CALIFORNIA FIRE SCIENCE CONSORTIUM

JOINT FIRE SCIENCE PROGRAM

Research Brief for Resource Managers

Release:	Contact:	Phone:	Email:
September 2012	Hugh Safford	707-562-8934	hughsafford@fs.fed.us

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

Long-term vegetation responses to prescribed fires in the southern Sierra Nevada

Webster, K.M., and C.B. Halpern. 2010. Long-term responses to reintroduction and repeated use of fire in mixed-conifer forests of the Sierra Nevada. Ecosphere 1(5): art9. http://www.esajournals.org/doi/abs/10.1890/ES10-00018.1

A century of fire suppression has led to major changes in composition, structure, and function of many western US forests. It is widely believed that reintroduction of fire is fundamental to restoring forest structure and function in fire-adapted forests, but relatively little is known about the consequences of reintroducing fire for plant diversity.

A 2010 paper by researchers Karen Webster and Charles Halpern examined two decades of post-prescribed fire data from permanent monitoring plots in mixed-conifer forests of Sequoia-Kings Canyon National Parks. The study provides evidence that repeated burning not only can reduce fuels and change forest structure; it can also enhance the richness and abundance of plant species that have been detrimentally affected by decades of fire suppression.

The researchers assessed changes in understory plant diversity and cover following first- and second-entry prescribed fires, and compared trends to a set of unburned control plots. Plots were sampled before burning; at 2, 5, 10, and 20 years after initial burning; and at 2, 5, and 10 years after second fires. The time between first- and second-entry burns averaged 13 years.

Management Implications

- Repeated, low to moderate severity fires in mixed-conifer forests can have significant positive effects on understory richness and abundance—effects that are manifested gradually over multiple decades.
- First-entry prescribed fires can reduce densities of shade-tolerant subcanopy trees, but repeated burning may be necessary to limit establishment of dense seedling populations and to promote tree species diversity.
- Successful restoration of frequent-fire systems like Sierra Nevada mixed-conifer forests will require a commitment to (a) more frequent cycles of prescribed fire (or managed wildfire), and (b) ecological monitoring to understand fire's long-term effects.

Fires greatly reduced the density of smaller trees (especially *Abies concolor* [white fir]), and did so without significantly altering stand basal area. However, fires were also followed by an increase in density of white fir seedlings. This result, which corroborates other prescribed fire studies in the Sierra Nevada, indicates that where regeneration is locally abundant, subsequent burning may be needed to reduce seedling densities.

A second-entry prescribed burn in 2005 in a mixed-conifer forest of Sequoia and Kings Canyon National Parks, California. A second-entry burn is typically conducted within one to two decades after an initial burn. Densities of small trees have already been reduced and fuels on the forest floor are mainly the accumulation of these small dead trees. Photo by Todd Erdody.

Species of concern, such as *Pinus lambertiana* (sugar pine) and *Sequoiadendron giganteum* (giant sequoia), **were most abundant in plots that experienced two fires**, further highlighting the importance of *repeated* burning for reestablishing populations of these fire-dependent tree species.

Areas experiencing first- and second-entry burns showed **gradual yet significant increases in understory species composition** and cover over time. Mean differences in species richness between burned and unburned plots were large, but not statistically significant until 5 years after fire. Similarly, **understory cover increased after burning**, but did not differ statistically from unburned plots until year 20. Shrub species showed the largest differences in response between burned and unburned plots.

Fire severity ranged from low to moderate (as likely occurred historically) and typically **had positive relationships with understory richness and cover** over time. However, the nature and strength of these relationships varied among growth forms: relationships were strong for annual forbs and shrubs, but were weak for grasses and perennial forbs. Long-term trends suggest that moderate severity fire and repeated burning can have highly beneficial effects on understory diversity and abundance.

Suggestions for further reading:

Agee, J.K., and H.H. Biswell. 1970. Some effects of thinning and fertilization on ponderosa pine and understory vegetation. Journal of Forestry 68: 709-711.

Collins, B. M., J. J. Moghaddas, and S. L. Stephens. 2007. Initial changes in forest structure and understory plant communities following fuel reduction activities in a Sierra Nevada mixed conifer forest. Forest Ecology and Management 239:102–111.

Dodson, E. K., D. W. Peterson, and R. J. Harrod. 2008. Understory vegetation response to thinning and burning restoration treatments in dry conifer forests of the eastern Cascades, USA. Forest Ecology and Management 255: 3130–3140.

Metlen, K.L., C.E. Fiedler, and A. Youngblood. 2004. Understory response to fuel reduction treatments in the Blue Mountains of northeastern Oregon. Northwest Science 78: 175–185.

Metlen, K.L., and C.E. Fiedler. 2006. Restoration treatment effects on the understory of ponderosa pine/Douglas-fir forests in western Montana, USA. Forest Ecology and Management 222: 355–369.

Thomas, S.C., C.B. Halpern, D.A. Falk, D. A. Liguori, and K.A. Austin. 1999. Plant diversity in managed forests: understory responses to thinning and fertilization. Ecological Applications: 864-879.

Wayman, R. B., and M. North. 2007. Initial response of a mixed-conifer understory plant community to burning and thinning restoration treatments. Forest Ecology and Management 239:32–44.