Leaf nutrients and macroinvertebrates control litter mixing effects on decomposition in temperate streams

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Abstract

Plant litter decomposition is an essential ecosystem function that contributes to carbon and nutrient cycling in streams. The composition of both plant and decomposer communities are major determinants of the decomposition rates and the interactions (synergistic *vs.* antagonistic) occurring in litter mixtures. However, the extent to which such litter mixture interactions are affected by combined shifts in litter traits and decomposer community are not well understood. We used leaf litter from 10 European tree species in order to evaluate how litter mixture effects occurring in two-species litter mixtures are affected by litter nutrients in a temperate forested stream of northwestern France. The study distinguished between (i) decomposition involving microorganisms alone or microorganisms together with invertebrates, and (ii) decomposition involving litter mixtures of similar litter quality (two nutrient-poor or nutrient-rich litters) or of dissimilar litter quality (one nutrient-poor and one nutrient-rich litter). The highest litter mixture effects occurred in mixture containing two nutrient-rich litters, rather than in the mixture of dissimilar litter quality. Moreover, the synergistic effects of litter mixing were found to occur only in macroinvertebrate presence. Both the community weighted mean traits (TraitCWM) and the functional dissimilarity of litter traits (TraitFD), as metrics of the mass-ratio and niche complementarity mechanisms, respectively, contributed to explain litter mixture effects. TraitCWM was found to be a better predictor than TraitFD. No evidence was found of the TraitFD effect in the presence of macroinvertebrates, while both TraitCWM and TraitFD contributed to litter mixture effects driven by microorganisms alone. Finally, when evaluated separately the individual contributions of litter nutrients, calcium and magnesium appeared as important drivers of litter mixture effects. As litter decomposition is mainly controlled by macroinvertebrates in temperate streams, our findings suggest that the mass-ratio hypothesis overrules the niche complementarity hypothesis as a driver of litter diversity effects.

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