CALIFORNIA FIRE SCIENCE CONSORTIUM

Research Brief for Resource Managers

Release:	Contact:	Phone:	Email:
October 2016	Shana Gross	(530) 543-2752	segross@fs.fed.us

Sierra Nevada Fire Science Delivery Consortium | One Shields Avenue, Davis, CA 95616

Prescribed Fire Can Ease Drought Induced Forest Mortality in Mixed Conifer Forests in the Sierra Nevada

van Mantgem, P.J., A.C. Caprio, N.L. Stephenson, and A.J. Das. 2016. Does prescribed fire promote resistance to drought in low elevation forests of the Sierra Nevada, California, USA? Fire Ecology ***12****(1): 13-25. doi: 10.4996/fireecology.1201013*

California is currently experiencing its most severe drought in last 120 years and drought is expected to become more frequent and severe in the future. Drought caused by decreasing precipitation and increased temperatures can lead to considerable forest die-back where entire stands are lost due to direct and indirect mortality, insects and pathogens.

Van Mantgem *et al.* investigated if prescribed fire can create conditions that will reduce drought induced mortality in mixed conifer forests in the Sierra Nevada.

In 2014, 9,950 trees were surveyed from 56 plots (38 burned and 18 unburned) in low elevation (<2100 m a.s.l.) mixed conifer forests in Kings Canyon, Sequoia, and Yosemite national parks. In burned plots, fire occurred between 6 to 28 years prior to sampling. Mortality assessments identified trees that died in 2013 or 2014. They compared stem density, stand basal area, and quadratic mean diameter between burned and unburned plots.

Management Implications

- Prescribed fire can increase resistance to drought induced mortality.
- Individual tree mortality varied by tree size, species, and history of fire.
- The highest mortality occurred in the smaller (<15 cm dbh) conifer species (white fir, incense cedar, sugar pine, ponderosa pine) in unburned plots.
- As tree density increased, mortality increased.
- Prescribed fire alone may not get to historic stand structure conditions (density, basal area, and QMD) which may be essential for long term resistance and resilience to drought induced mortality.

The most common tree species in the study were white fir, incense cedar, sugar pine and ponderosa pine.

Burned plots had lower average stem density ($P = 0.001$) and larger trees (higher QMD ($P = .001$) and average stand basal area ($P = 0.417$)) compared to unburned plots. The density of trees that died in 2013 and 2014 was negatively related to the history of prescribed fire.

Individual tree mortality varied by tree size, species, and history of prescribed fire. Mortality of common conifer species was

lower in burned versus unburned plots and mortality was most pronounced in the smaller trees (<15 cm dbh).

Their results suggest that as tree density increases, and therefore competition for water resources increases, mortality also increases.

After prescribed burning treatments, stand densities and basal area are still higher than historic estimates. In the burned plots, average stand density was 118% greater than historic stand density estimates (159 versus 72.7 trees ha^{-1}) and average basal area was 244% greater than historic basal area estimates (74 versus 21.5 m^2 ha^{-1}). Based on historic stand estimates, do prescribed fire treatments need to be more aggressive in order to promote longer term resistance and resilience?

While van Mantgem et al. results are promising, additional work needs to be conducted to determine how long treatments last and if they continue to reduce mortality as drought years increase.

Figure 1: Drought-related tree mortality in Sequoia National Park. Photo credit: Nate Stephenson. (Figure 2 in paper).

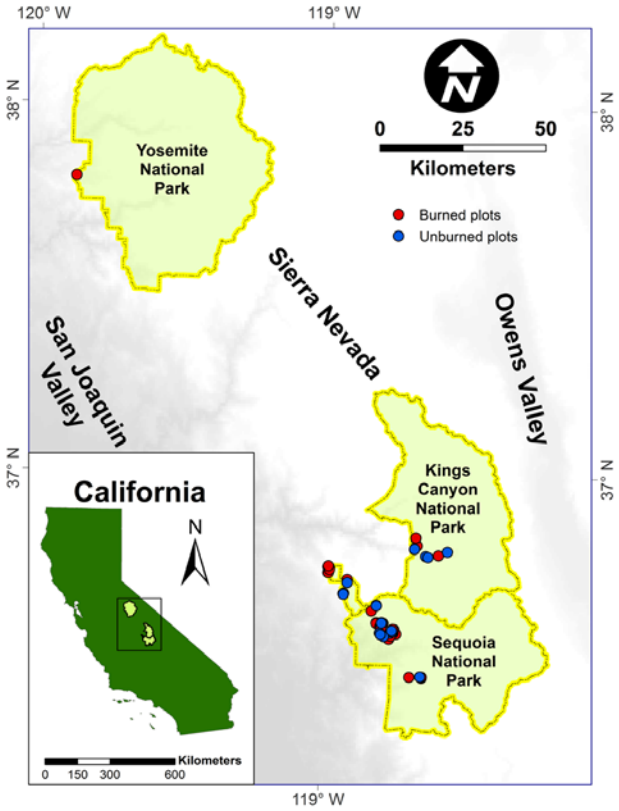

Figure 2: Study locations; burned plots are red and unburned plots are blue. (Figure 1 in paper).

FURTHER READING

D'Amato, A.W., J.B. Bradford, S. Fraver, and B.J. Palik. 2013. Effects of thinning on drought vulnerability and climate response in north temperate forest ecosystems. Ecological Applications ***23****:1735-1742. DOI: 10.1890/13-0677.1*

Collins, B.M., J.M. Lyderson, R.G. Everett, D.L. Fry, and S.L. Stephens. 2015. Novel characterization of landscape-level variability in historical vegetation structure. Ecological Applications ***25****(5): 1167-1174. DOI: 10.1890/14-1797.1*