

Project title:

Variation of litter decomposition across a European gradient

Promoter: Jutta Stadler, Mark Frenzel & the multisite experiment group

1. Aim (for EnvEurope and LTER)

Mobilization of nutrients that are necessary for increased primary production is expected to increase in alpine/arctic environments because of soil warming - this will lead to higher levels of microbial activity and increased decomposition. At the same time northerly movement of plant species will *tend* to be associated with an influx of less recalcitrant litter, which will also help speed up this decomposition cycle and enhance nutrient availability. However this would only be the case for soils where low temperatures slow decomposition. In other soils climate change may not be associated with increased nutrient availability - in oceanic systems increasing rainfall might further limit decomposition through enhanced peat formation, while in water-limited Mediterranean systems (for example) climate change would be associated with drought and reduced nutrient availability. Therefore, drought is expected to counteract the effects of elevated temperature in terms of nutrient mobilization. See EU funded project CLIMOOR and VULCAN (see Publications in Ecosystems (2004) Vol.7 (6)).

2. Research questions and Hypothesis (500 words)

Why is a harmonised Pan-European investigation of decomposition important?

- The biogeographic gradient covers a variety of biomes and allows to draw general conclusions on ecosystem functioning
- Decomposition is an important ecosystem service and is a surrogate measure for several ecosystem functions
- It is related to carbon sequestration
- It is influenced by global change

Which hypotheses can be tested with this experiment?

- Decomposition rate shows a humped-shaped distribution along the geographic gradient: in boreal as well as Mediterranean ecosystem decomposition will be lower than in Middle Europe due to climatic constraints

- Increase in nutrient availability will increase decomposition rate along the biogeographic gradient in a non-linear way.
- There is a positive relationship between C/N ratio of substrate and decomposition rate
- (The contrast between fast and slow decomposing litter species will be lower in constrained environments)

3. Spatial and temporal coverage

Minimum running time 1 vegetation period; “Open End” which means, can run several years

4. Parameters used/needed* (if not only aquatic habitat are to be selected then the parameter group could be enlarged)

Parameter group (theme)	Selected parameter	Details about the parameter	Should be taken from existing data (yes/no)	Feasibility/constraints regarding existing data	Should be recorded in field (A5 work) (yes/no)	feasibility/constraints regarding field sampling
1) Climate and physical variability						
2) Biogeochemistry data						
3) Structure and function of the ecosystems, communities and populations	Decomposition activity Can be conducted both in aquatic and terrestrial ecosystems	Standard litter bags/bait laminas Manipulation of decomposable C-N content of the litter	Yes/no	Easy to do, Financial input as litter bags/baits are expensive; the cheaper variant is to produce baits and bags by oneself, this is time consuming	yes	Easy to do;
4) Human population and economy						

5. METHODS USED

Standard litter bags and bait lamina stripes

We use Litter bags with two different mesh size (5x5 mm and 20x20µm) filled with standard litter substrate (barley) in two different qualities (grown with and without fertilization). The bags were filled with 2g of dried standard litter and placed out in the field for 2, 4 and 10 month. The

remaining standard litter was re-weighed after removal from the field. Furthermore, to test whether an increase in C-or N- content accelerates decomposition activity in relation to temperature/rainfall (represented by the biogeographic gradient), plots were watered with glucose or ammoniumnitrate fertilizer.

To test the general activity of soil organism, bait lamina stripes, filled with a mixture of wheat bran and cellulose, have been placed out into the plots for two weeks. The amount of removed bait material is an indication for the general activity of soil organisms.

6. EXPECTED RESULTS

- Decomposition rate shows a humped-shaped distribution along the geographic gradient: in boreal as well as Mediterranean ecosystem decomposition will be lower than in Middle Europe due to climatic constraints
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7. REFERENCES

Graca M., Bärlocher F. & Gessner M. (Eds.; 2005): Methods to study litter decomposition - a practical guide. Springer Netherlands

Ostrofsky, M.L. (2007): A comment on the use of exponential decay models to test non-additive processing hypotheses in multispecies mixtures of litter. J. N. Am. Benthol. 26(1)

Wardle, D.A. (1992): A comparative assessment of factors which influence microbial biomass carbon and nitrogen levels in soil. Biol.Rev.,67(3)

Scheu, S., Schaefer (1998): Bottom-up control of the soil macrofauna community in a beechwood on limestone: manipulation of food resources. Ecology,79(5)

Bowman et al. (2006): Nitrogen critical loads for alpine vegetation and terrestrial ecosystem response: are we there yet? Ecological Applications,16(3)