CALIFORNIA FIRE SCIENCE CONSORTIUM

JOINT FIRE SCIENCE PROGRAM

Research Brief for Resource Managers

Release:	Contact:	Phone:	Email:
September 2012	Susie Kocher	530-542-2571	sdkocher@ucanr.edu

Sierra Nevada Fire Science Delivery Consortium | 2132 Wickson Hall, One Shields Ave., Davis, CA 95616

Forest fuel reduction treatments do a lot of good and not a lot of harm

Stephens, Scott L.; McIver, James D.; Boerner, Ralph E.J.; Fettig, Christopher J.; Fontaine, Joseph B.; Hartsough, Bruce R.; Kennedy, Patricia L.; and Dylan W. Schwilk. 2012. Effects of forest fuel-reduction treatments in the United States. Bioscience 63:549-560.
http://treesearch.fs.fed.us/pubs/40902

Forest fuels reduction is increasingly being done in seasonally dry forests such as those found in California's Sierra Nevada and Cascade mountains where, in the past, frequent low-intensity fires regularly consumed burnable material and favored fire-resistant tree species such as ponderosa pine over more fire-intolerant species such as white fir. Median high-severity patch sizes were about 4 acres in the upper mixed-conifer of the Sierra Nevada.

One hundred years of fire suppression, along with removal of large trees during logging, has created more crowded forests with more fire-susceptible trees. This has led to wildfires that are larger and more intense, often killing most of the trees over large areas.

A recent scientific review, published in the journal Bioscience, found that forest fuel reduction using prescribed fire and 'mechanical treatments', which involve removing small trees with heavy equipment and/or grinding up small trees and shrubs, is generally effective at reducing future fire intensity and improving tree health without negatively impacting understory vegetation, soil density or erosion, wildlife, or carbon storage. However, effects vary by resource and treatment type.

Management Implications

- Current research shows that forest fuels treatments create more fire resistant forests without causing long-term harm to other resources.
- Managers can use a variety of fuels treatment methods including prescribed fire, mechanical thinning, and managed wildfire to meet fuels objectives and create heterogeneity in the forest landscape.
- Though mechanical treatments do not serve all the ecological functions of fire, they reduce risks in areas near communities.
- Fuels treatments should not be used to eliminate all high-severity fire, but to contain high severity patches to relatively small areas.

Fuels and fire behavior: Prescribed fire is more effective than mechanical treatments at reducing surface fuels including downed wood, litter, and shrubs. The disadvantage of using prescribed fire alone is that trees killed by the fire are left to eventually fall and potentially increase the severity of future fires. The most effective way to reduce the risk of crown fires is to use prescribed fire and mechanical treatment in combination because this removes surface fuels as well as the shrubs and intermediate-size trees which carry fire into the forest canopy.

The effectiveness of mechanical thinning alone is largely dependent on the type of harvest system used and whether it leaves logging debris in the treated stand. Whole-tree removal is the most effective mechanical option because limbs and other debris are removed that would otherwise become fuel on the forest floor.

Tree health: Forest treatments reduce forest susceptibility to bark beetles in the long-term. In the short-term, both prescribed fire and mechanical treatments may cause increases in bark beetle attack, but tree mortality is generally less than 5% and is concentrated in smaller trees - though occasionally larger trees may die later on. Research in the Sierra Nevada showed that 80% of all trees killed by bark beetles die in the first two years after treatment. Bark beetles also kill trees in nearby untreated areas because trees are overcrowded and stressed.

Vegetation: Mechanical treatments, like fire, open the forest canopy, increase sunlight, and so increase the productivity and diversity of plants on the forest floor. However, treatments that leave a large amount of woody debris may inhibit understory vegetation. Prescribed fire is most effective at killing fire sensitive species and cueing seed germination of fire-dependent species. Both fire and mechanical treatments may increase abundance of exotic species.

Soil: Researchers found that the potential for significant erosion or hydrological impact from treatments is low, especially in comparison to the impacts from wildfire. Mechanical treatments expose very little soil, less than 2% of the forest floor. Prescribed fires expose more bare soil, but only for a short time. No soil compaction was found as a result of mechanical treatments.

Wildlife: Thinning alone may adequately mimic low- to moderate-severity fire effects on birds and mammals in areas where prescribed fires are hard to implement. However, thinning treatments do not create conditions suitable for all species, especially those that require early successional habitat created by patches of high-severity fire. Across all species of birds and small mammals, responses appear to be similar between mechanical thinning and low- to moderate-severity prescribed fire for the first 0-4 years after treatment. Researchers found that depending on treatment type, between a quarter and a half of bird and small mammal species had positive responses while 5% to 44% had negative responses, respectively. The rest showed little response either way.

Figure 1. A feller buncher removing small trees that act as fuel ladders and transmit fire into the forest canopy.

Carbon: Forests store carbon in the soil, litter and dead wood, and in standing trees. Prescribed fire reduces carbon on the forest floor, but only in the short-term. Mechanical treatments significantly reduce carbon stored in vegetation, though about a third is recovered within three years after treatment. Combined treatments reduce carbon both in vegetation and on the forest floor. None of the treatments affect stored carbon in the soil.

Costs: Forest fuel treatments cost from hundreds to thousands of dollars per acre depending on method, material to be removed, terrain, and location. Prescribed fire is a relatively inexpensive way to reduce surface and ladder fuels. Mechanical treatments are generally more expensive, though the small and intermediate trees removed can produce wood products such as sawlogs or biomass chips to offset treatment costs. This is highly dependent, however, on the proximity of the site to a sawmill or biomass facility since the cost of transporting chips and logs is relatively high. Any cost comparison of fuel reduction treatments should include a comparison of costs associated with wildfire including loss of forest products, habitat, water and other values, and the cost of fire suppression.