THE ROLE OF BIOLOGICAL DISTURBANCE IN MAINTAINING DEEP-SEA BIODIVERSITY

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Challenge

The most striking finding in biological oceanography over the past decades was the discovery of an extremely high biodiversity in the deep-sea realm.

Different, even controversial hypotheses have been established to explain the high species richness of deep-sea sediments.

The Intermediate Disturbance Theory (Connell, 1978) and the Spatial Temporal Mosaic Theory (Grassle, 1989) implicate the impact of small-scale, recurring biological disturbances in providing habitat complexity of deep-sea sediments. Such disturbances would be effective in maintaining co-existence of large numbers of species by contributing to niche diversification.

By means of *in situ* caging experiments, this study aims at testing the hypothesis that small-scale heterogeneity in sediment structure and physico-chemical properties, created by larger motile benthic deep-sea species are important in promoting high biodiversity in small-sized organisms at the deep-sea floor.

Study Design

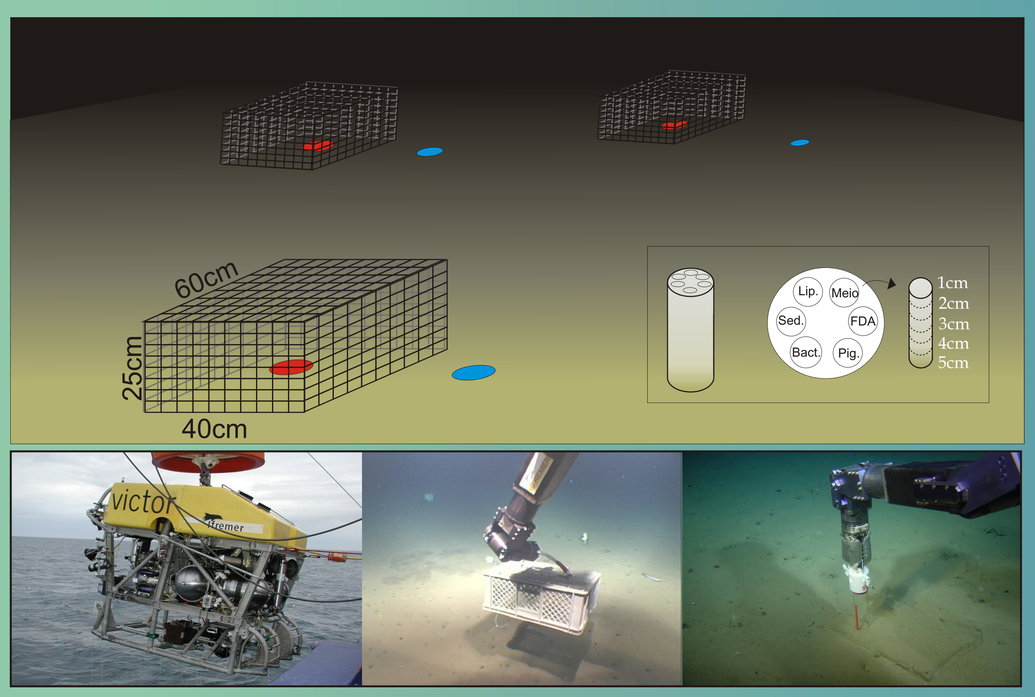

Fig.1. Scheme of experimental and sampling design (above) and the deep-diving Remotely Operated Vehicle (ROV) "VICTOR 6000", the deployment of one of the cages and push-coring under one of the cages (below).

Exclosure experiments were conducted *in situ* at the arctic deep-sea long-term station "Hausgarten", west of Spitsbergen, to follow the development of deep-sea meiobenthic communities when predation/disturbance by larger benthic organisms is excluded.

By means of the deep-diving Remotely Operated Vehicle "VITOR 6000", six plastic cages were deployed at the seafloor at 2500 m water depth and were sampled after 4 years.

One push-core was taken from under each cage (●) and, as a control (●), one push-core was sampled beside each cage. From each push-core, 6 subsamples were taken for: 1) Meiofauna (focus on nematode communities), 2) Chloroplastic pigments (chl.*a* and phaeopigments, indicating the availability of organic material), 3) Phospolipids (indicating total microbial biomass), 4) Fluorecein-di-acetate (FDA, estimating the potential bacterial exo-enzimatic activity), 5) bacteria (estimates of biomass and diversity), and 6) sediment grain size analysis.

All subsamples were sectioned horizontally in 1-cm-layers to investigate gradients within the sediment column .

Preliminary Results

The meiofauna was represented by 13 taxa (12 under the cages and 10 in the controls). Nematodes dominated all samples both inside and outside the cages, representing 95%of the total meiofauna. Other meiofauna taxa represented each less than 2 % of the total metazoan fauna.

Chlorophyll *a*, which indicates the availability of fresh organic material, was significantly higher at the 1st cm under the cages than in the controls ($p<0.05$).

Meiofauna densities and the other parameters on Fig.2, although had mean values generally higher under the cages, showed no significant differences between cages and controls at all sediment depths ($p>0.05$).

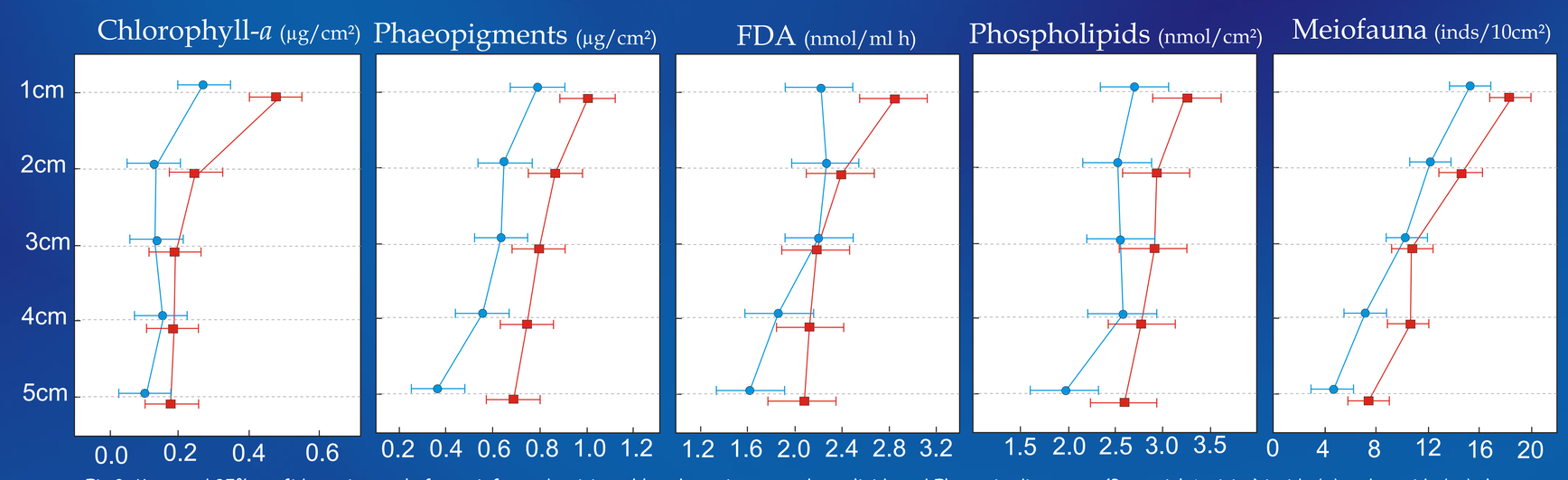

Fig.2. Mean and 95% confidence intervals for meiofauna densities, chl.a, phaeopigments, phospolipids and Flurecein-di-acetate (Bacterial Activity) inside (■) and outside (●) the cages.

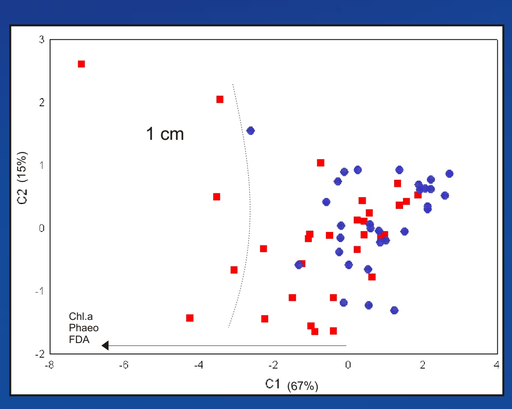

Fig.3. PCA plot on the parameters showed on Fig.2

The C1 of a correlation-based PCA on all parameters separated mainly the samples from the 1st cm under the cages from all the others. This variation along C1 was primarely explained by Chl. *a* and Phaeopigment concentrations as well as Bacterial Activity (FDA).

First Conclusions and Next Steps...

There was a significant increase in food availability in the 1st cm under the cages. This can be a result of (a) increased deposition due to cage artefacts or (b) absence of grazing and/or sediment disturbance and consequent food redistribution by megafauna. Further investigations are needed.

Both absence of megafauna and increased food availability showed slight effects on meiofauna densities and microbial biomass (phospholipids).

Our next step will be to unravel if the absence of biological disturbance will affect bacteria and nematodes diversity. For that, nematodes (95 % of total meiofauna) will be identified to putative species level and bacteria diversity will be estimated by Fluorescence *in situ* Hybridization (FISH).

References

Connell JH, 1978. Diversity in tropical rain forests and coral reefs. Science 199: 1302-1310

Grassle JF, 1989. Species diversity in deep-sea communities, Trends in Ecology and Evolution 4: 12-15