Monitoring the ecological effects of forest fuel treatments in wildfire areas

Dr. Hugh Safford[1,2,*], David Schmidt[3], Kyle Merriam[1], Chris Carlson[4], Jens Stevens[2], and Dr. Marc Meyer[1]

[1]USDA Forest Service, Pacific Southwest Region Ecology Program
[2]University of California-Davis
[3]The Nature Conservancy
[4]University of Montana

*Author for correspondence: hughsafford@fs.fed.us

A popular response among land management agencies to the threat of increasing wildfire frequency, size, and severity has been to strategically "treat" forest stands to decrease tree density, reduce surface and ladder fuels, and increase forest resilience to disturbances such as wildfire. Where properly implemented, such forest treatments have been shown to greatly reduce fire severity, to abet fire control, and to result in higher survival of canopy trees after fire (Safford et al. 2009). Modeling work has shown that although properly executed forest fuel treatment removes carbon from the forest stand, the reduction in fire hazard in forest types characterized by frequent fire can more than off-set this original carbon loss through enhanced growth and long-term survival of the larger retained trees (Hurteau & North 2009). Although the potential long-term carbon-balance benefits of forest fuel treatment are enticing, there are a number of questions that must be answered about the ecological impacts of fuel treatments. Some of these have been answered by recent studies, while others remain to be tackled (see PSW Literature Review). Detractors of forest treatment in California forests have raised concerns related to some of these ecological uncertainties, including the effects of forest fuel treatments on soil, forest heterogeneity, plant biodiversity and animal habitat.

In 2008, we began a program, funded by the Forest Service, to monitor areas that had been impacted by recent wildfires that had burned into areas of forest fuel treatment. Our purposes were to collect data to compare fire effects on important ecological measures in treated adjacent untreated forest over a 3 to 5 year period. At this point, we have sampled treated and untreated forest stands in 7 wildfires and we plan to add more fires this summer. The charts below present some of the preliminary results from the first year of monitoring in these fires. The take-home lesson is that properly implemented forest fuel treatments can not only reduce biomass loss to fire, but they can play a variety of positive ecological roles as well.

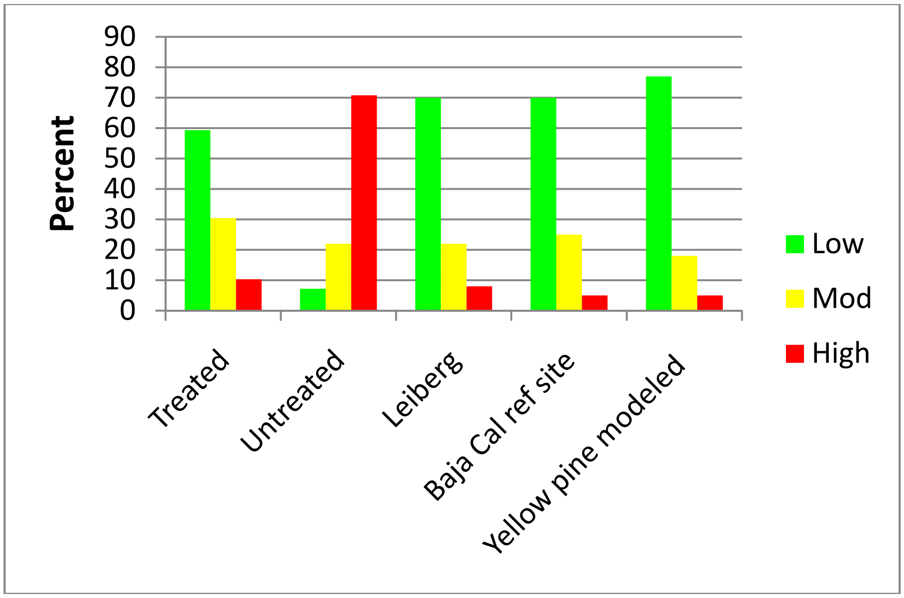

Figure 1. Comparison of forest area burning at low (0-25% mortality), moderate (25-75%), and high severity (>75%), in treated and untreated stands, compared with three versions of "properly functioning" reference conditions. Even under severe wildfire conditions, fire severity in properly implemented forest fuel treatments was remarkably similar to the reference conditions. Neighboring untreated stands burned at very high severity, which translates into high forest mortality, carbon loss, and susceptibility to soil loss in postfire rain events. Severity in treated and untreated areas estimated from remotely sensed severity mapping in the Angora and Peterson Fires. In each fire, severity was assessed in fuel treatments and then an equal area of neighboring untreated forest was assessed. "Leiberg" refers to Leiberg's (1902) estimates for 19th century (i.e., pre fire-suppression) fires in the northern Sierra Nevada. "Baja Cal" refers to severity data that Stephens et al. (2008) measured in a wildfire in the Sierra San Pedro Martir, Baja California, Mexico. Conifer forests in this mountain range are considered ecological analogues to drier pine forests of the eastern Sierra Nevada and southern California (Stephens and Fulé 2005), but they have not experienced either extensive logging or fire suppression. "Yellow pine modeled" refers to independent modeling of pre-Euroamerican settlement disturbance and growth dynamics for ponderosa and Jeffrey pine forest (see Safford & Schmidt 2007).

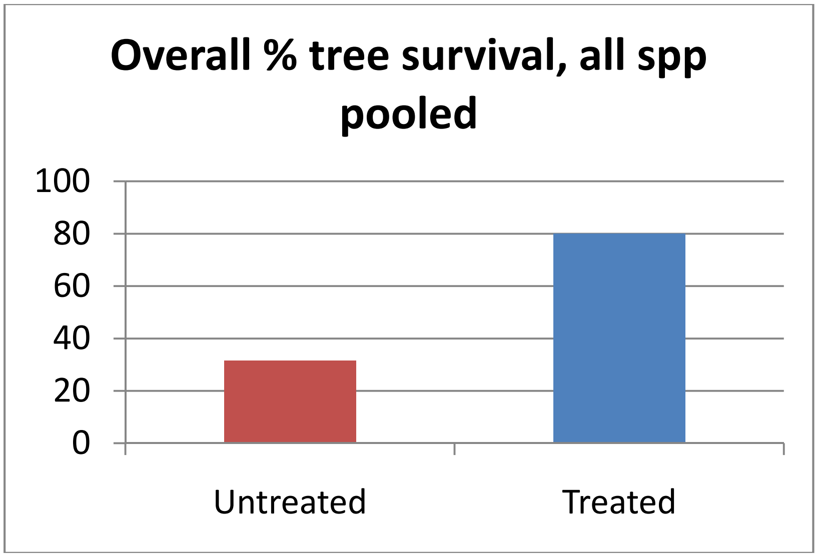

Figure 2. Overall tree survival (trees >5 inch dbh, all species pooled, one year after fire) for forest stands that were treated for fuels before fire versus adjacent stands that were not. 8 of 10 trees survived fire in the treated stands, only 3 of 10 in the untreated stands. Data from fire severity transects which sampled treated and adjacent untreated forest stands.

Figure 3. Cover of litter, bare ground, shrubs and herbaceous species in our vegetation plots in treated and untreated forest stands one year after they experienced fire. Higher litter cover and less bare ground in the treated stands translate into greatly decreased susceptibility to soil loss during postfire rain events. At >60% bare ground, the potential for major soil loss during a rain event is significantly enhanced (Johansen et al. 2001) – about 30% of the untreated burned sites had more than >60% bare ground.

Figure 4. Tree cover, tree and shrub seedling density, and understory species richness in our vegetation plots in treated and untreated forest stands one year after they experienced fire. After fire, treated stands supported about 3 times more overstory shade than untreated stands. Shrub seedling densities were about 6 times higher in untreated than in treated stands, due to greater germination of fire-following shrub species as a result of higher fire intensities experienced in untreated stands. For better or for worse, this will ultimately result in slower rates of conifer regeneration and growth in the untreated stands, due to higher levels of shrub competition. The diversity of understory plant species (shrubs, forbs, and grasses) was significantly higher in the sampled treated stands after fire than in adjacent untreated stands. This is probably linked to the severity patterns seen in Figure 1 (i.e., properly implemented treatments burn in a fashion that more resembles the “natural” state of the sampled forest types), and the fact that overall heterogeneity in burn severity tends to be higher in treated stands.

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