

## Broad-scale patterns of ecosystem nitrogen stocks and soil nitrogen availability in post-fire lodgepole pine ecosystems

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Nitrogen (N) is considered to limit lodgepole pine productivity in high elevation Rocky Mountain forests. Nitrogen availability is altered by stand-replacing fire, which affects > 4 million ha yr<sup>-1</sup> nationally. Both immediate and longer-term effects of severe fire on N cycling have been elucidated. However, few general hypotheses have emerged regarding how post-fire patterns of N availability and stocks vary at broad spatio-temporal scales. Here, we present results from a replicated chronosequence study in Yellowstone National Park (Wyoming, U.S.A.) directed at measuring N availability (ion-exchange resin bags) and N pools among stands at varying time since fire and post-fire densities. Among age-classes, N availability ranged from 0.63 (<25 yrs) to 1.67  $\mu\text{N bag}^{-1} \text{d}^{-1}$  (170-230 yrs), largely due to increases in nitrate availability, and remained high thereafter (1.10  $\mu\text{N bag}^{-1} \text{d}^{-1}$ , >250-yrs). N availability was lower in the young, high-density compared to low-density stands (0.47 vs. 0.92  $\mu\text{N bag}^{-1} \text{d}^{-1}$ ). N availability was similar among beetle-killed and non beetle-killed stands. Total N was lowest in the <25 yr age-class (130.6 gN m<sup>-2</sup>) and did not increase significantly beyond 40 yrs (average = 276.3 gN m<sup>-2</sup>). Live pool N ranged from 2% (<25 yr) to 53% (80-130 yr); soil N was 58% of total N in the <25-yr age-class, but 33 to 36% >80 years. Total N was positively correlated to Bray-P availability (p<0.005) but relative nitrification was negatively correlated to P (p<0.0001). Both total N availability and total N were negatively correlated with pH (<0.0001). Models to predict N availability (R<sup>2</sup>= 0.41) included stand tree density, pH and P availability, whereas models for total N (R<sup>2</sup>=0.43) included pH, P availability, and cation exchange capacity. We conclude that although patterns in total N stocks largely follow patterns of biomass accumulation through succession, increased nitrate availability in older stands did not support the notion of progressive N limitation with stand age and may reflect variation in tree density, pH, and soil P.