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Publication Brief for Resource Managers

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Fire Severity and Ecosystem Responses

Chaparral shrublands burn in large, high-intensity crown fires. Managers interested in how these wildfires affect ecosystem processes generally rely on surrogate measures of fire intensity known as fire severity or burn severity, which measures the extent of biomass consumption. Two important questions about fire severity that need to be answered are: to what extent can fire severity be measured by remote sensing indices, and do fire severity measurements predict ecosystem responses in vegetation recovery. In the September issue of *Ecological Applications,* USGS scientists investigated these questions following the 2003 wildfires in southern California.

Their study showed that fire severity, measured as twig diameter on shrub skeletons, was positively affected by stand age, consistent with previous empirical and modeling studies of fire behavior in this vegetation type. Prefire shrub density and the shortest interval in the prior fire history had significant direct effects on fire severity as well.

They compared their field measurements of fire severity with the remote-sensing index, dNBR, based on the difference between pre- and postfire normalized difference vegetation index NDVI. The absolute dNBR was strongly correlated with field measures of fire severity, but relative dNBR was not. dNBR was also found to correlate strongly with past fire history over all of the major 2003 burns.

Fire severity per se is of interest to resource managers primarily because it is presumed to be an indicator of important ecosystem processes such as vegetative regeneration and community recovery. The USGS study, however, showed that fire severity, whether measured on the ground or with remote imaging, contributed relatively little to explaining patterns of regeneration after fire. Two generalizations can be drawn for these shrubland ecosystems: fire severity effects are mostly short-lived (i.e., by the second year they are greatly diminished), and fire severity may have opposite effects on different functional types.

Management Implications:

- The remote sensing index dNBR correlates strongly with field measurements of fire severity.
- Fire severity is of most interest to resource managers as a predictive tool of ecosystem responses; thus it is of considerable interest that fire severity was not strongly correlated with vegetative recovery.
- Recovery of the native shrublands proceeded best following high-severity fires.
- Low-severity fires favored alien species richness and cover.

Specific findings included the fact that vegetative cover in the first growing season was only weakly correlated with fire severity and was more strongly correlated with elevation and substrate. Species diversity in the first year was negatively affected by fire severity, and much of this was tied to the sensitivity of alien propagules to high-intensity fires. The strongest effect of fire severity was the negative effect it had on both alien species cover and diversity.

It is concluded that chaparral shrublands are not only well adapted to fire-prone environments, but are highly resilient to high-intensity burning. The primary threat in these ecosystems is frequent fire that contributes to reduced fire severity and increased alien plant invasion.

Keeley, J.E., T. Brennan, and A.H. Pfaff. 2008. Fire severity and ecosystem responses following crown fires in California shrublands. Ecological Applications 18:1530–1546.

[Complete article can be downloaded from web site listed above.]