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Leaf litter decomposition of four different deciduous tree species - resource stoichiometry, nutrient release and microbial community composition

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Recently, there has been increasing interest in the role of microbial communities for ecosystem processes like litter decomposition and nutrient cycling. For example, fungi are thought to be key players during litter decomposition in terrestrial ecosystems because they are able to degrade recalcitrant compounds like lignin and also dominate the decomposition of cellulose and hemicellulose, whereas bacteria seem to play an important role for lignin decomposition especially under anaerobic conditions. However, our knowledge about the contribution of bacteria and fungi to decomposition is still scarce.

The aim of the present study was to elucidate how the microbial decomposer community is affected by resource stoichiometry and how changes in community composition affect litter decomposition and nutrient cycling. To this end, we collected leaf litter of four deciduous tree species (beech (Fagus), oak (Quercus), alder (Alnus) and ash tree (Fraxinus)) at four different seasons (winter, spring, summer and autumn) in an Austrian forest (Schottenwald, 48°14'N16°15'E; MAT=9°C; soil type: dystric cambiosol; soil C:N=16) in 2010. We determined litter nutrient content (micro- and macronutrients) and extractable nutrients and assessed the microbial community by PFLA analysis to test the following hypotheses: (i) tree species affects microbial community composition, (ii) microbial community composition changes over the course of the year, and (iii) narrow litter C:nutrient ratios favour nutrient release.

Our data show that litter of different tree species varied in their stoichiometry, with C:N ratios between 16 (alder) and 46 (beech) and C:P ratios between 309 (ash) and 1234 (alder). Tree species had a significant impact on microbial community composition: highest amounts of actinomycetes and protozoa were observed for alder, while arbuscular mycorrhizae were lowest for oak. Bacteria were favoured by litter with narrow C:N shortly after litterfall. During litter decomposition, microbial communities changed. An increase in fungi and actinomycetes was observed during decomposition in almost all tree species as well as a decline in gram negative bacteria. Generally our results revealed an enhancement in fungal to bacterial ratios, supporting the increasing importance of fungi towards later decomposition stages.