Prediction of changes in Arctic benthic ecosystems on the basis of large-scale study of Benthic Biomass Size Spectra

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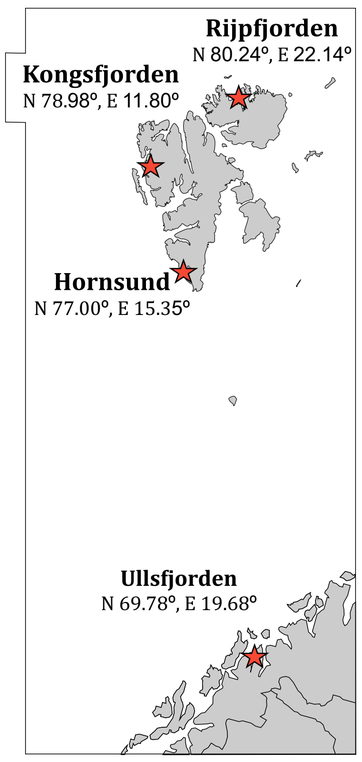
Introduction

Body size is a fundamental biological unit that is closely coupled to key ecological properties and processes. Decline in organisms' body-size has been predicted to be "the third universal response to global warming" (alongside changes in phenology and distribution of species) in both aquatic and terrestrial systems. We present the first assessment of Benthic Biomass Size Spectra along latitudinal/thermal gradient form subArctic to high Arctic to determine possible future effects of global warming on Arctic benthic systems.

Methods

Materials

Macrozoobenthos and sediments were collected from boards of r/v „Oceania" and r/v „Helmer Hanssen" in 4 fjords characterized by different temperature regimes: subArctic (Ullsfjorden, bottom water temperature 6°C), „warm" Arctic (Kongsfjorden, 4°C), "cold" Arctic (Hornsund, 1°C) and cold, high Arctic (Rijpfjorden, -1°C). Based on photosynthetic pigments concentrations in sediments the fjords were classified as high food (Hornsund, Kongsfjorden) or low food (Ullsfjorden, Rijpfjord) localities.

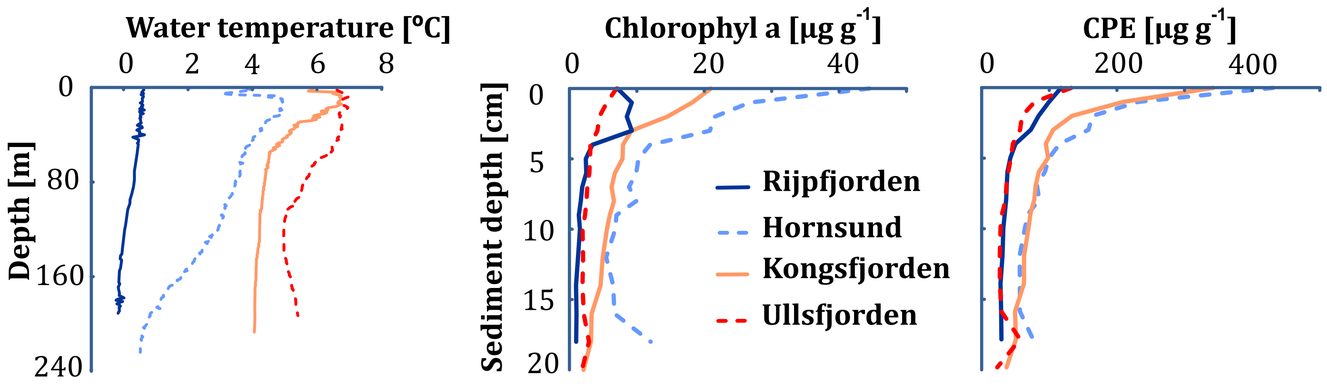


Biomass Size Spectra assessment

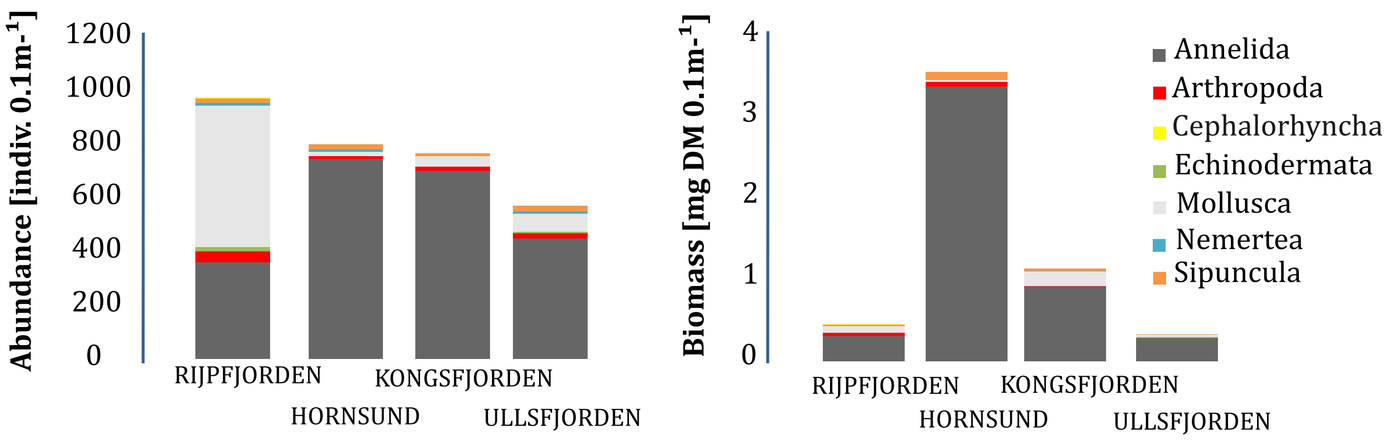
Individual body mass was assessed for every specimen, based on its dimensions measurements and biovolume determination. In case of fragmented polychaetes their total length was assessed using a regression formulas for selected cheatiger width/total animal length relationship. Size classes were defined as Log_2 biomass [ug DM] and Normalized Biomass Size Spectra (NBSS) were plotted after dividing total biomass in each class by the class width.

Results & Conclusions

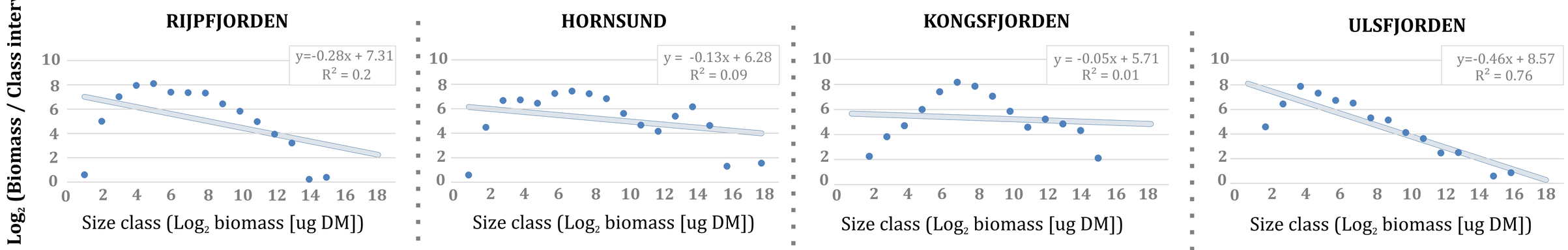
Environmental settings



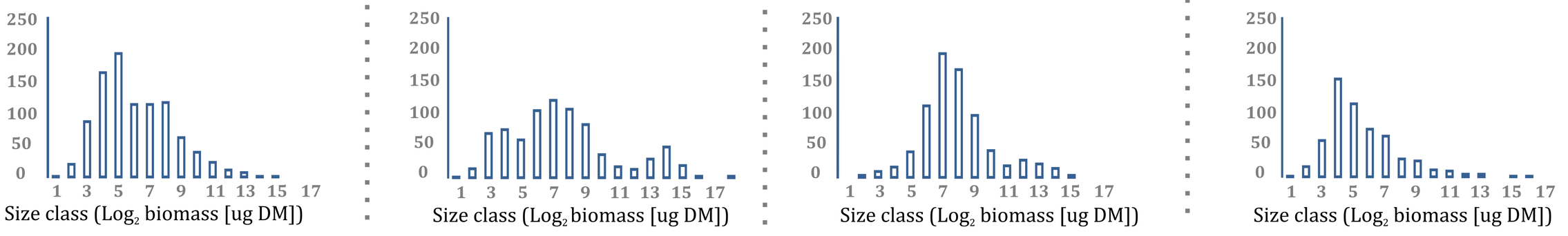
Total biomass & abundance



Normalised Biomass Size Spectra



Abundance Spectra



Increasing temperature

No clear effect of latitude/temperature on benthic size spectra was observed. In more productive fjords both NBSS and Abundance Size Spectra show higher contribution of larger organisms. Our results suggest that productivity and supply of fresh organic matter rather than temperature does impact the size structure and biomass of benthic communities. Instead of warming induced size decline we can expect that increased supply of fresh plant-origin organic matter enhanced by increase of primary production driven by climate change may cause an increase of larger specimens' contribution in Arctic benthic communities. The secondary production may also be altered as it is size-dependent.