Abstract for 2013 ESA meeting

Landscape patterns of early postfire lodgepole pine regeneration dominate stand structure and function 24 years after the 1988 Yellowstone Fires

Monica G. Turner, Zoology Department, University of Wisconsin, Madison, WI
William H. Romme, NREL, Colorado State University, Fort Collins, CO
Daniel B. Tinker, Botany Department, University of Wyoming, Laramie, WY
Timothy G. Whitby, Zoology Department, University of Wisconsin, Madison, WI

Background/Questions/Methods
Understanding the rate and spatial variability of postfire succession in western US forests is increasingly important given recent increases in fire frequency, fire size, and the resulting area of young forests. However, few long-term studies have tracked landscape patterns of succession after large, stand-replacing fires. We studied postfire succession in areas burned by the 1988 Yellowstone Fires, which affected >300,000 ha of coniferous forest and created a complex postfire landscape mosaic. Early postfire tree regeneration varied enormously (0 to > 500,000 stems ha^{-1}), primarily due to prefire serotiny and fire-severity patterns. We asked whether stand structure and function were beginning to converge 24 yrs postfire and, if so, what mechanisms might contribute. In 2012, we re-sampled 72 widely distributed 0.25-ha plots in postfire lodgepole pine (*Pinus contorta* var. *latifolia)* that were sampled previously in 1999. We expected landscape variation in postfire tree density and aboveground net primary production (ANPP) to have declined, primarily in response to density-dependent mortality, indicating that processes leading to convergence in stand structure might begin to dominate the successional landscape. We also expected that postfire tree density would remain a "master variable" that largely determines stand-level ecosystem function by establishing different trajectories of biomass accumulation.

Results/Conclusions
Between 11 and 24 yrs postfire, lodgepole pine density remained the same or increased in 65% of the plots and declined in 35% of the plots. Contrary to our expectations, landscape variation in lodgepole pine density remained very high (0 to 344,000 stems ha^{-1}), and among-stand coefficients of variation were similar at 11 (285%) and 24 yrs (250%) postfire. Although mean postfire lodgepole pine density decreased from 33,000 to 22,000 stems ha^{-1}, this change was driven by declines > 100,000 stems ha^{-1} in three stands of extremely high density (> 350,000 stems ha^{-1}). At 24 yrs postfire, lodgepole pine basal area ranged from 0 to146 m^2 ha^{-1} and increased with tree density, although trees in high-density stands were smaller. Herbaceous ANPP ranged from 0.14 to 2.78 Mg ha^{-1} yr^{-1} and declined with increasing lodgepole pine basal area and ANPP. Gradual lodgepole pine recruitment in low-density stands and mortality in high-density stands suggest these stands will converge over the long term, as predicted by chronosequence studies. However, initial patterns of postfire tree density still dominated stand trajectories 24 years after the 1988 Yellowstone Fires, indicating a persistent legacy of the contingent factors that govern landscape patterns of tree regeneration.