Mare Incognitum cruise (r/v Helmer Hansen, January 2015) – report of IOPAN group

Cruise participants (5-16th January 2015):
Maria Włodarska-Kowalczuk (leader of the Polish group)
Joanna Legeżyńska
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The group performed sampling for a few projects undertaken by IOPAN scientists within the scope of the Mare Incognitum program The project and its methodology that referee to Mikołaj's Mazurkiewicz PhD thesis is described below (**underlined title**) and names of other projects, that student helped with sampling are just listed.

1. **Impact of polar night environmental factors on mineralogical and elemental composition of carbonate skeletons of marine organisms. (project leader: Piotr Kukliński, IO PAN)**

2. **Hyperbenthos during the polar night – community structure and trophic interactions (leader: Jan Marcin Węsławski, IO PAN)**

3. **Winter diets of Arctic molluscs and amphipods (project leader: Joanna Legeżyńska, IO PAN)**

4. **Benthic infaunal communities in Arctic sediments during the polar night (project leader: Maria Włodarska-Kowalczuk, IO PAN).**

Introduction:

Changes in food availability are expected primary driver of the seasonal variability in the benthic infauna (i.e. marine invertebrates dwelling in soft sediments) in deeper sublittoral (at depths largely exceeding the depth of the euphotic zone) in polar coastal waters. Soft bottom sublittoral faunal communities depend on the organic carbon that is produced in water column. The pelagial productivity is restricted to a few months of the optimum light conditions and is fluctuating throughout the season with peaks (phytoplankton blooms) triggered by the nutrient availability and hydrological settings. The vertical fluxes of organic matter to the sea-bottom are therefore strongly seasonal, however the organic carbon that sedimented to the see-floor can be accumulated in sediments and provide the food source for infaunal communities long after its deposition. A 'food bank' hypothesis has been proposed for the benthic systems of Antarctic shelf sediments (Smith and deMaster 2008). It was claimed that the organic material produced during the intense summer phytoplankton blooms and deposited onto the shelf floor provided a sustained source of labile POC (i.e. "the food bank") for benthic detrivores during the winter season. Indeed, Glover et al (2008) showed that macrofaunal densities remained constant throughout a year which was consistent with the hypothesis of presence of the 'food bank' in sediments. Moreover, McClintic et al (2008) have documented no significant changes in bioturbatory activity (quantified using the diffusive mixing coefficient , based on 234-Th analyses in sediment cores) among the seasons that further supported the hypothesis that organic matter accumulated in sediments sustain the benthic communities on a year-round basis. In the Arctic the studies of the functioning of the benthic sedimentary systems in polar night are very rare. Renaud et al (2007) showed that the seasonal inputs of phytodetritus to the seafloor can be utilised by benthic organisms dwelling in Arctic sediments quite quickly.

Recently, in an experimental study, Morata et al (in press) have documented a strong and quick response in benthic activities following the food input to the sediments collected during the polar night in one of Svalbard fjords (Ripfjorden). The seasonal studies of soft bottom benthic communities in Spitsbergen fjords are only a few and give equivocal results – of either a strong seasonal variability in macro- and meiobenthic standing stocks correlated to the seasonal variability in organic carbon fluxes (Pawlowska et al. 2011), or no difference in benthic communities between summer and winter seasons (Kedra et al 2011).

The present study aims to test the 'food bank' hypothesis in Arctic fjordic sedimentary systems. The quantity and quality of organic matter stored in subtidal sediments during the polar night will be compared to those present in the same localities in other seasons. The comparative analyses of the meio- and macrobenthic communities will include the assessment of density, biomass, species composition and diversity as well as biomass size spectra and vertical distribution of the fauna in sediments. The bioturbatory activity of benthic biota will be also explored – it will be quantified using the diffusive mixing coefficient, based on 234-Th analyses in sediment cores.

The results of the study will allow to answer following research questions (1) Do the infaunal benthic communities of macro- and meiofauna of the polar night differ from those in summer season in terms of density, biomass, species richness, diversity and biomass size spectra? (2) What is the quantity and quality of organic matter stored in Arctic sediments and available for benthic consumers over the polar night? (3) If and how the food availability shapes the structure (vertical distribution in sediments) and functioning (bioturbation) of benthic communities during polar night?

Approach: Sediments, and fauna have been sampled in the central basin of the fjord. The collected materials included samples of macrozoobenthos collected with van Veen grabs and samples of the fauna and sediments collected with use of sediment cores. Sediment cores were sliced in 1 cm layers. Meiofaunal organisms will be identified to the higher group level (representatives of the dominant taxon- Nematoda to species level), the volumetric method, together with conversion factors, will be used to determine the wet weight of the meiobenthic organisms. Macrobenthic invertebrates will be sorted, identified to the lowest possible taxonomic level (species level) and weighted. Macrofauna from stations KST1, KST2 and KST3 will be also measured with use of Leica M205C Microscope connected to computer with Leica LAS software. Both sediments and suspended matter in water column will be analysed in terms of the organic matter content (Particulate Organic Carbon (POC) and Total Nitrogen (TN) content, POC/TN, isotope signatures $\delta^{15}N$ and $\delta^{13}C$, photosynthetic pigments content as indicators of organic carbon origin). Benthic community structure will be described in terms of density, biomass, species composition, diversity and benthic biomass size spectra. Vertical distribution of the fauna in the sediment cores will be determined. Bioturbation activity will be assessed with use of Th-234 sediment cores.

Benthic biomass size spectra from stations KST1, KST2 and KST3, as well as sediment characteristics like bioturbation rate or organic matter contet and characteristic, will be compared with results obtained in summer 2014 to check for the seasonality differences.

Sampling during the Helmer Hansen January 2015 cruise:

Sampling was undertaken at three stations (Fig. 2). at each station the CTD profile was performed and a set of samples were collected. The set of samples included: 3 samples of macrofauna (van Veen grabs), 1 sample for bioturbation (Th-234, a core from a box-corer), 3 replicate samples for meiofauna, POC and photosynthetic pigments (cores from a box-corer). The meiofauna and macrofauna samples have been fixed with use of formalin, the sediment samples were frozen (samples for photosynthetic pigments at -80°C, other samples at -20°C).

Additionally the samples of macrofauna and meiofauna were collected at ECOTAB stations (project lead by Nathalie Morata).

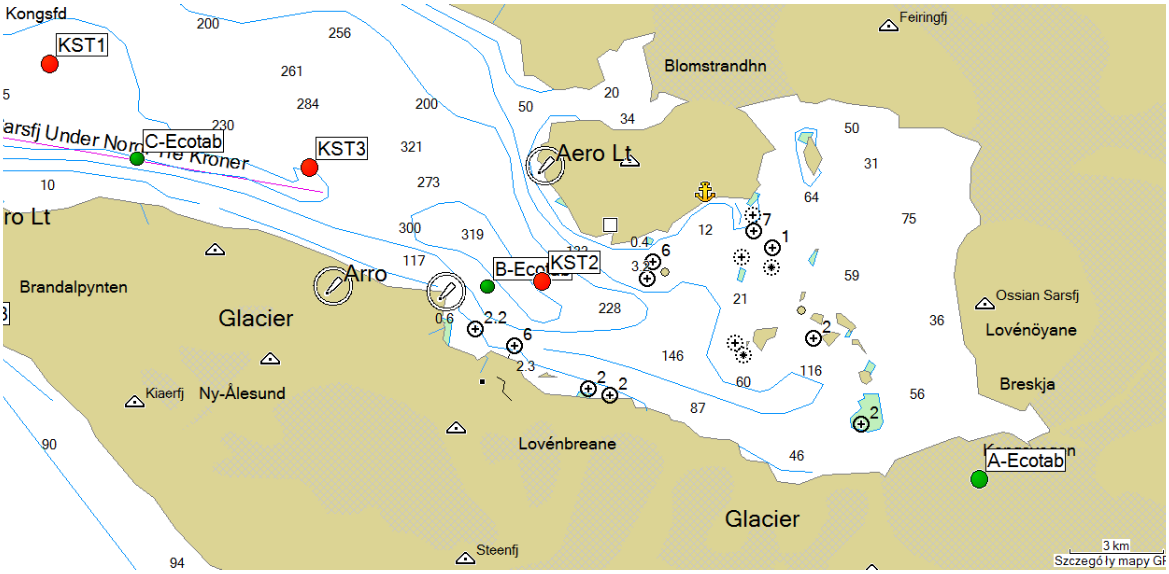

Fig. 2. Soft bottom sampling: red circles – IOPAN Marine Night stations, green circles – ECOTAB stations.

Table.1 Details of soft-bottom sampling.

Station name	Date (UTC)	Time (UTC)	Instrument	Latitude N	Longitude E	Depth [m]
KST1	15.01.2015	05:07	CTD; 3x Box corer; 3 x Grab	79'00.76"	11'25.61"	350
KST3	14.01.2015	02:07	CTD; 3 x Box corer; 3 x Grab	78'58.60"	11'43.44"	307
V1/ECOTAB-A	12.01.2015	03:30	CTD; 3 x Grab; 3x Mini corer (Boris)	78'53.74"	12'25.99"	81
KST2 / KB3/ECOTAB-B	11.02.2015	23:06	6 x Mini corer (Boris)	78'56.88"	11'59.25"	270
KST2 / KB3/ECOTAB-B	11.01.2015	18:25	CTD; 1x Box corer; 3x Grab	78'56.68"	11'59.82"	260
E4/ECOTAB-C	11.01.2015	15:02	CTD; 1 x Box corer, 3 x Grab	78'59.10"	11'31.22"	305