

ESA 2005 ABSTRACT – symposium on cross-scale interactions.

TURNER^{1*}, M. G., W. H. ROMME², D. B. TINKER³, E. A. H. SMITHWICK¹, K. L. METZGER¹ and J. ZHU¹. ¹University of Wisconsin-Madison. ²Colorado State University. ³University of Wyoming. Disturbance, spatial variability and cross-scale interactions in the post-fire Yellowstone landscape

Abiotic and biotic causes of spatial pattern have been well described for many ecological systems. Nonetheless, explaining and predicting landscape patterns remains surprisingly difficult, in part because complex interactions among multiple drivers are poorly understood. We studied spatial variability in vegetation and nitrogen (N) cycling rates following stand-replacing fires in the Yellowstone landscape, and here we explore cross-scale relationships among drivers and evaluate their capacity to predict spatial patterns of recovery following fire. We hypothesized that post-fire spatial patterns of vegetation and N cycling would result from detectable interactions among drivers operating at multiple scales: the very broad-scale (100 km) abiotic template of climate, landform and fire regime; broad-scale (1 to 10 km) patterns of pre-fire stand structure and serotiny; meso-scale (0.1 to 1 km) patterns of fire severity, initial post-fire plant establishment, and abundance of coarse wood; and fine-scale (0.001 to 0.1 km) variability in vegetation, coarse wood, microclimate and soils within post-fire stands. Fire increased meso-scale and broad-scale spatial variability in vegetation structure (aboveground cover, species richness, tree density) and aboveground productivity. However, fine-scale spatial structure of vegetation was similar before and after fire (autocorrelation distances typically < 6 m). Variation in net N mineralization was greatest at fine scales, and cross-scale interactions among drivers were needed to predict rates. Relationships between net nitrate availability and plant cover were established soon after fire and showed significant scale dependence in young post-fire stands. The space-time mosaic of ecosystem structure and function in the Yellowstone landscape results from cross-scale interactions that appear to mediate the effects of stand-replacing fire and accelerate system recovery from disturbance.