

**Title: Ecosystem function in heterogeneous landscapes: variation in soil nitrogen availability among post-fire lodgepole pine stands in Yellowstone National Park**

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Understanding natural variation in ecosystem processes is an important research goal in ecology. In particular, spatial variability in processes such as nutrient cycling across landscapes is not well understood. The 1988 fires in Yellowstone National Park produced a landscape mosaic of early successional forests that vary widely in stand density (ranging from 0 to > 500,000 stems ha<sup>-1</sup>). In this study, we asked whether the differences in stand structure and aboveground net primary production (ANPP) observed in 17-yr old post-fire lodgepole pine (*Pinus contorta*) are associated with differences in inorganic nitrogen availability at the stand level. During summer 2005, we sampled 25 stands that burned in the 1988 fires. Lodgepole pine density and basal diameters were measured in each stand, and ANPP rates were calculated from allometric equations. Free resin bags were used as an index of nitrogen availability during the growing season; 36 were distributed randomly in each stand in June 2005, retrieved in September 2005 and extracted for nitrate and ammonium. A composite soil sample was also collected in June 2005 from each stand to measure total soil nitrogen, phosphorus, cation concentrations and percent organic matter. Among the stands, lodgepole pine density ranged from 200 to 430,500 stems ha<sup>-1</sup>, and tree ANPP ranged from 0.22 to 17.75 Mg ha<sup>-1</sup> yr<sup>-1</sup>. Total soil nitrogen varied three-fold (0.03 to 0.10%) and exchangeable phosphorus varied seven-fold (3 to 20 ppm) among stands. Surprisingly, tree ANPP was negatively related to total soil nitrogen and exchangeable phosphorus. However, ammonium and nitrate availability varied predictably with biotic and abiotic characteristics of the stand. This study contributes to a more synthetic understanding of ecosystem biogeochemistry in heterogeneous landscapes and illustrates the importance of landscape patterns generated by natural disturbances.