Mid- to long- term fuel treatment impacts on forest structure and fuel loads in California

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Extended Abstract

Introduction

Under the guidance of the National Fire Plan and the 10-Year Comprehensive Strategy, the use of fuel treatments to reduce the likelihood of catastrophic fires has increased over the past decade. The FLAME Act of 2009 and resulting National Cohesive Wildland Fire Management Strategy re-iterated the need to address wildland fire and fuels management. The most effective treatments alter both canopy fuels and surface fuels, creating more resilient forest structure. The short-term effectiveness (1 to 2 yr) of fuel treatments to abate undesirable fire behavior and effects is well studied and known (i.e., Stephens and Moghaddas 2005; Vaillant *et al.* 2009; Fulé *et al.* 2012; McIver *et al.* 2012). Mid- to long- term effectiveness of fuel treatments is not quite as well understood. The longevity of fuel treatment effectiveness to alter potential fire behavior is a crucial question for managers preparing plans for fuel hazard reduction, prescribed burning, fire management, forest thinning, and other land management activities. To understand fuel treatment effectiveness, quantification of impacts on fuel loads and canopy characteristics over time is needed.

Methods

As a part of the Fuel Treatment Effectiveness and Effects Monitoring in the Pacific Southwest Region project, National Forests in California each provided a minimum of one candidate fuel treatment project from 2000 through 2006. Up to six permanent plots were randomly placed in each project area. All plots were sampled prior to treatment (P00), then 1 yr post (P01), 2 to 3 yr post (P03), 4 to 5 yr post (P05), 7 to 8 yr post (P08), and 10 yr post-treatment (P10) as possible. Some plots do not have data for all post-treatment intervals due to various uncontrollable circumstances. The field sampling protocol was based on the National Park Service Monitoring Handbook (USDI NPS 2003) with some modifications to optimize sampling efficiency (Vaillant *et al.* 2009). The plots included data collection on forest floor and surface fuels, understory vegetation, and trees.

Plots were grouped into treatment-forest type combinations for analysis (Fig. 1). Prescribed fire (FIRE) treatments were treated with only fire. The mechanical treatment (MECH) included a thinning treatment followed by a surface fuel treatment. Plots were assigned to three forest types based on dominant tree species, similarities in fuel characteristics, and expected fire behavior, including: yellow pine (YP) dominated stands, red fir (*Abies magnifica*) (RF) which consisted of short needle conifers dominated by red fir, and mixed conifer (MC) which included the remainder of plots where two or more conifer species shared dominance.

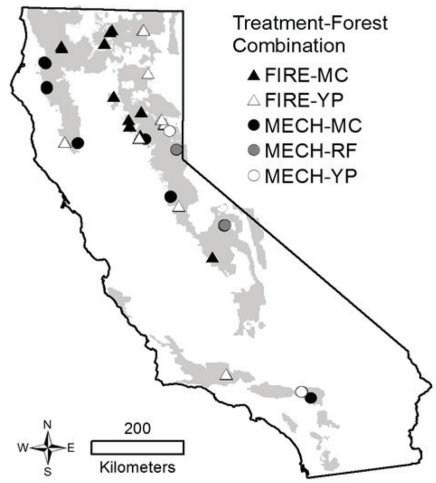

Fig. 1. Location of all plots depicting treatment-forest combinations. FIRE – fire-only treatment, MECH – mechanical treatment, MC – mixed conifer forest, YP – yellow pine dominated forest, RF – red fir dominated forest.

Results

A great deal of spatial and temporal variability in fuel loads between and within treatment-forest combinations were found. Our dataset indicated a great deal of variability; the lack of clear fuel reduction or accumulation trends was apparent in our time series for a few FIRE and most MECH treatment metrics. The inconsistent trends are common, given the spatial variability in surface fuels, and the overall variability within one project area and across similar treatment and forest types (Keane *et al.* 2012). Chiono *et al.* (2012) also did not find temporally consistent trends but rather even more variability where the post 5 to 7 yr period was often higher or more typically lower than prior and latter sampling periods. A large part of our temporal variability had to do with uneven sample sizes; both P05 and P10 have a very low number of plots.

By 8 years post treatment (P08), live understory fuel load recovered to, or exceeded, that of P00 on all MC sites and for FIRE YP sites. This live fuel load recovery could lead to higher fire hazard in later years as associated shrubs become more decadent. The composition of the understory vegetation (proportion of dead versus live material and ignitability), and height will both impact potential fire behavior. Although using a different method to quantify potential ladder fuels, Chiono *et al.* (2012) found shrub cover in treated stands exceeded non-treated controls 2 to 4 yr after treatment in both Jeffrey pine (*Pinus jeffreyi*) and mixed conifer stands.

Forest structure was affected more by MECH treatments than FIRE treatments. MECH treatments reduced tree density more than did FIRE treatments in most size classes. The MECH treatments removed trees of all size classes, and the reductions were fairly stable over time. The FIRE treatments reduced both seedling and pole-sized trees but did not impact overstory tree density much between P00 and P01. Overstory density decreased through P05 as a result of delayed mortality from FIRE for both forest types. Canopy cover, canopy bulk density, and tree density were reduced and canopy base height increased on all plots; however, changes were more pronounced and stable from MECH treatments. Canopy base height increased from treatment through P02 for all treatment-forest combinations relative to P00 and then declined through P10 except for FIRE-MC where P10 canopy base height was extremely high. This peak can be explained by the small sample size in P10. The fact that canopy base height is continuing to decrease could have implications for crown fire activity; if canopy base height is low enough, the stands have a potential for increased passive crown fire in later years relative to P01 and P02. Chiono *et al.* (2012) found a similar increase followed by a decrease in Jeffrey pine stands; however, the decline did not start until more than 8 years after treatment. Stephens *et al.* (2012) had findings similar to Chiono *et al.* (2012) in stands treated mechanically.

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References

Chiono LA, O'Hara KA, De Lasaux MJ, Nader GA, Stephens SL (2012) Development of vegetation and surface fuels following fire hazard reduction treatment. *Forests* **3**, 700-722.

Fulé PZ, Crouse JE, Roccafort J.P, Kalies EL (2012) Do thinning and/or burning treatments in western USA ponderosa or Jeffrey pine dominated forests help restore natural fire behavior? *Forest Ecology and Management* **269,** 68-81.

Keane RE, Gray K, Bacciu V (2012) Spatial variability of wildland fuel characteristics in northern Rocky Mountain ecosystems. USDA Forest Service, Rocky Mountain Research Station Research Paper RMRS-RP-98. (Fort Collins, CO)

McIver J, Erickson K, Youngblood A (2012) Principal short-term findings of the National Fire and Fire Surrogate study. USDA Forest Service, Pacific Northwest Research Station General Technical Report PNW-GTR-860. (Portland, OR)

Stephens SL, Moghaddas JJ (2005) Experimental fuel treatment impacts on forest structure, potential fire behavior, and predicted mortality in a California mixed conifer forest. *Forest Ecology and Management* **215**, 21-36.

Stephens SL, Collins BM, Roller G (2012) Fuel treatment longevity in a Sierra Nevada mixed conifer forest. *Forest Ecology and Management* **285**, 204-212.

Vaillant NM, Fites-Kaufman J, Reiner AL, Noonan-Wright EK, Dailey SN (2009) Effect of fuel treatment on fuels and potential fire behavior in California, USA, National Forests. *Fire Ecology* **5**(2), 14-29.

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