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Soil nutrition and phenols in mountain pine beetle-killed forests

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Abstract

Background/Question:
Outbreaks of the mountain pine beetle (MPB) result in extensive overstory tree mortality which triggers a cascade of interlinked effects which can eventually manifest in soil nutrient and chemical legacies. Nutrient legacies are influenced by the balance between inputs (e.g., litter quantity, quality, and decomposition) and losses (e.g., vegetative immobilization and hydrological export). Soil nutrients play a critical role in seeding regeneration and forest succession; therefore, a better understanding of their dynamics is necessary to predict short- and long-term impacts of MPB outbreak on the recovery outcomes for intensively or minimally managed stands. Thus, we sought to determine the strength and direction of relationships between levels of beetle kill to soil moisture, nutrition, and total mineral soil phenols.

Methods /Results/Conclusions:
We performed a survey of above- and below-ground site properties associated with a gradient of beetle kill (0 – approx. 50 m^2/ha basal area killed) in lodgepole pine forests of northwestern Alberta. Between one and two years after peak mortality, overstories lost significant quantities of pine needle litter and retained elevated levels of litter nitrogen and phosphorus; soils showed elevated nitrate and moisture supply. After 2-3 years, we observed a decline in pine needlefall and soil phenols, and a re-stabilization of moisture. Our results show that elevated soil moisture had greater transience than soil nitrate supply and are consistent with past studies reporting an inverse relationship between total phenols and nitrate, whereby phenols strongly inhibit nitrification and thus nitrate availability. Ultimately, soils will likely have higher moisture and nitrate supply several years after outbreak which has been shown to induce a positive growth response in existing and regenerating vegetation.

Notes: