Abstract:

A key challenge to maintaining resilient landscapes is adapting to and maintaining dynamic ecological processes. In fire-dependent ecosystems, this includes identifying and defining mechanisms through which fire influences forest structure and functionality. Interpretations of tree patterns via land survey records in the Lake States have often highlighted the importance of infrequent moderate to extreme disturbance events. However, historical survey methods are limited to observing higher severity disturbances and over large landscapes, thus it is not clear if the origin, structure, and forcing factors for either patterns or processes are adequately quantified by these methods. We used dendrochronological methods to determine how fire history and stand structure, including cohort structure, tree density, and spatial patterning, are linked within Lake States mixed conifer forests in Wisconsin. We found relatively short mean fire return intervals (MFRIs) ranging from 6 to 13 yr with little variation in fire frequency among sites. Current densities of red-pine-dominated forests are 4–37 times historical (ca. 1860) densities (mean 129) and almost entirely spatially random, whereas historically forests were spatially aggregated at stand scales. Stands also contained multiple and/or loosely defined cohort structures suggesting very different controls operating historically than currently. Heterogeneity that helped maintain ecosystem resilience in these ecosystems historically came from frequent fire disturbance processes that affected stand-scale forest resistance. This was likely the historical dynamic across fire-adapted transitional pine forests of the Lake States.