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# Microbial plant litter decomposition in aquatic and terrestrial boreal systems along a natural fertility gradient

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Plant litter decomposition is a global ecosystem process, with a crucial role in carbon and nutrient cycling. The majority of litter processing occurs in terrestrial systems, but an important fraction also takes place in inland waters. Among environmental factors, pH impacts the litter decomposition through its selective influence on microbial decomposers. Fungal communities are less affected by pH than bacteria, possibly owing to a wider pH tolerance by this group. On the other hand, bacterial pH optima are constrained to a narrower range of pH values. The microbial decomposition of litter is universally nutrient limited; but few comparisons exist between terrestrial and aquatic systems.

We investigated the microbial colonisation and decomposition of plant litter along a fertility gradient, which varied in both pH and N availability in both soil and adjacent water. To do this we installed litterbags with birch (Betula pendula) in streams and corresponding soils in adjacent riparian areas in a boreal system, in Krycklan, Sweden. During the four months covering the ice-free growth season we monitored the successional dynamics of fungal (acetate incorporation into ergosterol) and bacterial growth (thymidine incorporation), microbial respiration in leaf litter, and quantitative and qualitative changes in litter over time.

We observed that bacterial growth rates were initially higher in litter decomposing in streams than those in soils, but differences between terrestrial and aquatic bacterial production converged towards the end of the experiment. In litter bags installed in soils, bacterial growth was lower at sites with more acidic pH and lower N availability, while aquatic bacteria were relatively unaffected by the fertility level.

Fungal growth rates were two-fold higher for litter decomposing in streams than in soils. In aquatic systems, fungal growth was initially lower in low fertility sites, but differences gradually disappeared over the time course. Fungal growth rates measured on litter-bags in soils were relatively stable over time, with unclear links to fertility. Microbial respiration rates were highest in litterbags buried in soils, and only initially negatively affected by pH. There was a large decrease in litter mass loss initially in aquatic systems. Subsequently the rates of loss stabilized to similar values to those in terrestrial systems, to finally be exceeded by the rates of loss in terrestrial systems.

In conclusion, initial decomposition of litter appeared to be N-limited in aquatic systems, which was associated with a fungal dominance. In contrast, litter decomposition in terrestrial systems appeared to be lower in acidic sites, which coincided with lower growth rates of bacteria. Litter degradation was initially faster in aquatic systems, but overall mass-loss over the full time course was higher in terrestrial systems.