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Microarthropods accelerate litter decomposition and alter the fate of litter carbon and nitrogen in the soil

Jennifer Soong, Andrew Horton, Diana Wall, and Francesca Cotrufo
Natural Resource Ecology Laboratory, Colorado State University, Fort Collins, CO, USA

Soil fauna have been found to accelerate litter decomposition in some ecosystems, with calls for the need to include them in global models of C and N cycling. However, their influence on the fate of decomposing litter C and N is not clear. Does the acceleration of mass loss affect how much litter C and N end up stored as soil organic matter (SOM), or how much C and N are lost to the atmosphere during decomposition? We will present the results from our three-year, 100% mass loss, tracking of 13C and 15N labeled Andropogon gerardii leaf litter decomposing at a tallgrass prairie site, where we used a naphthalene treatment to suppress microarthropods and examine their effects on the fate of decomposing litter C and N. Initially, leaching was the main pathway of litter inputs to the mineral associated SOM. We found that microarthropods accelerated the first 18 months of litter mass loss, but after 24 months mass loss rates converged. This early acceleration of mass loss was associated with an increase of litter fragment inputs to the soil. This increase in litter inputs to the soil caused by microarthropods resulted in an increase in microbial uptake of litter C (measured by tracing 13C into phospholipid fatty acids), and a shift in the microbial community. The C:N ratio of litter inputs to the soil was significantly increased by the presence of microarthropods. Together these results demonstrate how microarthropods accelerate shredding, mass loss, and litter fragment inputs to the soil during the early stages of decomposition but they do not affect the total amount of litter contribution to SOM over the entire course of decomposition. However, microarthropods do alter the C:N composition of litter inputs to the soil through their top-down influence on the microbial community responsible for decomposing and transforming litter inputs to the soil. Our results reveal the complex interactions between microarthropods, litter mass loss, soil microbes and C:N dynamics, and how these change over the course of the litter decomposition process. After complete mass loss of our labeled A. gerardii, 19% of the initial litter C was recovered in the soil for both the control and microarthropod suppressed treatment, but the C:N ratio was significantly increased by the presence of microarthropods.