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Research Brief for Resource Managers

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How are forests structured under an active-fire regime?

Lydersen, Jamie & North, Malcolm. (2012). Topographic variation in structure of mixed-conifer forests under an active-fire regime. Ecosystems, Published online 26 July 2012.

One goal of current forest management is the promotion of resilience to environmental disturbances like fire, which is projected to become more common and severe under a warmer climate. Structurally and compositionally heterogeneous forests are thought to be more resilient to severe disturbances, but heterogeneity in modern Sierran mixed conifer forests has been greatly decreased by a history of widespread logging and a century of fire suppression.

Restoring forest ecosystems requires a set of reference conditions that can serve to guide management. Reference conditions are best derived from contemporaneous, properly functioning ecosystems, but the extent of ecosystem alteration in many western forests has necessitated a heavy reliance on historical data. Many historical stand reconstruction studies have now been carried out in Sierran mixed conifer forests, but such studies necessarily lack information on the natural range of variability for many important variables. These include small tree density, surface fuel conditions, coarse woody debris, understory vegetation, and variation of forest structure with topography. In addition, most historical data come from periods with different climatic conditions than today or the projected future.

Management Implications

- Use topography as a guide for managing large diameter trees, and prescribed fire to create canopy openings that can be occupied by fire-tolerant conifer seedlings.
- Fire-intolerant species that established after fire suppression and now dominate the intermediate size classes may be less likely to die in low intensity fires.
- Landscapes under an active fire regime exhibit topography-driven variability in forest structure, fuel conditions, and canopy cover and provide a diverse array of habitat for sensitive species.

Lydersen and North addressed these shortfalls by assessing forest heterogeneity under current conditions in rare forest stands that continue to be characterized by an active fire regime. The authors sought to determine how mixed conifer forests under an active fire regime differ from forests under fire suppression. They focused on three factors: (1) the size-class distribution of live stems; (2) the influence of topography on forest structure; and (3) fire effects on understory plant dynamics.

Study areas were selected through a GIS query identifying old-growth status, location of low severity burns, and recent fire history. From this subset, study sites were selected that had experienced at least two low severity fires (wildfire or prescribed fire) in the last 65 years, with one being in the last 30 years. The authors note that selected study sites experienced some period of fire suppression in the past but maintain that they represent useful references for restoring an active-fire regime in forests with a history of suppression.

Within each study plot, topography, surface fuels, trees, snags, shrubs, regeneration and canopy cover were assessed. Maximum char height was used as a surrogate for overall fire intensity.

The study found that the forest understory (shrubs, seedlings, saplings) is influenced by fire frequency and intensity. Differences in the understory are promoted by variation in fire intensity, with shrubs becoming more dominant, and small trees less dense, in frequent, higher-intensity fires. Canopy tree metrics are influenced by topographic variability, with stands characterized by fire-intolerant trees, high basal area, high canopy cover, and abundant large snags and logs tending to be found in areas of low slope position where conditions are more mesic. Fire-tolerant trees and more open forests tend to occupy more xeric sites and higher slope positions.

Although all of the study sites had experienced at least two fires in the last century, tree size-class distributions revealed that distinct changes had occurred as a result of fire suppression. A comparison between fire-tolerant and fire-intolerant tree species showed that more fire-intolerant trees (especially white fir) established during fire suppression. These trees now dominate intermediate size classes in lower and middle slope positions, while larger diameter fire-tolerants continue to persist on upper slopes and ridge tops. Fire-intolerant species of substantial size may be more resistent to mortality in cases of low intensity prescribed fires, allowing them to survive to eventually replace the large fire-tolerant pines that dominate these sites. Since white fir and other fire-intolerant species are more sensitive to water stress under dry growing conditions, management for forest resilience to climate

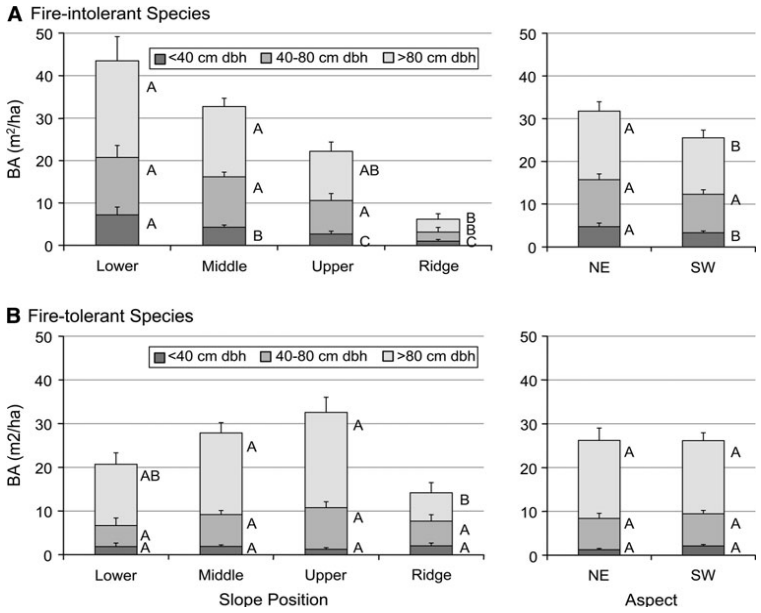

Figure 3. Average basal area of live (fire tolerant and intolerant) trees by slope position and aspect.

change is often focused on restoration of fire-tolerant species. Managers will need to consider how topography and fire interact to affect the sustainability of restoration actions.

Suggestions for further reading:

Collins, B.M., Everett, R.G., Stephens, S.L., 2011. Impacts of fire exclusion and recent managed fire on forest structure in old growth Sierra Nevada mixed-conifer forests. Ecosphere 2, 1-14.

Nesmith JCB, Caprio AC, Pfaff AH, McGinnis TW, Keeley JE. 2011. A comparison of effects from prescribed fires and wildfires managed for resource objectives in Sequoia and Kings Canyon National Parks. For Ecol Manage 261:1275–82.

Taylor, A.H., 2010. Fire disturbance and forest structure in an old-growth Pinus ponderosa forest, southern Cascades, USA. J Veg Sci 21, 261-572.

Underwood, E.C., Viers, J.H., Quinn, J.F., North, M., 2010. Using topography to meet wildlife and fuels treatment objectives in fire-suppressed landscapes. Environ Manag 46, 809-819.

Webster, K., Halpern, C.B., 2010. Long-term vegetation responses to reintroduction and repeated use of fire in mixed-conifer forests of the Sierra Nevada. Ecosphere 1, 1-2.