Western Ecological Research Center

Publication Brief for Resource Managers

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Fuel Hazard Management in Severely Burned Sierra Nevada Forests

After experiencing stand-replacing fire, mid-elevation Sierra Nevada forests may transition through a shrub-dominated stage in forest succession. To expedite forest recovery in these areas, the USDA Forest Service often intervenes in the fire-shrub-forest cycle through logging fire-killed trees, the herbicide treatment of shrubs, and planting conifers.

But in what ways do post-fire logging and shrub removal affect fuel loads and potential fire behavior? To address this question, scientists at USGS and at University of California-Berkeley measured live and dead fuels in four Sierra Nevada stands that had experienced large, stand-replacing fires ranging from 4 to 21 years ago, and modeled their potential fire behavior.

In extreme cases, cheatgrass can overrun an herbicide-treated clearing, such as in this pine plantation. Photo: T. McGinnis, USGS.

Management Implications:

- Although post-fire salvage logging tends to increase total available dead fuel loads in the short term, slash can be managed to have negligible effects on the reburn potential.
- Killing shrubs with herbicide to increase the growth and survival of young conifers results in an increase in highly ignitable grass and forb fuels. Therefore, only the minimum area around each tree should be treated to minimize the probability of a grass fire.
- In the first two decades after a stand-replacing fire, conifers are generally too small to survive a surface fire in any fuel type. Therefore, preventing flashy grass fuels is more important than reducing live woody fuel loads in these stands.

The scientists found that logging fire-killed trees significantly increased total available dead fuel loads in the short term (4 to 6 years post-fire), but not in the longer term (14 to 21 years post-fire). Logging fire-killed trees did not affect shrub cover, grass and forb cover, alien species cover or alien species richness. Modeled fire behavior was not different between logged and untreated stands in the short or longer term, due to abundant shrub fuels in both logged and untreated stands.

However, scientists found that herbicide treatments directed towards shrub removal resulted in significantly greater alien species diversity and greater cover of alien grasses and forbs. This response of alien grasses and forbs to herbicide treatments increases the risk of frequent fires, especially where human ignitions are most likely to occur.

Modeled surface fire flame lengths and rates of spread were found to be greater in stands dominated by shrubs, compared to herbicide-treated conifer plantations. However, surface fires in either scenario would still be intense enough to kill most trees, given the trees' small size and low crown heights. Also, modeling indicated that many 14- to 21-year-old conifer plantations could burn like tall shrub fields during severe fire weather and low fuel moisture conditions.

Fuel trade-offs must be considered when deciding if, how and where to treat severely burned forests. Killing shrubs to increase the survival and growth of conifers may cause an increase in fire-prone grass and forb fuels. Therefore, treating a minimum area around each tree — rather than an entire hillside — may result in better protection for young stands. Young conifers have a low likelihood of surviving a fire, whether fueled by shrubs, litter or grass. Treatments intended to protect conifers in the first few decades should concentrate on minimizing the likelihood of ignition. Treating for fire intensity only matters later, when trees are larger.

McGinnis, T.W., Keeley, J.E., Stephens, S.L. and Roller, G.B. 2010. Fuel buildup and potential fire behavior after stand-replacing fires, logging fire-killed trees and herbicide shrub removal in Sierra Nevada forests. Forest Ecology and Management 260 (1): 22-35.
http://dx.doi.org/10.1016/j.foreco.2010.03.026

Research Website:
http://www.werc.usgs.gov/Project.aspx?ProjectID=177