CALIFORNIA FIRE SCIENCE CONSORTIUM

Research Brief for Resource Managers

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Managing fuel profiles in high severity burns

Moore, I.B., Collins, B.M., Foster, D.E., Tompkins, R.E., Stevens, J.T., and S.L. Stephens. 2021. Variability in wildland fuel patches following high-severity fire and post-fire treatments in the northern Sierra Nevada International Journal of Wildland Fire. https://doi.org/10.1071/WF20131

Management Implications

- In the absence of post-fire forest management wildland fuel loads are very high a decade after high-severity fire.
- Post-fire treatments such as mechanical site preparation and radial herbicide release treatments can reduce woody surface fuel loads and the size and continuity of live shrub fuel load patches.
- The timing of post-fire treatments is an important consideration and can affect the efficacy of the treatments. A more rapid response may be better at reducing fuel loads.

High-severity fire, which in forests represent complete or nearly complete tree mortality, is occurring at greater extents and in larger contiguous patches across the western United States. Fire-killed snags, which then become downed logs, tend to dominate landscapes burned at high severity. In addition, these early seral environments facilitate vigorous establishment of shrubs, inhibiting tree regeneration. These conditions are at risk of reburning with high-severity fire, further inhibiting forest re-establishment and increasing potential for forest conversion to shrublands.

This study measured wildland fuels (shrubs, downed logs, and fine woody debris) eleven years after high-severity fire converted a Sierra mixed-conifer forest to shrub-dominant vegetation (Fig 2a). Measurements were taken both before and after site preparation and reforestation treatments which were designed to reduce downed woody fuels and live shrub continuity. These treatments utilized excavators to pull shrubs, fell snags, and pile treatment debris, which was subsequently pile burned. These sites were subsequently planted with seedlings and herbicides were utilized to kill remaining shrubs in the immediate vicinity of planted trees. It should be noted that such treatments typically occur immediately after fire while these treatments were implemented eleven years later. Given the current rates of high severity fire, this delayed treatment may become more common as the need is exceeding the capacity of forest managers to respond.

Site preparation treatments significantly reduced total fuel loads by nearly half. Total fuel loads prior to the treatment were 131.4 Mg/ha (58.6 tons/ac) and were reduced to 73.4 Mg/ha (32.7 tons/ac) after treatment. Additionally, shrub cover was reduced from 84% pre-treatment to 21% post-treatment. While these total post-treatment fuel loads may still be considered higher than desired, the new fuel arrangement was highly fragmented and discontinuous (Fig 2b), qualities that limit the ability of wildfire to spread easily. The prevalence of large shrub

patches decreased significantly following the site preparation (Fig 1) and average shrub patch length decreased significantly. Furthermore, modeled chances of encountering continuous high fuel load patches (shrubs and/or fine woody debris) were reduced from 41% to 1%.

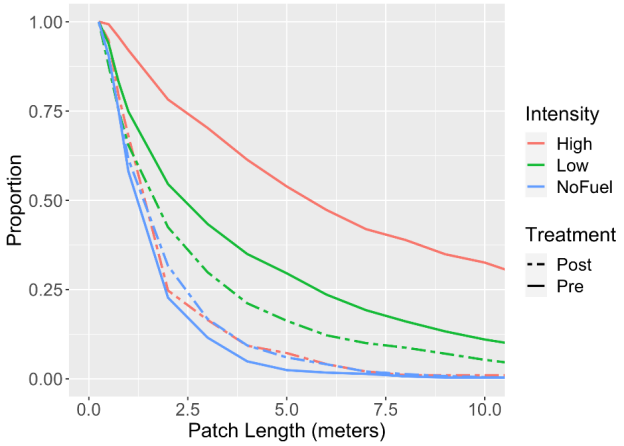

Figure 1. Proportion of patches of equal or greater length by height class before and after shrub removal treatment. Tall fuel comprised tall shrubs >0.5 m height, short fuel comprised short shrubs ≤0.5 m, grasses, forbs, and dead and down surface fuels, and no fuel was bare ground and rock. Note the substantial change in the tall fuel class; 54% of tall fuel patches pre-treatment are 5 m long or greater. Post-treatment, tall fuel patches 5 m or greater account for only 7% of all tall fuel patches.

When salvage logging is not conducted, standing snags begin to deteriorate and fall, further contributing to very large, continuous surface fuel loads characterized by a complex arrangement of downed wood in a homogenous matrix of live shrubs. Mechanical site preparation treatments can effectively reduce total fuel loads and continuity of fuel profiles. Site preparation treatments a decade after the fire reduced 1000-hr fuels to an average of 57.8 Mg/ha (25.8 tons/ac) which is often greater than desired; however, these mechanical treatments altered the overall structure of the fuel profile which may help facilitate the future use of prescribed fire to further manage fuels. Timing of mechanical site preparation treatments may impact the extent to which fuel loads are reduced. If left for too long, snag and downed log deterioration may reach a point where mechanical equipment is unable to efficiently remove and pile them for burning due to breakage. This highlights the importance of timeliness in post-fire restoration efforts.

Figure 2. Pre (a), and post (b) site preparation. Pre-treatment (a): extensive, continuous shrub cover with many standing dead trees characterize the area. Post-treatment (b): shrub cover is limited to small, scattered patches with shorter stature. Few snags remain but a scattering of fine fuels is visible. Areas in (a) and (b) are representative but are not identical locations.

The findings of this study suggest that site preparation and vegetation control is an effective tool to reduce fuel loads and continuity of live and downed woody fuels in early seral environments created by high-severity fire (Fig 2). Furthermore, these treatments can help promote finer-scale heterogeneity while still retaining live shrub and down wood components. This not only creates favorable fuel and planting environments for artificial re-establishment but also mitigates fuel accumulations on reforested sites. Without these treatments, undesirable fuel profiles may perpetuate risk of high severity re-burn and inhibit forest re-establishment. However, these treatments can be very expensive, and given the deteriorated state of the snags there is no cost offset from selling logs.