Pyric—Tree Spatial Patterning Interactions in Historical and Contemporary Mixed Conifer Forests, California, USA

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Abstract

Tree spatial patterns in dry coniferous forests of the western US, and analogous ecosystems globally, were historically aggregated, comprising a mixture of single trees and groups of trees. Modern forests, in contrast, are generally more homogeneous and overstocked than their historical counterparts. As these modern forests lack regular fire, pattern formation and maintenance is generally attributed to fire. Accordingly, fires in modern forests may not yield historically analogous patterns. However, direct observations on how selective tree mortality among pre-existing forest structure shapes tree spatial patterns is limited. In this study, we (1) simulated fires in historical and contemporary counterpart plots in a Sierra Nevadan mixed-conifer forest, (2) estimated tree mortality, and (3) examined tree spatial patterns of live trees before and after fire, and of fire-killed trees. Tree mortality in the historical period was clustered and density-dependent, because trees were aggregated and segregated by tree size before fire. Thus, fires maintained an aggregated distribution of tree groups. Tree mortality in the contemporary period was widespread, except for dispersed large trees, because most trees were a part of large, interconnected tree groups. Thus, post-fire tree patterns were more uniform and devoid of moderately sized tree groups. Post-fire tree patterns in the historical period, unlike the contemporary period, were within the historical range of variability identified for the western US. This divergence suggests that decades of forest dynamics without significant disturbances has altered the historical means of pyric pattern formation. Our results suggest that ecological silvicultural treatments, such as forest restoration thinnings, which emulate qualities of historical forests may facilitate the reintroduction of fire as a means to reinforce forest structural heterogeneity.

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