Soil, vegetation, and nitrogen dynamics following mountain pine beetle outbreak in lodgepole pine forests of the Greater Yellowstone Ecosystem

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Outbreaks of multiple native bark beetle species are currently affecting many forests throughout western North America. Bark beetle disturbance causes unique changes in forest structure that initially affect two major fluxes of the terrestrial nitrogen (N) cycle: (1) decreased nutrient uptake by live biomass, and (2) increased organic N inputs to soil via litterfall and root turnover. These changes in N fluxes to and from the soil profile, along with altered soil temperature, have the potential to change rates of soil N mineralization and subsequent N availability to vegetation. To assess the effects of bark beetle outbreak on vegetation, soil, and N cycle ecosystem variables, we established a chronosequence of study plots representing four stages of stand condition, ranging from undisturbed to 30-yr post mountain pine beetle outbreak in lodgepole pine (*Pinus contorta* var. *latifolia*) forests of the Greater Yellowstone Ecosystem (Wyoming, USA).

Beetle-induced tree mortality, ranging from 60-100% of basal area, initiated three-fold increases in soil N mineralization rates in the first four years after outbreak, which in turn contributed to increases in foliar N concentration in both canopy and understory vegetation during the same period. Across the chronosequence, some ecosystem variables (e.g. foliar %N and soil N mineralization) returned to pre-outbreak levels by thirty years after the outbreak, while others (e.g. canopy N pool size, soil C:N ratio, and soil temperature) did not. Variables closely linked to slowly changing drivers such as aboveground tree biomass and decomposition had not recovered after thirty years, while variables closely linked to quickly changing drivers such as nutrient uptake, microbial processes, and understory biomass had recovered. Our study demonstrates that bark beetle outbreaks alter the biogeochemistry of conifer forests, and that several soil, vegetation, and abiotic ecosystem characteristics remain altered relative to pre-disturbance conditions three decades after insect outbreak.