CALIFORNIA FIRE SCIENCE CONSORTIUM

JOINT FIRE SCIENCE PROGRAM

Research Brief for Resource Managers

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First-entry fires create forest structures resilient to wildfire

Kane, Van R.; Bartl-Geller, Bryce N.; North, Malcolm P.; Kane, Jonathan T.; Lydersen, Jamie M.; Jeronimo, Sean M.A.; Collins, Brandon M.; Moskal, Monika L. 2019. First-entry wildfires can create opening and tree clump patterns characteristic of resilient forests. Forest Ecology and Management. 454: 117659. https://doi.org/10.1016/j.foreco.2019.117659.

Forests that have experienced fire-suppression management techniques are more susceptible to wildfire, drought, and insects. In the past, low-to-moderate severity fires have created varying forest structure patterns. This reduced the potential for crown fires, large tree mortality rate, and post-fire drought mortality. Current efforts to return forests to historical spatial patterns include the usage of prescribed fires and mechanical thinning, both of which are limited by lack of resources and management conflicts.

The authors of the paper explore the effectiveness of using wildfires as a tool to restore historical forest structures. They used lidar data to collect data on two forests that have experienced two fires, one of which had been a site of timber management. The other area had no harvest history. Both areas contained control areas which had not experienced a fire since 1878. The paper addressed four main questions:

1. How does burn severity affect tree clump patterns and gaps?
2. Does increasing burn severity change the distribution of tree heights?
3. What are the effects of a first-entry fire on the forest structures of both managed and wilderness forests and how do they differ?
4. Do first-entry fires produce forest structures that are in an active-fire reference condition?

Management Implications

- Allowing wildfires to burn during periods of mild weather can create tree-clumping patterns that support fire resilience
- Low to moderate severity prescribed burns best replicate historical patterns of tree clumping
- The distribution of tree clumping and opening structure classes produced by this report can be used to guide mechanical thinning

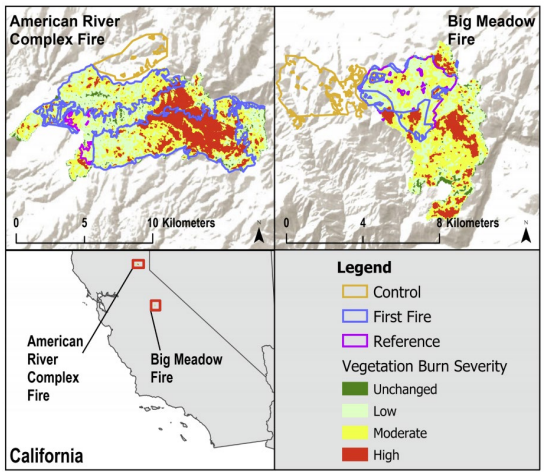

Fig. 1. Study area locations for the 2008 American River Complex Fires in Tahoe National Forest and the 2009 Big Meadow Fire in Yosemite National Park.

The study areas both were located in mixed-conifer forests in the Sierra Nevada. The American River Complex (ARC) Fires in the Tahoe National Forest had a history of active management while the 2009 Big Meadow Fire in Yosemite National Park was a wilderness area with no history of active management (Fig.1).

Due to lidar data availability and different management histories, there was a limited number of viable study areas. Therefore, there is a disparity between the mean elevation of the two areas.

The authors estimated the severity of burn sites in both study areas using the data from the Monitoring Trends in Burn Severity project. They made canopy height models using the US Forest Service's FUSION Lidar Toolkit and found tree-approximate objects (TAOs) in the lidar data using the FUSION TreeSeg tool. The TAOs represent trees that may or may not contain smaller trees beneath the surface. The use of tree spatial analysis patterns included Individuals, Clumps, and Openings and allowed the authors to identify individual TAOs and clumps of TAOs. The average canopy areas of TAOs in various-sized clumps were described by clump size distributions. The modeled canopy area for each TAO was recorded as the highest point in the TAO. Snags were omitted from the living overstory using lidar to identify TAOs with lower mean intensities. Open space was recorded as any area without vegetations taller than 2 m. Core openings were classified as openings that were further than 9 m away from any vegetation shorter than 2 m.

The area of the openings increased linearly with burn severity in both fires. The mean increase of core burn openings only increased by a few percentages above zero, however it is estimated that these openings will increase once trees fall that were killed in the fire. The canopy area for each individual tree increased as burn severity increased, but the canopy area of tree clumps larger than five TAOs decreased as burn severity increased. The canopy area of tree clumps of 2 to 4 TAOs increased after moderate-severity burns, but decreased after high-severity burns. The mean proportional canopy area for TAOs taller than 16 m in both fires decreased with increasing burn severities in comparison to the control areas. The proportional mean canopy area for TAOs 2-8 m increased with burn severity.

The proportion of classes of smaller tree clump sizes increased with burn severity. Low-and-moderate-severity burn patches had greater structural complexity amongst the clump sizes than high-severity patches which mainly consisted of open clump classes. The first-entry low severity burns of the ARC fire resulted in a larger proportion of larger and mega clump structure classes than the control area, while the first-entry low-severity burns of the Big Meadow Fire had a lower proportion of larger and mega clumps structures than its control. Both fires had the highest areas of shorter class in high severity burn patches.

The authors reported that a moderate-severity fire replicates the stand structures of fire resilient forests in fire-suppressed forests. This optimal structure for fire-repression is created with the increase of open areas without an increase in core opening areas. Burns of low and moderate severity create similar forest structures with different proportions of individual structures while high-severity burns result in the dominance of the open clump structure class.

High-severity burns create large core openings and small clumps of TAOs. While the core areas allow for more light needed in pine reproduction, it also allows for dense shrub fields to flourish and crowd out the pine saplings.

An increase in smaller trees subsequent to fire-suppression efforts has caused large high-severity burn patches across California.

Opening and clump patterns for burn severities and the references of both fires had similar changes with increased burn severity. This suggests that fires create similar clump and opening structures in spite of elevation and management differences.