

Landscape heterogeneity following large fires: insights from Yellowstone National Park, USA

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Symposium on Large Fires
3rd International Fire Ecology and Management Conference
November 13-17, 2006
San Diego, CA

Large, high-severity burns typify the fire regime of relatively cool mesic high-elevation, high-latitude and coastal forests where canopy fuels are abundant. Areas affected by large, severe fires are commonly perceived as devastated, homogeneous, biologically poor areas. To the contrary, early-successional forests often contribute to high biological, structural and ecosystem diversity. Yellowstone National Park provides an excellent laboratory for inferring the effect of the large fires on subsequent landscape heterogeneity. Although the 1988 fires burned 1.4 million acres in the Greater Yellowstone Area predominantly at high severity, the pattern of burning was heterogeneous, leaving a complex mosaic of burn severities. Variable burn patterns shaped the spatial distribution of biological legacies, organisms and structures that persist from the pre-fire forest. The abiotic template (e.g. elevation, soils) and past disturbance regimes (reflected in levels of serotiny and time since last fire), also contribute to the spatial heterogeneity of biological legacies. Such legacies had a significant influence on understory vegetation and post-fire tree densities, which varied 6 orders of magnitude, where smaller dense patches were interspersed within a matrix of larger patches of low-density trees. Patterns of initial post-fire succession generated significant spatial variation in ecosystem processes such as NPP. Although infrequent, the ecological consequences of large fires in Yellowstone have persisted for long periods of time, and with climate change, landscape structure may become more heterogeneous. Overall, the Yellowstone case study suggests that large fires tend to promote heterogeneity both within the burn perimeter and across the larger forested landscape. Biologically rich and ecologically important, large unmanaged post-fire landscapes are relatively rare in time and space, and should be maintained as an important source of heterogeneity across forested landscapes.