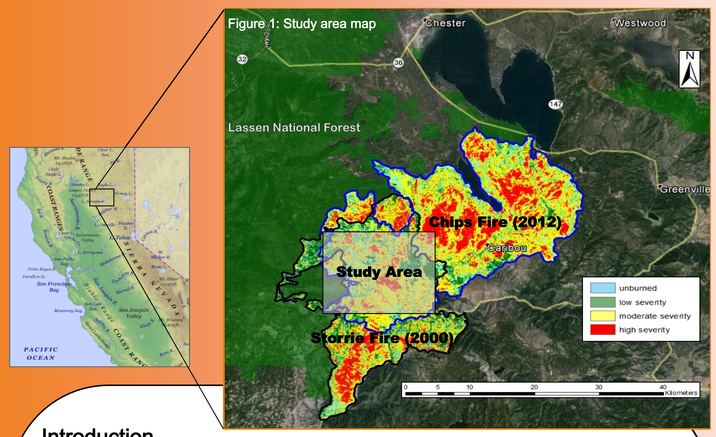
Can wildfires restore conifer-encroached California black oak woodlands?

Deborah Nemens, J. Morgan Varner, Kathryn R. Kidd (Virginia Tech), Brian Wing (USFS-PSWRS), Jesse Kreye (Mississippi State University) and Nicole Vaillant (USFS-PNWRS)

Contact: dnemens@vt.edu



Introduction

Oak communities in the western United States have been in decline since the advent of large-scale fire exclusion in the early 20th century. In the absence of fire, oak woodlands and the species dependent on them are increasingly dominated by conifers that encroach on oaks, reducing oak vigor. One potential avenue for restoration of suppressed oaks in mixed-conifer forests is via resprouting following high severity fires. We examined California black oak (*Quercus kelloggii*) sprout vigor and shifts in patterns of species composition across a spectrum of fire severities following two wildfires that burned over approximately the same landscape in 2000 (Storrie Fire) and again in 2012 (Chips Fire) in the Lassen National Forest in northern California.

Methods

Ninety-three randomly established plots were sampled across all fire severity combinations (unburned-unburned to high-high) within the 9,900 ha region where the two fire areas intersected (Figure 1). Within each 0.045 ha fixed area plot, the following data were recorded for all trees and snags: species, diameter, percent live crown or snag condition stage, and fire history (e.g.; top-killed in Storrie Fire, killed in Chips Fire). The closest oak or oak sprout clump to plot center was selected to be the "focal oak"; diameters and fire histories of all live and dead sprouts were recorded for this tree. The focal oak was then used as the locus for a 0.031 ha sub-plot, within which diameter and fire history were recorded for all stumps.

Research Questions

What is the impact of fire severity on California black oak sprout vigor?

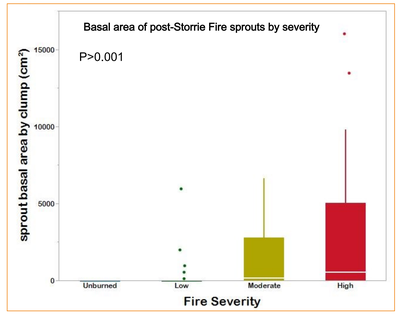


Figure 3: Sprout basal area was greater at higher severities when compared with unburned and low-severity.

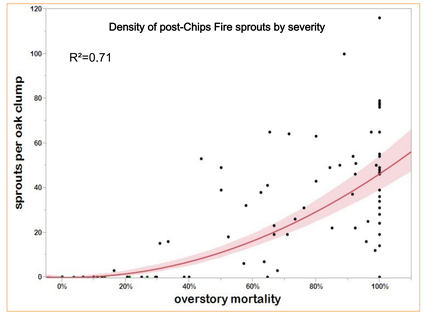


Figure 4: Density of post-fire sprouts increased with fire severity, measured at a fine scale by overstory tree mortality (P<0.001).

What is the impact of subsequent fires on regenerating oaks?

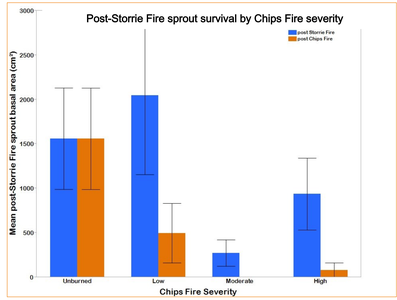


Figure 5: Basal area of post-Storrie Fire sprouts decreased more than 80% when burned at low-severity in the Chips Fire.

What is the impact of fire severity on overstory composition?

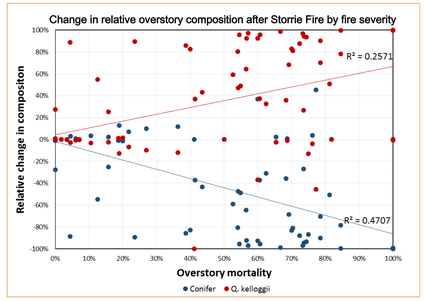


Figure 6: Relative oak canopy composition increased with increasing fire severity after the Storrie Fire.

Results

- Sprouting response (measured by basal area and number of sprouts per oak clump) was positively related to fire severity (Figures 3 & 4)
- Low-severity fires negatively impacted 12 year-old oak sprouts from Storrie Fire (Figure 5)
- **After high-severity fire, canopy dominance shifted from conifers to oaks** (Figures 2 & 6)
- Acorn production was recorded on greater than 40% of post-Storrie sprouts and infrequently on post-Chips Fire sprouts
- Less than 0.1% of oaks top-killed in either fire failed to resprout
- **Prolific sprouting allows oaks to recover quickly from high-severity fire**
- Sprouting response is subdued under conditions of low fire severity (Figures 2 & 7)

Conclusions

More than a century of fire exclusion has led to the decline of many higher-elevation oak ecosystems in the western United States. Consequently, many plant and animal species dependent on these habitats are also in decline. While the restoration of oak woodlands is increasingly considered a conservation priority by land managers, associated costs of conifer removal are often prohibitive, especially on a landscape scale. We found that **oak woodlands can re-establish after severe wildfire, effectively reversing decades of conifer encroachment.** These results suggest that wildfires can produce positive restoration outcomes in degraded oak habitats over large landscapes, where other options to recover them are limited.

Further research

Our on-going work will address additional research questions, including the following:

- What is the combined impact of the two fires on oak vigor?
- What is the impact of fire severity on regenerating conifers?
- How should a burned landscape be managed in order to retain newly re-established oak woodlands?
- Can prescribed fire be used to maintain oak overstory dominance in these habitats?
- What management actions are necessary in order to maximize treatment effectiveness and minimize negative effects on regenerating oaks?

Acknowledgements

We thank the following people for their assistance on this project: the staff of the USFS Lake Almanor Ranger District, Lassen National Forest, especially Patrick Doyle, Melissa Hennessy, and John Bristow.

This work was funded by the USDA Forest Service, Pacific Southwest Region.