Regional and local-scale variation in benthic megafauna from the LTER observatory HAUSGARTEN in the Arctic

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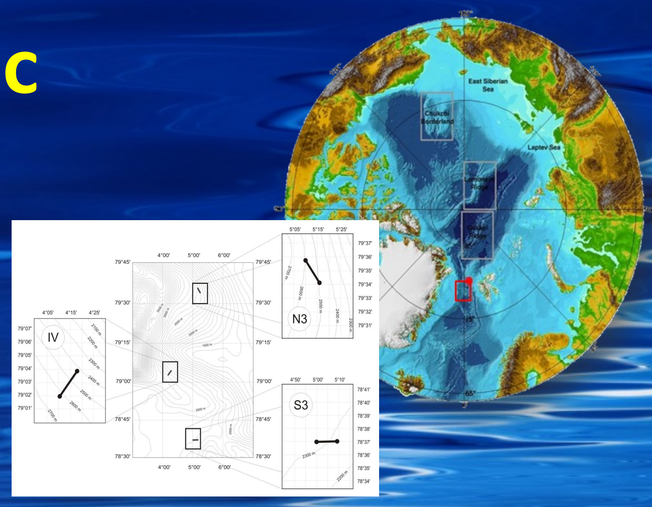
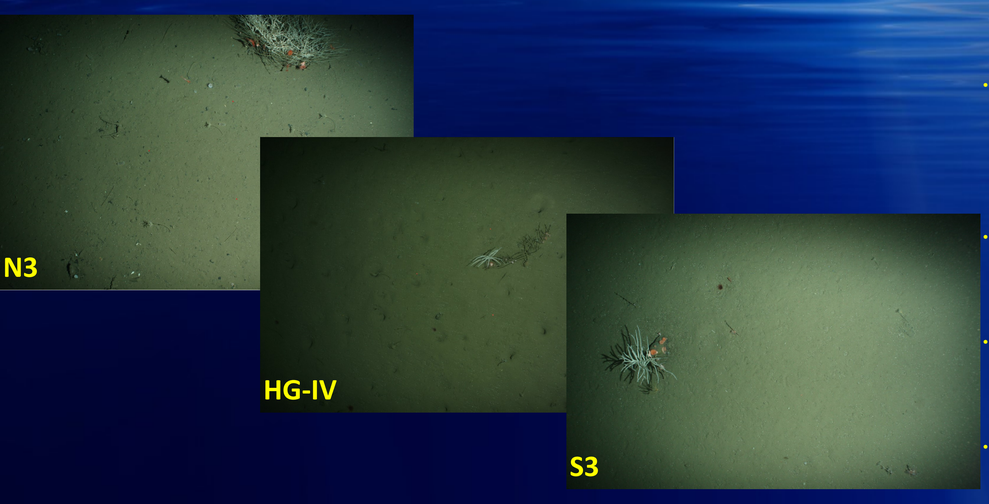


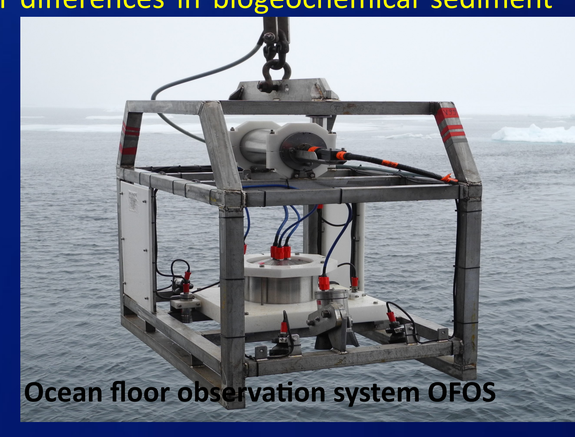


Background

- In 1999, the AWI established the LTER observatory HAUSGARTEN in the eastern Fram Strait to study the impact of global warming. Three stations of the observatory are located along a latitudinal transect to assess the influence of the marginal ice zone
- Epibenthic megafauna are biota > 1.5 cm that inhabit and structure the sediment-water interface and the benthic community
- Here, we assess regional and local-scale variability in the megafaunal community by analysis of seafloor photographs from the latitudinal gradient
- We assess total megafaunal abundance and composition in the context of differences in biogeochemical sediment parameters and sea-ice cover to interpret the observed variability

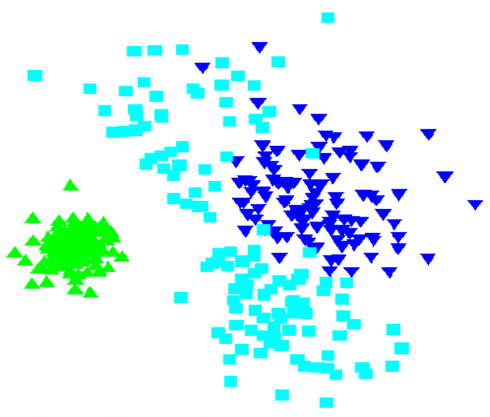
Methods

- Images were taken at 30-s intervals by a towed camera system (OFOS) at HG stations N3, HG-IV & S3 (2500 m depth, 1.5 m altitude) in 2011
- Suitable images were analysed manually with the Web 2.0-based software *BIIGLE*
- 29 taxa/morphotypes, which were always recognised with certainty, were used for statistical analysis


Ocean floor observation system OFOS

Results

Regional-scale megafaunal variability

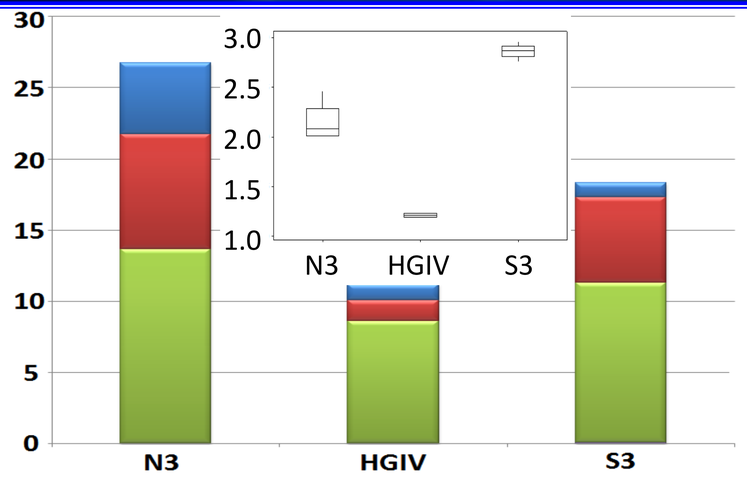


Global R = 0.70, p = 0.021

ANOSIM	*R*
N3 v S3	**1.00**
N3 v HG-IV	0.60
HG-IV v S3	0.41

- Significant regional-scale differences in megafaunal composition
- Dissimilarities between N3 and HG-IV/S3 caused by high sea cucumber (*Kolga hyalina)* (>40 x) and significantly different *Mohnia* spp. and *Bathycrinus carpenterii* densities
- Dissimilarity between HG-IV and S3 due to differences in the abundance of *Gersemia fruti-cosa, B. carpenterii* and *Elpidia heckeri*

Megafaunal densities (ind. m^{-2}) and protein concentrations (mg^{-3})



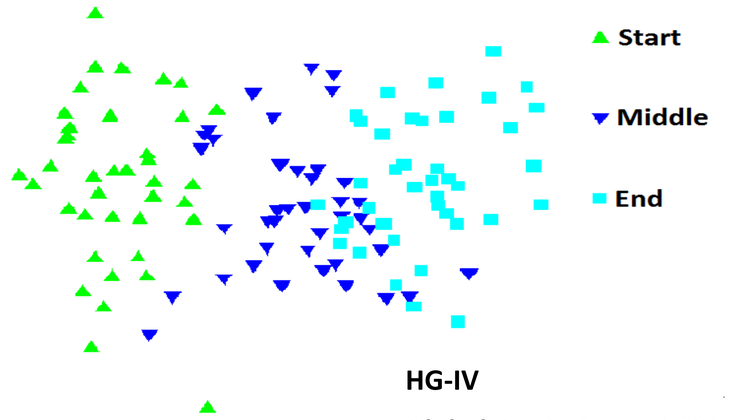
Trophic composition

- Significant regional-scale differences in total megafaunal densities
- Significantly higher densities of predator/scavengers at N3 *cf.* HG-IV/S3
- Significant regional-scale differences in suspension feeder and deposit feeder densities

Sea-ice concentration & sediment parameters

- Significantly more days of sea ice cover along latitudinal gradient (2009 - 2011): N3 (41 days) > HG-IV (22 days) > S3 (2days) (p= <0.0005, χ^2 = 106.50)
- Significant regional-scale differences in sediment protein concentrations (indicator of detrital biomass), not in other parameters

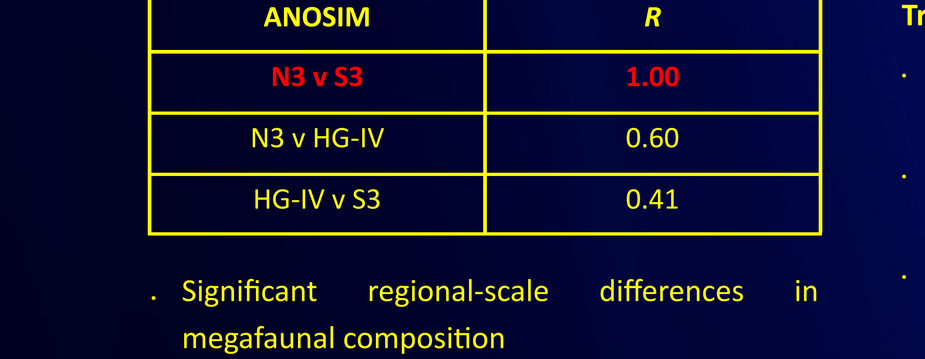
Local-scale megafaunal variability



Global R = 0.58, p = 0.001

ANOSIM	*R*
Start v Middle	0.57
Start v End	**0.88**
Middle v End	0.29

- No significant local-scale variability at N3 & S3
- R = 0.88 suggests almost entirely separate communities at the start and end of HG-IV transect, due to *B. carpenterii, Neohela lamia,* a purple actinarian, *Ascorhynchus abyssi* and *Mohnia* spp.
- Moderate difference between the middle and end



Megafauna from HAUSGARTEN stations used in statistical tests: (A) *Caulophacus arcticus*, (B) *Cladorhiza* cf. *gelida*, (C) Purple actinian, (D) cf. *Bathyphellia margaritacea*, (E) *Gersemia fruticosa*, (F) Hormathiidae, (G) White long-tentacled actinian, (H) *Byglides groenlandica*, (I) *Mohnia* spp., (J) *Ascorhynchus abyssi*, (K) *Neohela lamia*, (L) *Saduria megalura*, (M) *Bythocaris* spp., (N) *Kolga hyalina*, (O) *Elpidia heckeri*, (P) *Bathycrinus carpenterii*, (Q) *Hymenaster pellu-cidus*, (R) *Pourtalesia jeffreysi*, (S) *Lycodes frigidus*

Discussion and Outlook

- Our study is one of few to show local and regional-scale differences in deep-sea megafauna, which has important implications for spatial planning or environmental prospecting (e.g. deep-sea mining, closed areas)
- Local-scale variability was only observed at HG-IV, probably caused by slope along this transect (2,639 -2,407 m depth)
- Results from microbial (Jacob *et al*. 2013) and macrofaunal studies (Vedenin *et al*., subm.) showed no regional scale differences indicating that megafaunal communities operate at different spatial scales.
- Differences were due to variability in relative abundance of taxa rather than different taxonomic inventories
- Large numbers of the sea cucumber *K. hyalina* characterised N3 (= > *Amperima*-like event?)
- Higher megafaunal densities at N3 and differences in the composition indicate sea ice cover as an important factor structuring megafaunal composition at HAUSGARTEN
- With higher abundances and greater trophic diversity being correlated with the health and maturity of an ecosystem it could be argued that N3 is the most established community, followed by S3 and HG-IV
- This is likely to change as the sea ice cover decreases due to global change, which will be addressed in our next study on interannual changes in megafaunal communities

Acknowledgments

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Literature:

Jacob, M., Soltwedel, T., Boetius, A., Ramette, A., (2013) "Biogeography of Deep-Sea Benthic Bacteria at Regional Scale (LTER HAUSGARTEN, Fram Strait, Arctic)" PLoSONE, **8**, e72779.

Vedenin, A., Budaeva, N., Mokievsky, Pantke, C., Soltwedel, T., Gebruk, A., (in submission). "Spatial distribution patterns in macrobenthos along a latitudinal transect at the deep-sea observatory HAUSGARTEN."