Assessing interactive effects of nutrients and temperature on headwater ecosystem functioning: a correlative approach along natural gradients

Jeremy Jabiol*†[1], François Guérold[2], Baba Issa Camara[2], Michaël Danger[2], Franck Gilbert[1], Alice Gossiaux[2], Antoine Lecerf[1], Pascal Poupin[2], and Eric Chauvet[1]

[1]Laboratoire Ecologie Fonctionnelle et Environnement (EcoLab) – CNRS : UMR5245, Institut National Polytechnique de Toulouse - INPT, Université Paul Sabatier-Toulouse III - UPS – France
[2]Laboratoire Interdisciplinaire des Environnements Continentaux (LIEC) – CNRS : UMR7360, Université de Lorraine – France

Abstract

Among global change drivers, increases in temperature and nutrient availability have often been pointed out as among the most widespread and alarming threats to the integrity of ecosystems. They have been shown to enhance leaf litter decomposition – a key process in stream ecosystems – through increased metabolism and relaxed nutrient limitation. However, the consequences of concomitant rises of both factors are far less understood and could lead to unexpected, non-additive alterations of ecosystem processes.
In an extensive experiment we studied the decomposition of hazelnut (*Corylus avellana*) leaf litter in 12 headwater streams from 2 regions, exhibiting contrasted average water temperature and dissolved nitrate concentrations. By repeating the experiment in each season our study encompassed a wide temperature gradient and relied on a total of 48 temperature × [nitrate] combinations. Moreover, using coarse and fine mesh bags to enclose leaf litter allowed to discriminate microbially and macroinvertebrate-driven decomposition.
In our study, decomposition rates were primarily explained by season, and they increased with stream temperature. The effect of [nitrate] per se was of lower importance, but a positive significant interaction between [nitrate] and temperature, indicating synergistic effects, was found. Finally, decomposition rates in coarse mesh bags was 4 times faster than in fine mesh bags. Such a mesh size effect was however less important in summer than in other seasons, which is interpreted as a consequence of the phenology of stream invertebrate dynamics.

Keywords: Leaf litter, temperature, nitrogen, decomposition, season, stream, aquatic hyphomycetes, invertebrates

*Speaker
†Corresponding author: jeremy.jabiol@univ-tlse3.fr