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C and N mineralisation in the decomposer food webs of a European forest transect

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Belowground processes are essential for the overall carbon and nitrogen fluxes in forests. Neither the functioning of the soil food web mediating these fluxes, nor its modulation by environmental factors is sufficiently understood. In this study the belowground carbon and nitrogen mineralisation of four European coniferous forest sites (northern Sweden to north-east France) with different climate and N depositional inputs was analysed by investigating the soil food webs using field observations and modelling. The soil fauna directly contributed 7–13% to C mineralisation, among which the testate amoebae (Protozoa) made the largest contribution. Microbial grazing was suggested to have an important indirect effect by stimulating bacterial turnover. Due to relatively high C:N ratios of their substrate, bacteria immobilized N, while the fauna i.e. testate amoebae, nematodes, microarthropods and enchytraeids, counteracted this N immobilisation.

Despite similar food web biomass, the sites differed with respect to food web structure and C and N flows. Model calculations suggested a significant influence of food web structure on soil ecosystem processes in addition to environmental factors and resource quality. Mineralisation rates were lowest at the low N input boreal site with a food web dominated by fungal pathways. Further south, as N availability increased, bacterial pathways became more important and the cycling of C and N was faster. The bioavailability of degradable C sources is suggested to be a limiting factor for microbial activity and overall mineralisation rates. In this respect, above- and belowground interactions e.g. transfers of labile C sources from the vegetation to the decomposer system deserve further attention.

Our study revealed the combined effects of climate and nutrient inputs to ecosystems and the subsequent changes in the structure and functioning of the systems. If decomposition, and therefore carbon loss, is stimulated as a consequence of structural and/or nutritional changes, resulting for example from continuous industrial N emission, the storage capacity of forest ecosystems could be altered.

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The amount of C and N stored in and released from forest ecosystems is an essential part of the global carbon (C) and nitrogen (N) cycle. The uncertainty in current estimates of these terrestrial fluxes results to a large extent from our limited understanding of the soil and the decomposition processes mediated by the soil organisms (Dufresne et al. 2002). The ecological understanding of the decomposer system and its contributions to biogeochemical cycling is essential to environmental management purposes and questions of global change (Currie 1999). In this study the C and N fluxes from the soil were derived from the contributions of the organisms involved. The decomposer food webs at four European coniferous forest sites were monitored

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