

Western Ecological Research Center

Publication Brief for Resource Managers

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Contacts:

Dylan Schwilk

Phone:

559-565-3175

Email:

dschwilk@usgs.gov

Sequoia and Kings Canyon Field Station, USGS Western Ecological Research Center, 47050 Generals Highway #4, Three Rivers, CA

Tree Mortality After Early and Late Season Burning

Over the last century, fire exclusion in the forests of the Sierra Nevada has allowed surface fuels to accumulate and has led to increased tree density. Stand composition has also been altered as shade tolerant tree species crowd out shade intolerant species. To restore forest structure and reduce the risk of large, intense fires, managers have increasingly used prescription burning.

Most fires prior to EuroAmerican settlement occurred during the late summer and early fall. Atmospheric inversions during autumn, however, hinder smoke dispersal, and air quality regulations restrict opportunities for burning during the natural fire season. Legal and logistical constraints are causing managers to increasingly consider burning during the late spring and early summer. There is evidence from other ecosystems that burning out of the natural fire season may have detrimental effects, and previous reports have suggested that burning during the time when trees are actively growing may increase mortality rates due to fine root damage and/or bark beetle activity. In a study published in *Forest Ecology and Management*, scientists from the USGS, U.S. Forest Service, and University of California, Los Angeles examined the effects of fire on tree mortality and bark beetle attacks under prescription burning during early and late season.

The authors established replicated early season burn, late season burn and unburned control plots in an old-growth mixed conifer forest in the Sierra Nevada that had not experienced a fire in over 120 years. Although prescribed burns resulted in significant mortality of particularly the smallest tree size classes, no differences between early and late season burns were detected. Direct mortality due to fire was associated with fire intensity; secondary mortality due to bark beetles was not significantly correlated with fire intensity but in some cases showed slight increases with early season burns. Overall tree mortal-

Management Implications:

- In mixed-conifer forests, early season burns may provide managers with a longer period available for burning.
- Early season burns do not result in increased tree mortality relative to burns in the historical late summer-early fall fire season. In fact, lower fuel moisture in late season burns tended to result in higher fuel consumption and more homogeneous burning, leading to slightly higher tree mortality following autumn burns.
- Only one effect on trees was more severe in early season burns: bark beetle attacks on small firs (*Abies* species) were slightly higher in early season burns. The large size of bark beetle populations relative to the area of these treatments, however, makes it possible that this result is an artifact of the timing of treatments and location of the experimental units relative to one another.
- Results from other vegetation types suggest that out-of-season burning may have dramatic adverse effects, but aspects of the mixed-conifer system may make it relatively resilient to burns in the early season.

ity appeared to be primarily the result of fire intensity rather than fire season. Early season burns are generally conducted under higher fuel moisture conditions, leading to less fuel consumption and potentially less injury to trees. This reduction in fire severity may compensate for relatively modest increases in bark beetle attack probabilities on some tree species, ultimately resulting in a forest structure that differs little between early and late season prescribed burning treatments.

Schwilk, D. W., E. E. Knapp, S. M. Ferrenberg, J. E. Keeley, and A. C. Caprio. 2006. Tree mortality from fire and bark beetles following early and late season prescribed fires in a Sierra Nevada mixed-conifer forest. Forest Ecology and Management 232:36-45.