. In 11 of 12 sites this was accomplished through some form of controlled burning. On average, total fuel loads at the study sites had been reduced by 50-60% by treatment before the studied wildfire occurred.

The study found that measures of fire severity were significantly reduced in treated forest compared to untreated forest at most sites. About 90% of the sites showed significant reductions in measures of tree scorch and torch, and 2/3 showed significant reductions in char height. Tree

survivorship was significantly higher in treated areas compared to untreated areas for all but two sites and tree species identity strongly influenced tree survival. Jeffrey and ponderosa pine (*Pinus jeffreyi, P. ponderosa*) had the highest survival rates, white fir (*Abies concolor*) the lowest.

Treatment showed strong distance effects, with fire severity decreasing as distance from the untreated boundary increased. 40-70 meters of treatment was usually sufficient to reduce a canopy fire to a surface fire. When combined with fire spread rates, fire fighter response times, and other complicating factors, this suggests a 400-500 m minimum recommended treatment width in areas where fire control is a management focus.

Safford et al. showed that fire severity in treated areas was generally fuel-load driven, while severity in untreated areas was generally driven by fuel-moisture. This provides further evidence that fire suppression-driven changes in forest density, composition and fuel load have led to a transition of mixed conifer and yellow pine forests from generally fuel-limited fire regimes to more climate- or weather-limited regimes. This has major implications for forest restoration, and underlines the importance of reducing fuels in these forest types before they are restored to more natural fire frequencies. Treatment prescriptions should also allow for 5-15% fire-driven canopy tree mortality (whether in a treatment-subsequent wildfire or in a prescribed fire incorporated as part of the treatment), which best mimics natural fires and can provide critical habitat structures for wildlife.

Additional references for this topic:

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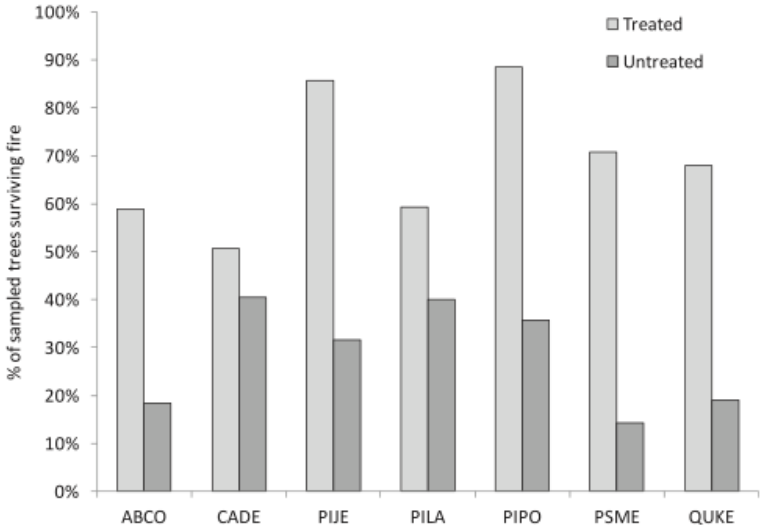

Fig. 5. *Percent of sampled trees surviving fire in treated and untreated stands for species occurring in at least four fires and with N P 20 in both treated and untreated samples. All assessments of survival made at least one year after fire, except for Cougar (4 months postfire). Species codes as in Tables 2a and 2b; PSME = Pseudotsuga menziesii.*