Environmental drivers of leaf litter decomposition in streams

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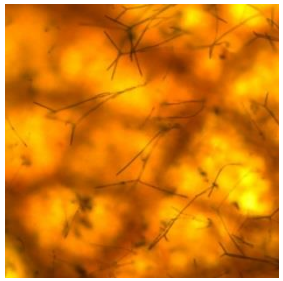
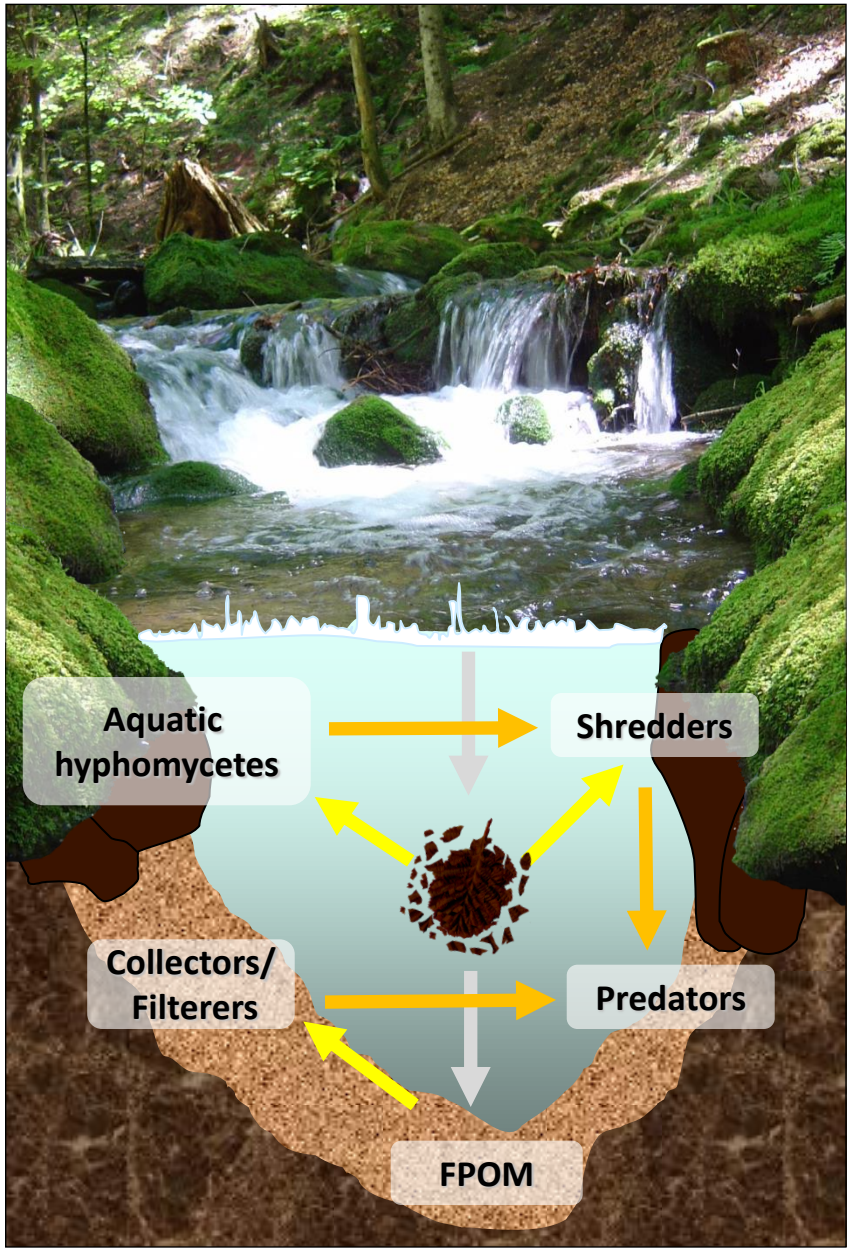
food webs of forested streams

Aquatic hyphomycetes



Collectors/Filterers



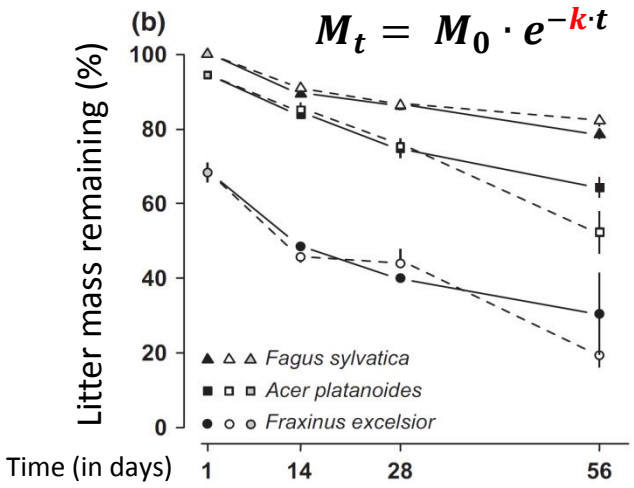
Shredders

Predators

leaf litter decomposition

Abiotic factors

Biotic factors



Bruder et al. (2014) Freshwater Biology

Abiotic factors

> Temperature

> Dissolved chemicals

> Pollution

> Flow velocity

> …

Biotic factors

> Litter characteristics

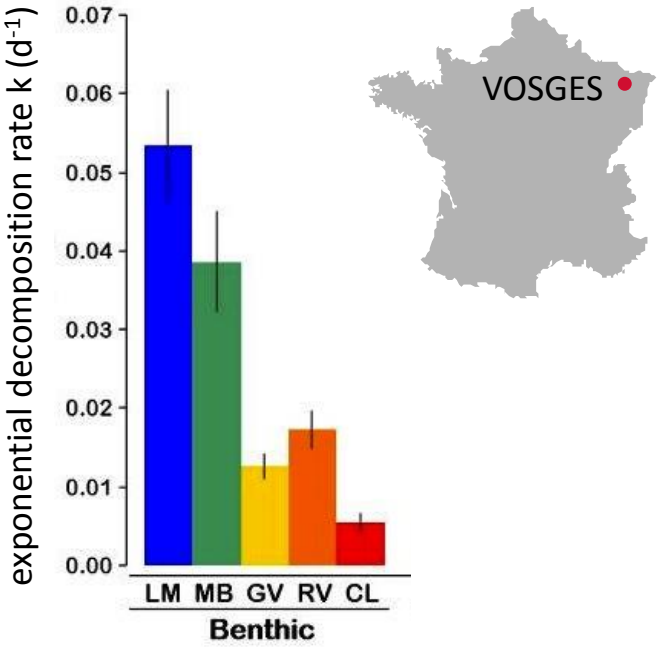
> Biodiversity

> Community composition

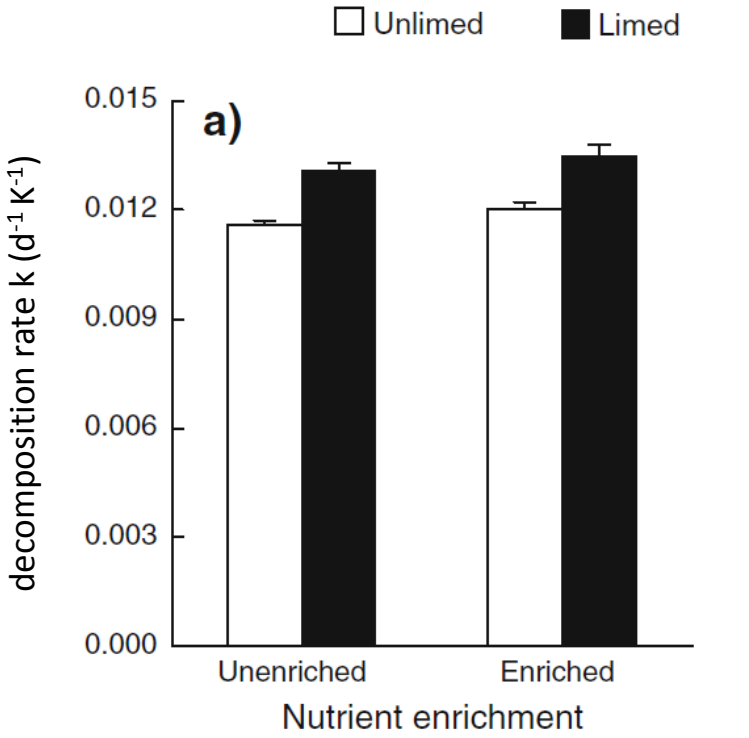
> …

role of abiotic conditions

acidification



Stream	LM	MB	GV	RV	CL
pH	7.4	7.0	6.4	6.1	4.6

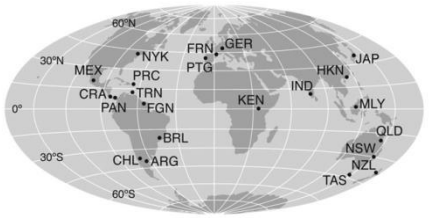


McKie et al. (2009) Oecologia

In this study, effects of acidification on fungal and shredder biomass was small > but negative effects on their activity and in turn on decomposition

role of abiotic conditions

temperature and latitudinal gradient (and decomposer groups)



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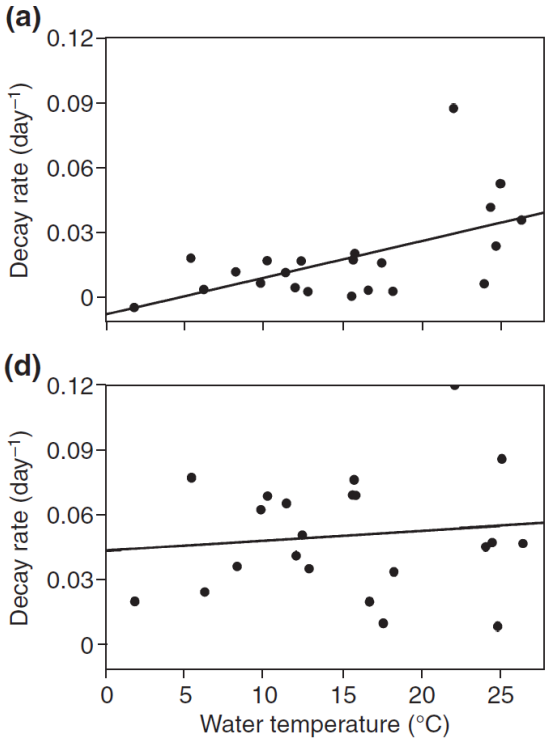
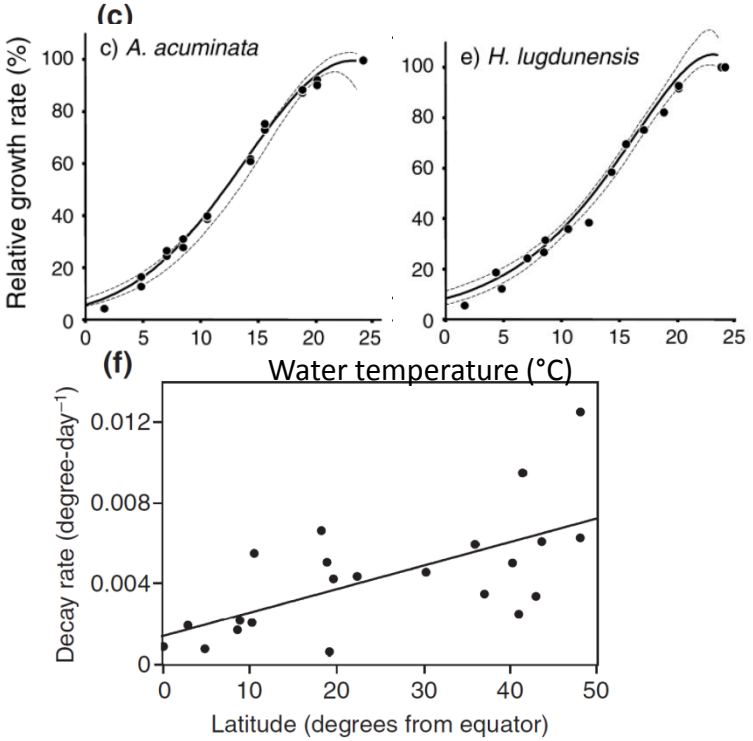


Boyero et al. (2011) Ecology Letters



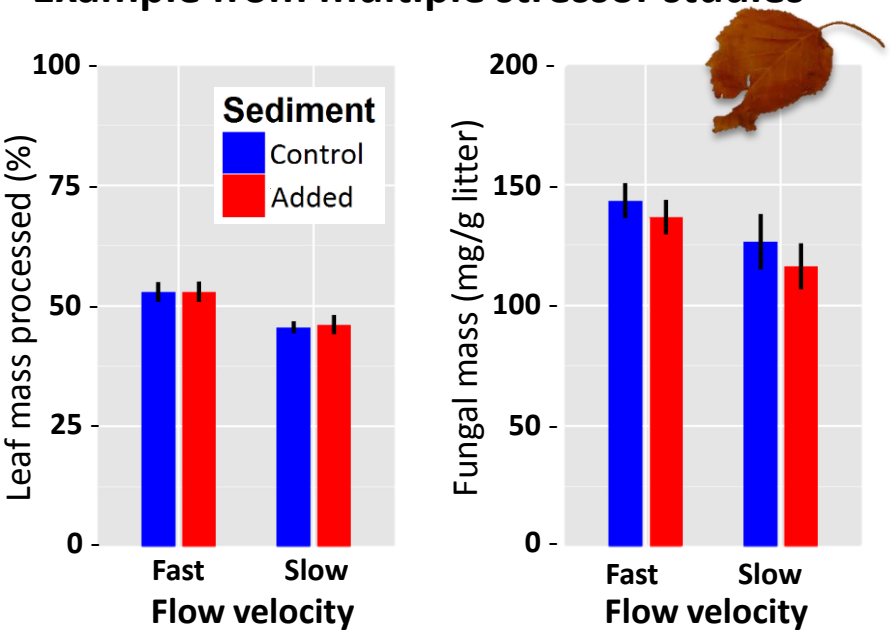
Dang et al. (2009) Ecology

Activity of fungi and shredders respond differently to temperature and latitude
> climate warming could change their relative importance for litter decomposition and affect the carbon cycle

role of abiotic conditions

flow velocity and fine sediment

Example from multiple stressor studies



Bruder et al. (2016) Functional Ecology

Outdoor/streamfed

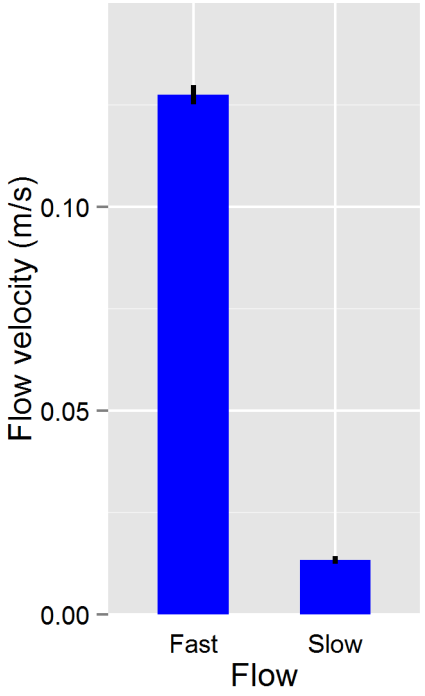
N:	128
Area	0.045 m^2
Discharge:	2 $L \cdot min^{-1}$
Volume:	3 L
Sediment:	0.5 L
Res. Time:	75s

Slow flow velocity reduces litter decomposition rate and fungal biomass
> situations comparable to littoral zones of forested lakes?

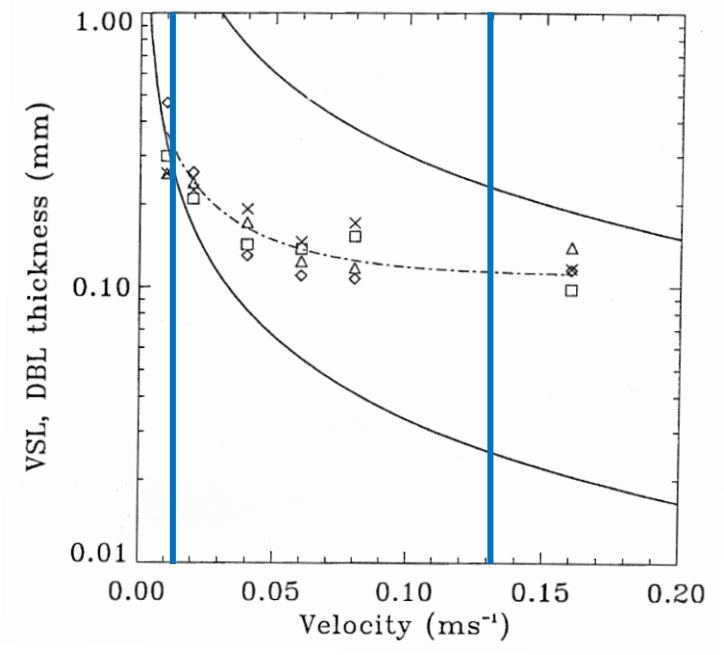
role of abiotic conditions

flow velocity and fine sediment

Measured flow velocity

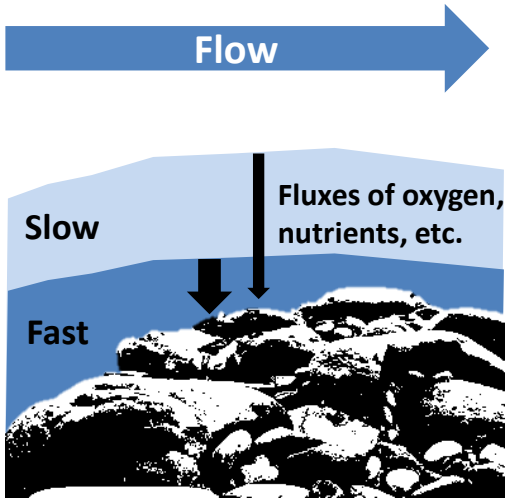


Flow velocity effects on boundary layer



mod. from Stevens & Hurd (1997) Hydrobiologia

Boundary layer effects on benthic habitat

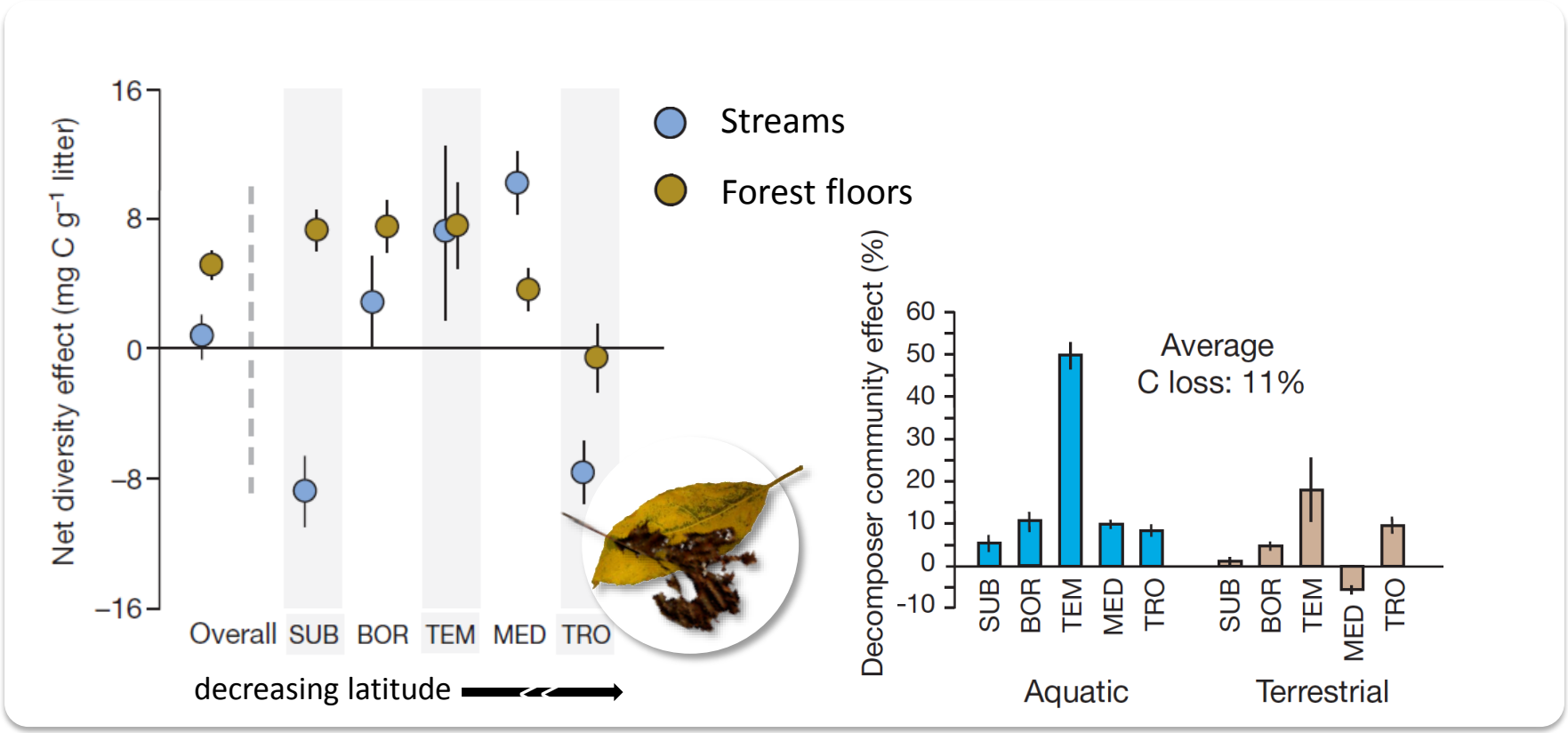


Fluxes = *f*(boundary layer thickness) = *f*(flow velocity)

Effects on physicochemical conditions in/on the sediment with consequences on organisms and biological processes

role of biodiversity

leaf litter diversity (and biome effects)

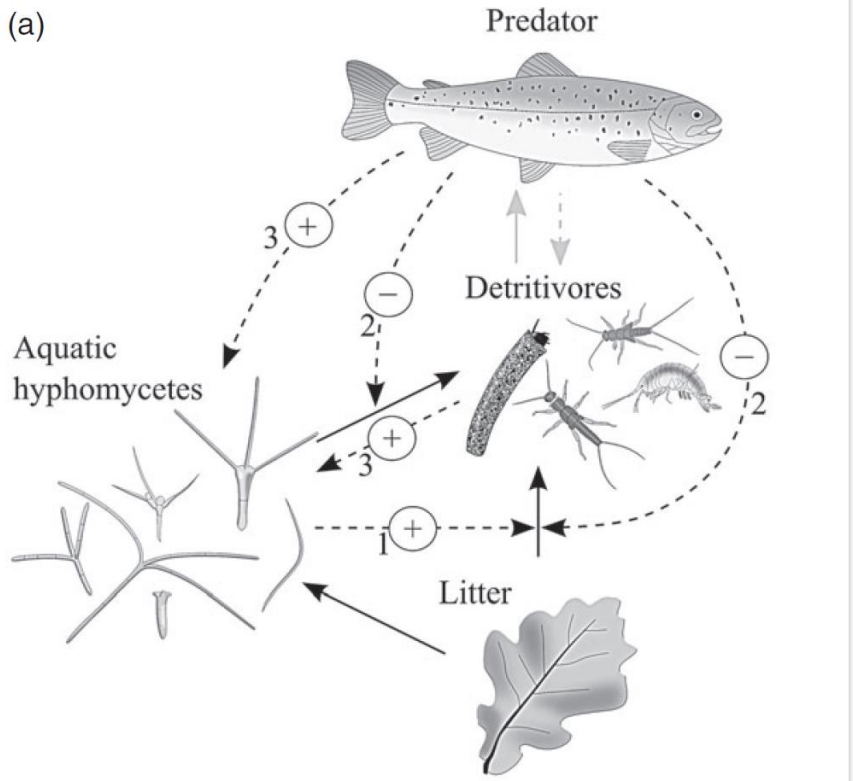


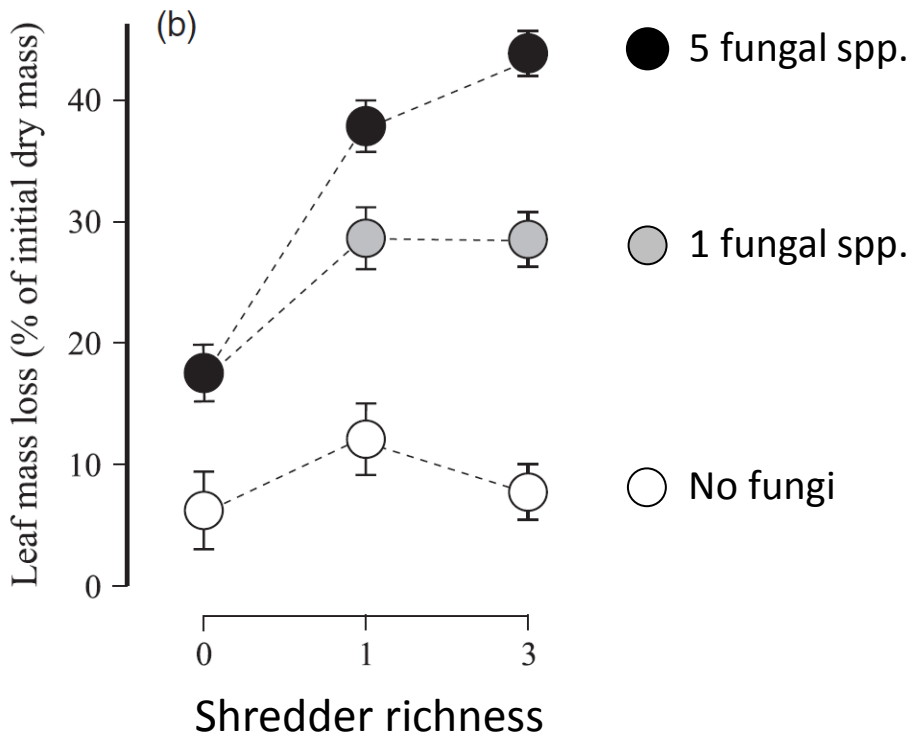
Species identity and environmental conditions dominate diversity effects

Handa et al. (2014) Nature

role of biodiversity

Decomposer diversity (and food-web complexity)





Both vertical and horizontal diversity influences litter decomposition rates

Jabiol et al. (2013) Journal of Animal Ecology

conclusions

Litter decomposition is sensitive to environmental conditions but:

> response depends on specific ecological and environmental situation

> can be different for the main decomposer groups (fungi *vs* shredders)

> depends on biodiversity *but* the picture is not very clear for aquatic situation

Part of ecological variation could be reduced using standardized substrate:

> for instance cotton strips (mainly cellulose)

> this approach is used in the ICP IM indicator *Microbial Decomposition* but also in other global studies (e.g. CELLDEX – testing decomposition in streams and riparian vegetation)

> results are transferable between studies using leaf litter and those using cotton

Thank you for your interest

and the Swiss Federal Office for the Environment (FOEN) for financial support to participate at the ICP IM TF Meeting