Invertebrate biodiversity affects algal decomposition in the marine benthos

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Human induced changes to ecosystems have affected biodiversity on a global scale and the extent to which changes in biodiversity are causally linked to ecosystem processes is a primary focus of contemporary ecological research. Data indicate that, irrespective of the system studied, increasing diversity has a linear and positive effect on generative processes such as primary production and above/below ground biomass. We established an *in-situ* mesocosm experiment to investigate how changes in macrofaunal diversity affect decomposition, the complementary process to primary production in the carbon cycle.

Fig. 2: Experimental plot in the Ythan estuary (n = 125). Insert: Mesocosm containing macrofaunal consumers and algal resource was pushed 10 cm deep into the mud

Fig. 1: Macrofaunal invertebrates, (a) *Hediste diversicolor*, (b) *Hydrobia ulvae* and (c) *Littorina littorea*

Methods

- Macrofaunal communities of grazers alone and in combination (Tab. 1)
- 3 macro-algal treatments (n=40 treatment^{-1}): *Fucus spiralis* (low quality); *Enteromorpha intestinalis* (high quality); 50:50 mixture of *E. intestinalis* and *F. spiralis* (intermediate quality)
- Algal biomass loss as a proxy for decomposition
- Determined sediment surface microbial activity (INT-F production, nmol g^{-1} h^{-1})
- **Statistical analysis:** Extended linear regression with generalised least squares (GLS) estimation using variance covariates to model the variance structure (Pinheiro & Bates, 2000).

Tab. 1: Macrofaunal combinations and biomass (g mesocosm^{-1}) for each algal treatment. SR = Species richness, ID = invertebrate identity

SR	ID	*H.diversicolor*	*H. ulvae*	*L. littorea*
0	0			
1	1	1		
1	2		1	
1	3			1
2	4	0.5	0.5	
2	5	0.5		0.5
2	6		0.5	0.5
3	7	0.3	0.3	0.3

Results

1) Increased benthic macrofaunal diversity enhances macro-algal decomposition on intertidal mudflats ($p<0.05$).

2) But, effects are modified by **algal identity × microbial activity** ($p<0.01$) (Fig. 3.) and **invertebrate identity × algal identity** ($p<0.0001$)(Fig. 4).

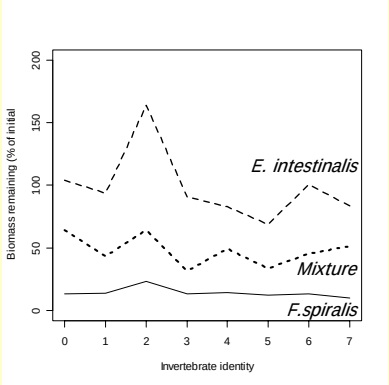

Fig. 4: The effects of species richness on algal decomposition per se. Model visualisation of the interaction algal identity × invertebrate identity. Invertebrate identity combinations see Tab.1.

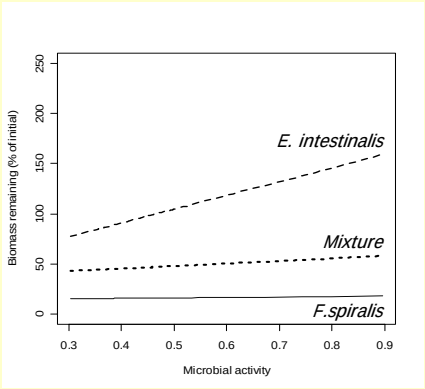

Fig. 3: The effects of species richness on algal decomposition per se. Model visualisation of the interaction algal identity × microbial activity.

Conclusions

- Our study reveals clear and positive effects of increased invertebrate species richness on algal decomposition, although algal and invertebrate identity effects, as well as microbial activity, contribute and modify the decomposition process.
- Overall, *L. littorea* had the greatest impact on algal decomposition, followed by *H. diversicolor* and *H. ulvae*. The differential contribution of each species reflects species-specific traits that relate to algal consumption and processing.

References
Pinheiro & Bates (2000) Mixed-Effects Models in S and S-PLUS. Springer, New York

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Paper currently in review for publication in Ecology