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Litter and fauna functional identity effects on litter degradation

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Main issue : is functional biodiversity as a key driver of organic matter degradation ?

- Soil fauna represents a **huge diversity** of soil animals **involved** in a great number of **soil ecosystem services** (Lavelle et al. 2002, Kibblewhite et al., 2008)
- In spite of their crucial issues, the relations between soil fauna biodiversity and soil behaviour are still poorly understood and very poorly predicted.
- The use of **functional groups** and **trait-based approaches** improved the understanding of soil invertebrate diversity effect on soil functions compared to historically taxonomic approaches.
- **Soil macrodetrivores** roles are pivotal insofar as they are implied in organic matter degradation and participate to the regulation of biogeochemical cycles of elements such as carbon and nitrogen
- Studies using a functional approach mainly concern litter decomposition in **forest systems**. **Meadow systems** are scarcely studied.
- There are only scarce studies which **deals** with **both** **functional diversity** of litter and soil invertebrates.

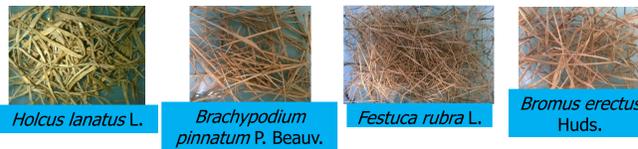
Objectives : assess functional identity of litter and soil invertebrate effects on degradation in meadows

- A first step to contribute to the understanding of the relations between soil invertebrates and litter functional diversity on decomposition in **meadow** systems
- 1) Assess the effect of **functional identity of litters** (through functional group of litters and trait-based approaches) on litter decomposition by soil invertebrates
- 2) Assess the effect of **functional identity of macrodetrivores** (through their functional group) on litter decomposition by soil invertebrates

Materials & Methods : combining litter and soil macrodetrivore with different functional identities (FI)

Litter selection

Four species of forage grasses were chosen for their litter. They belong to different plant **functional groups (FG)** based on a trait analysis related to palatability (Cruz et al., 2010). We made the hypothesis that they will contribute differently to the litter decomposition)



Experimental design and analysis

Plants and macrodetrivores were put in monospecific combinations in plastic boxes (120 x 90 x 50 mm) = 4 litter FG * 3 macrodetrivore FG = 12 treatments. Four additional treatments were made of each of litter FG without fauna. Four replicates were made.

HL/AV	HL/GM	HL/PM	HL
BP/AV	BP/GM	BP/PM	BP
FR/AV	FR/GM	FR/PM	FR
BE/AV	BE/GM	BE/PM	BE

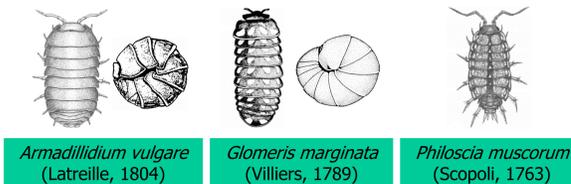
At day 7

Litter consumption

Faecal pellet production

Macrodetrivore selection

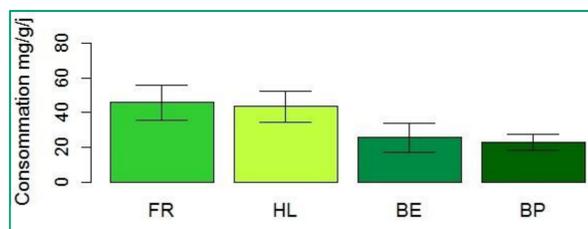
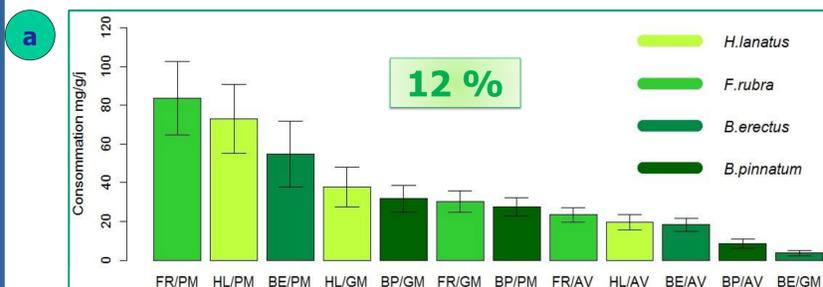
Three species of macrodetrivores were chosen for (i) their **dissimilar ecological and morphological characteristics** and (ii) **because they are common in temperate climate**. We made the hypothesis that they will contribute differently to the litter decomposition. They are thus considered as three different **functional groups (FG)**.



Litter traits

Measures were done on the litter : C, N, P and water holding capacity. Mean litter and plant measures (the study of Cruz et al., 2010) were used as litter traits. Standard errors (d) were used as traits to express litter plasticity.

Litter degradation depends on litter functional groups (a) and on particular litter and plants traits (b) ...



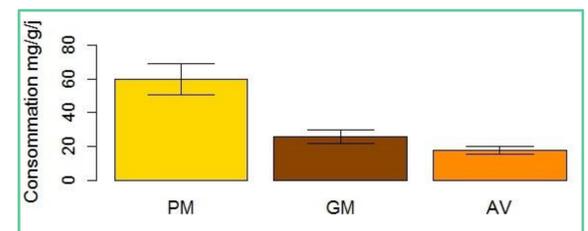
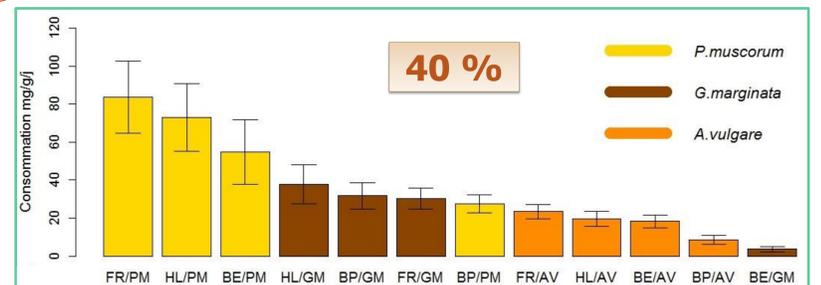
We performed a two-ways ANOVA on litter consumption with the functional group of litter and the functional group of macrodetrivore as factors. The consumption values were corrected with respect to the control in order to remove the effect of factors other than macrodetrivore effects on degradation. The consumption of litter was expressed as dried litter consumed per gram of biomass per day.

Results demonstrate that 12% of the litter consumption was explained by the litter functional group. The *Festuca rubra* and the *Holcus lanatus* present a higher degradation than *Bromus erectus* and *Brachypodium pinnatum*. Results for faecal pellet production were similar.

	<i>A.vulgare</i>		<i>G.marginata</i>		<i>P.muscorum</i>	
	Consumption	Production	Consumption	Production	Consumption	Production
dC	-	-	0.33	0.43	-	-
N	0.33	0.34	+ Chemical traits		0.24	0.30
P	0.29	0.30	+ Chemical traits		0.19	0.21
C/N	0.35	0.34	+ Chemical traits		0.26	0.25
TMS	0.34	0.31	-	-	0.24	0.21
dTMS	-	-	0.59	0.45	-	0.21
RES	+ Physical traits		0.61	0.53	-	-
dRES	+ Physical traits		0.40	0.26	-	0.33
dSSF	-	-	0.28	0.39	-	-

Linear correlations of litter consumption and faecal pellet production against litter and plant trait data were performed. Only significative correlations with a minimum R² of 20% were presented. First result is that there is no trait which is correlated neither to litter consumption nor faecal pellet production for the whole invertebrates. Second results are that consumption and production were mostly explained by chemical traits (mean) for *A. vulgare* and *P. Muscorum* whereas by physical traits (standard errors) for *G. marginata*. Litter traits = C : carbon, N : Nitrogen, P : Phosphorus. Plant traits = TMS : Dried matter content of water saturated leaf, RES : leaf resistance to breaks, SSF : specific leaf area

... but mainly on macrodetrivore FI.



The ANOVA results demonstrate that 40 % of the litter consumption was explained by the macrodetrivore functional group. The effect of macrodetrivore has a higher effect than the litter functional group.

Necessity to take all trophic levels into account

- > Both the litter and macrodetrivore functional identities are necessary to explain litter degradation
- > The macrodetrivore functional identity effect is however predominant compared to the effect of litter functional group
- > Interactions between the litter and macrodetrivore functional identities explain about 10% of litter degradation (results non presented)

Trait-based approaches to accurate results

- > Some chemical traits (C, P, C/N) mainly explained the litter degradation for some functional groups of macrodetrivores
- > Some physical traits of plasticity (dTMS, dRES, dSSF) explained the litter degradation for some others functional groups of macrodetrivores
- > Necessity to use a trait-based approaches for the effect of macrodetrivore functional identity

Perspectives

- > Scientific (this experiment) : mesure morphological traits (e.g. size of buccal pieces), faecal pellet traits (e.g. C and N) to better understand the effect of macrodetrivore functional identity effect
- > Scientific (general) : continue to acquire trait data on litter and macrodetrivore to better understand the relationship between soil fauna biodiversity and organic matter
- > Applied : to better manage meadows systems