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Conference Abstract

Disentangling carcass size and climate effects on soil biogeochemistry during decomposition

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Abstract

When an animal dies the decomposition of its carcass releases multiple compounds that become available to soil microbiota altering soil biogeochemistry. This zone of affected substrate is characterized by significant changes to numerous soil biogeochemical parameters including pH, conductivity, microbial respiration rates, dissolved organic carbon (DOC), C/N ratios, carbon and nitrogen stable isotopes ($\delta^{13}C$ and $\delta^{15}N$), and major/trace elemental concentrations. Although the effects of animal decomposition on these parameters have been recorded for various organisms and in a variety of ecosystems several knowledge gaps remain, including:

1. the effect of carcass size; and
2. decomposition effects in prairie ecosystems (i.e., semi-arid climates).

Here, we investigate how soil biogeochemical parameters are affected by the decomposition of a horse carcass (~660 kg) in a prairie ecosystem in comparison to beavers (~18 kg) in a temperate forest. Three parameters were identified as significantly influenced by carcass size: conductivity, DOC, and microbial respiration rate. Average soil conductivity underneath the horse carcass was three to fifteen times higher than control soils and reached a maximum at 1114 ADD, while maximum soil conductivity values were observed after 160 ADD in beaver-associated soils. Maximum DOC concentrations were observed after 160 ADD in beaver-associated soil (67 ± 40 mg C gdw^{-1}) and after 1114 ADD in horse-associated soil (326 ± 115 mg C gdw^{-1}). Microbial respirations rates were both greater in horse-associated soil and longer-lasting compared to beaver-associated soil. Respiration rates were greatest in two of the three horse-associated soils after 1114 ADD (~733 µg CO_2-C gdw^{-1} day^{-1}), which significantly differs compared to beaver-associated soils (300 ± 90 µg CO_2-C gdw^{-1} day^{-1} at 160 ADD). Taken together, these results demonstrate that larger carcasses result in a greater release of decomposition products, including C, and greater stimulation of soil heterotrophic communities. Other measured biogeochemical indicators of decay suggest a mixed influence due to carcass size and climate, notably $\delta^{15}N$ values of the soil, and major element concentrations. Climate was revealed to be more important in controlling changes to pH and gravimetric moisture than carcass size, with baseline soil conditions and type playing critical roles. Additionally, in semi-arid regions such as western South Dakota, the role of wet-dry cycles on carcasses undergoing decomposition may help to explain the pulses observed with C concentrations and C cycling. This study provides the first direct comparison of soil biogeochemistry associated with the decomposition of two different sized taxa decayed in two different climates. Attempting to normalize climate data using ADD was found to be an imperfect system that does not account for all climate variables affecting decomposition. Unravelling patterns in decomposition can better help to constrain nutrient cycling in modern and ancient ecosystems.

Keywords

Carbon cycling, hotspots, soils, ecosystems, carrion

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Conflicts of interest

The authors have declared that no competing interests exist.