Long term beach nourishment impacts in interaction with environmental factors on the abundance of four dominant intertidal macro invertebrate species

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Coastal squeeze is the largest threat for sandy coastal areas, beaches are trapped between sea level rise and coastal development. To mitigate the seaward threats - erosion and sea level rise, sand nourishments are commonly applied. However, its long term consequences on the beach macro invertebrate fauna are still unknown. We investigated the recovery times of four dominant intertidal macro invertebrates after beach nourishment and how their demands on their habitat modify their responses to beach nourishment.

Figure 1. Sampled beaches

Sampling

A chronosequence of 13 nourished and 4 control (nrs. 2, 4, 10, 16) beaches was sampled (fig. 1), with 20 stratified random samples for fauna and sediment between MTL and MHW, and beach characteristics were recorded.

Results

There was no effect of nourishment year on the individual species (fig. 2). Nourishment year explained only 1.74% of the community abundances (fig. 3). However, removing nourishment year from the analysis made the first axis insignificant. This suggests that the effect of nourishment year can only be detected when distributing the variance in species abundances across all relevant sources. Moreover, regression of the multivariate regression models' residuals and nourishment year showed a nearly significant positive effect on *S. squamata* (table 1).

RDA and multivariate regression showed that each species had different responses to the environment (table 1) and that latitude and morphological and sand characteristics were important (table 1 and 2).
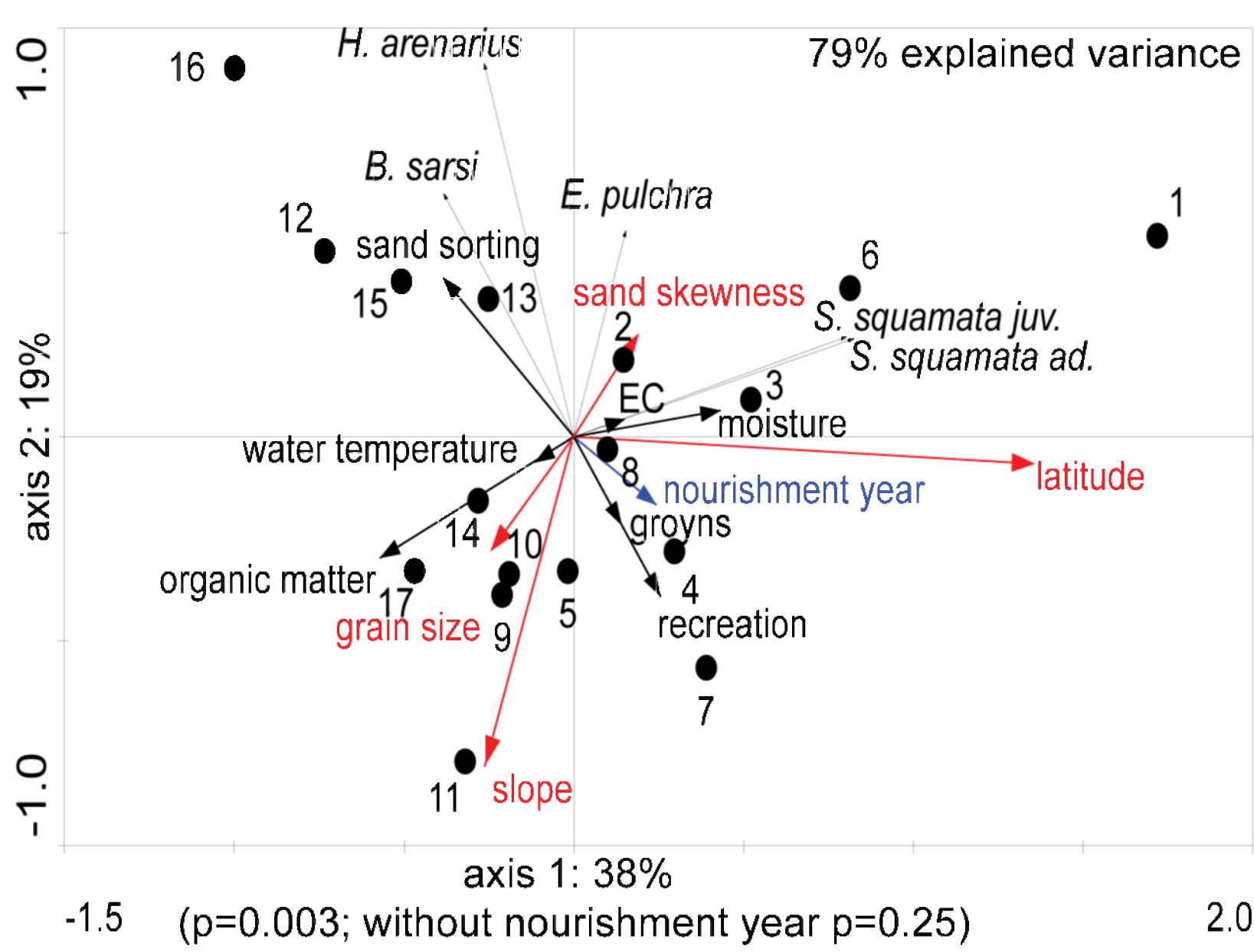

Figure 2. Single regressions year - abundance
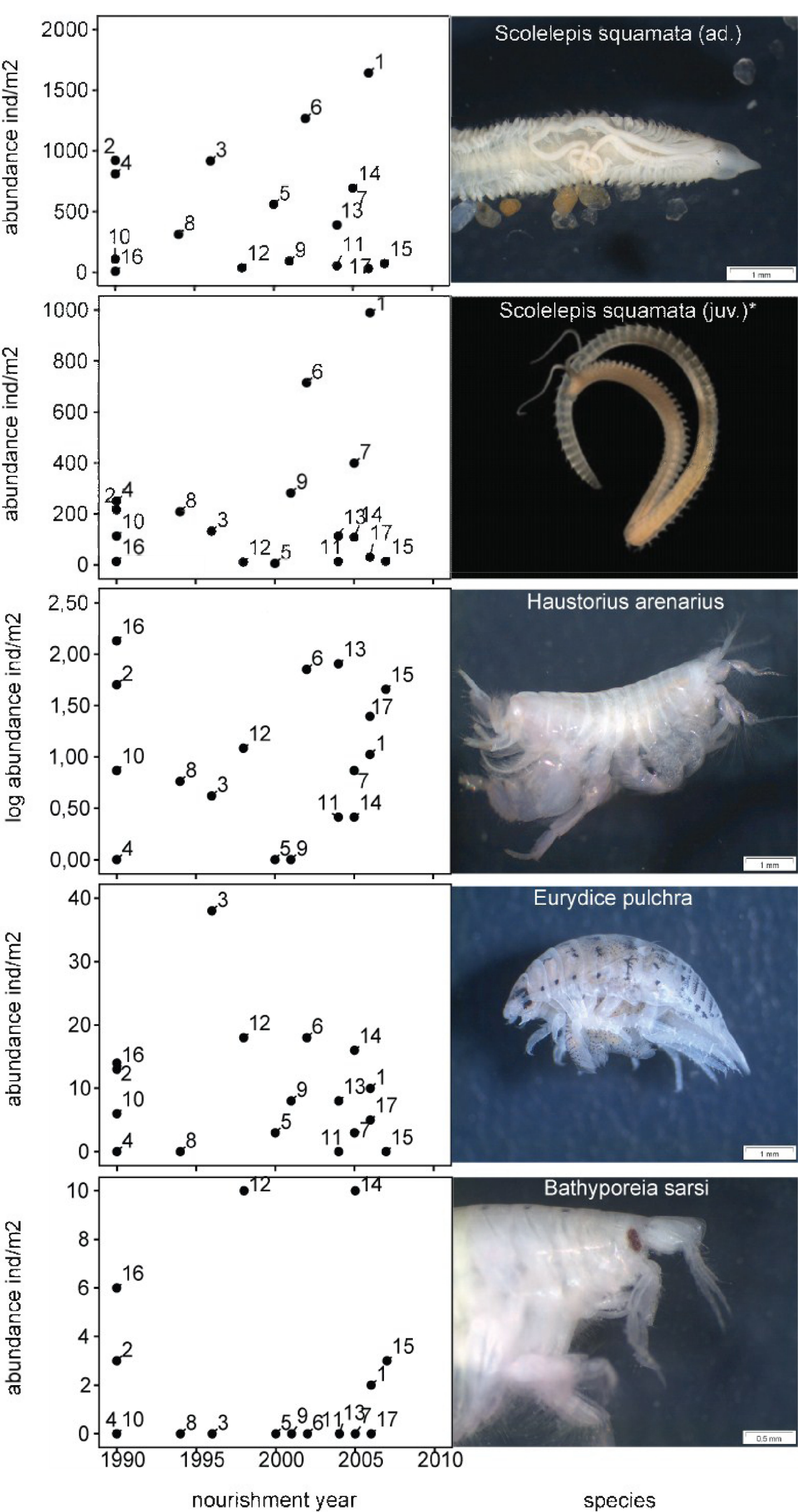

Figure 3. Redundancy Analysis (RDA)

Table 2	variance explained	p
latitude	24.9%	0.002
sand skewness	8.1%	0.038
slope	10.7%	0.058
grainsize	7.4%	0.114

Table 1	forward selection			year * residuals	
*Log transformed	Variable	R^2	P	R^2	p
S. squamata (ad.)	Latitude	0,648	0,000	0,218	0,059
S. squamata (juv.)	Latitude + grainsize	0,648	0,001	0,164	0,107
H. arenarius*	SK + slope + latitude	0,833	0,000	0,009	0,717
E. pulchra	-	-	-	-	-
B. sarsi	Sorting	0,414	0,005	0,001	0,893

Conclusions and management implications

We found no negative long term consequences of beach nourishment on the abundance of the sampled species, and all species seemed to have recovered within one year. *S. squamata* even profited from beach nourishments, confirming its opportunistic nature. Previous studies focussed on species richness and total abundance, but we found responses to the environment to be species specific. This shows the importance of knowing the autecology of the macro-invertebrate fauna of a sandy beach to mitigate impact effects. Moreover, slope and sediment characteristics (including sorting and skewness) of a beach nourishment should be matched with the original beach.

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