in the western part. A thorough investigation of the samples will elucidate the regional and vertical distribution of the zooplankton community, and the data will be discussed with respect to the life strategies of the dominant species, relationships to hydrography and ice cover and to the pelago-benthic coupling.

3.4.3 Meiobenthos

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Objectives

LARSEN: Due to its functional distinctness and intermediate size between macrofauna and microbiota, meiofauna is assumed to play an important role in marine benthic food webs. Little is known about benthic meiofaunal communities living beneath the Antarctic iceshelves. Is a suggested lower productivity limiting diversity in those environments? The disintegration of Larsen A and B (mainly 1995, 2002) gave way to study benthic areas formerly covered by iceshelves for several thousand years, and to compare these with long-term uncovered and probably more productive reference areas. Main goal is to investigate the succession of meiobenthic communities in the Larsen A and B areas. A first benchmark study in January 2007 showed that nematode communities near the former Larsen B iceshelf margin differed from those in the innermost parts in terms of diversity and composition. The same was true for Harpacticoida family composition (Rose, unpublished data). All stations from this first study, including a mud volcano site, were intended to be repeated during ANT-XXVII/3 in order to see how things have developed since then. Results will enhance our understanding of meiofaunal colonisation speed after catastrophic events caused by regional climate warming. Comparisons with other oligotrophic areas (ANDEEP samples from the Antarctic deep sea) will be of special interest according to diversity models (e.g. productivity-diversity relationship). Also environmental factors correlating strongest with meiofaunal major taxa abundance and harpacticoid species diversity are to be untangled. Furthermore, diversity differences will be evaluated on multiple scales. Finally, unknown species and life forms are to be expected which will enhance our understanding of Antarctic biodiversity. This study will contribute to a deduction of general rules concerning the resilience of Antarctic marine benthic ecosystems in times of increased climate change.

BENDEX: Few papers deal with the influence of iceberg disturbance on meiobenthos (e.g. Peck et al. 1999; Lee et al. 2001). These demonstrated that catastrophic iceberg disturbances lead to impoverished meiofaunal assemblages in fresh scours. Meiofaunal abundance and taxonomic diversity were significantly reduced in those. Older scours showed highest abundance and diversity values, even higher than those for an undisturbed area. The return of major meiofauna groups was accomplished 30 days after a disturbance event, compared to a control site. Since under normal circumstances it is difficult to assess the age of natural iceberg scours and the time scale of the ongoing succession, an experimental approach was chosen that was supposed to lead to a disturbed area with a defined starting point in time (December 2003, ANT-XXI/2). The BENDEX (benthos disturbance experiment) area was intended to be visited by later expeditions in order to assess the time scale of the ongoing succession of benthic organisms and the development of environmental parameters. This will be done during the actual cruise leg. BENDEX was mainly designed for the removal of macrofauna. It is suggested that a lot of meiofauna were whirled into the water column during bottom trawling and re-sedimentated afterwards. Hence, at least for meiofauna bottom trawling did not resemble a real iceberg disturbance event. Since it was not possible to remove all material from the area and some stripes had been left undisturbed, central stations of the area probably resembled marginal stations in so far that edge effects occurred. Therefore, the process of trawling did not allow a clearly defined disturbed area. Finally and taking into account the mentioned literature, seven years is probably a too long interval to assess the process of meiobenthic succession after a disturbance of this scale.

Work at sea

LARSEN: Five multicorer (MUC) stations from the Larsen A and B areas (*Polarstern* expedition ANT-XXIII/8, January 2007) were intended to be revisited. This was not always possible due to weather and ice conditions. Only the most important stations 'B South' and 'B West' could be fully worked up. Here the repetition of the benchmark study included intense sampling with five MUC replicates in order to get reliable results. From station 'A South' four replicated MUCs were hauled. The former station 'B Seep' was under thick pack ice in March 2011. Therefore a station close to the cold seep (distance about one nautical mile) with similar depth was chosen ('B Seep Ref'). 'B North' could not be reached due to expected bad weather conditions. As additional references two stations outside the Northern part of the Larsen C iceshelf ('Larsen C1', 'Larsen C2') and a station outside the former Larsen A iceshelf near Robertson Island ('A RobIsl') were sampled for the first time. For comparative purposes (first study and former ANDEEP programmes), the MUC6 (12 tubes: inner diameter 57 mm) was used. In one case (Larsen C2: station 243-4) 57 mm subcores were taken from 10 cm megacorer (MUC10) cores. The MUC cores were processed in different ways onboard. Always some cores of each haul were used for community analysis. Of these the upper 5 cm of sediment were taken as a bulk (plus 5 cm supernatant water) and fixed with 4 - 8 % formalin. One further core for community analysis was sliced from 0 - 1 cm (plus water), 1 -2 cm, 2 - 3 cm, 3 - 4 cm, 4 - 5 cm, 5 - 10 cm, 10 - 15 cm and fixed with 4 - 8 % formalin. One core was sliced similarly (but without water) for sediment and phytopigment analysis. Slices were frozen at –20 °C. Some cores from one haul of selected stations were processed for small-scale analysis. The upper 3 cm (plus 2 cm water) and the layer from 3 - 5 cm were cut into six cake-shaped pieces of equal size. Three non-adjacent pieces were taken for community analysis and preserved with 4 - 8 % formalin. One piece was taken for sediment and phytopigment analysis and stored at –20 °C. Additional qualitative meiofauna samples were taken by sieving disturbed cores and sponges. These samples were preserved in 70 - 80 % ethanol.

All organisms sampled quantitatively with the MUC will be sorted and counted on major taxa level at the labs of Senckenberg am Meer, Dept DZMB (Wilhelmshaven, Germany), and the Marine Biology Section of Ghent University. Harpacticoid copepods will be identified to species level at DZMB, nematodes down to genus level at the Marine Biology Section of Ghent University.

BENDEX: During the ANT-XXI/2 campaign in December 2003 three benchmark sample series had been taken in order to assess the impact of the experimental disturbance on meiobenthic assemblages. Since the preferred multicorer (MUC6) did not work properly due to thick sponge spicule mats, subsamples from the multibox corer (MG) were taken. Within the experimental area, stations were sampled both in central and marginal parts. Additionally, two of five pre-disturbance stations and three reference stations were sampled around the disturbed area at some distance.

The pre-disturbance series consisted of three multibox corer (MG) hauls taken on December 11th, 2003 (PS65/116, 124, 125), of which eight subcores of 10 cm^2 area were taken out of two adjacent boxes. Furthermore, two giant boxcorers (BC) were deployed on December 10th and 11th, 2003 (PS65/107, 123), of which the same number of subcores was taken. Two stations (116, 124) were positioned outside and three stations (107,123,125) inside the subsequently disturbed area. The initial post-disturbance series one week later consisted of four MG hauls (PS65/183, 187, 199, 202), of which eight subcores á 10 cm^2 were taken out of two adjacent boxes, and of one BC haul (PS65/203) with the same number of subcores. In the surrounding of the experimental area three reference MGs were deployed after the disturbance. Eight resp. seven subcores out of two adjacent boxes, and four cores out of one box were taken and processed on December 17th to 18th, 2003.

Of these initial BENDEX stations three MG hauls of the post-disturbance (old 183, 187, 199; now 288-4, 280-1, 289-1), two of the reference sampling series (old 185, 197; now 297-1, 279-3), and one post-disturbance MG station (old 106; now 295-2) were resampled during the actual cruise leg. Furthermore, three new reference stations (274-3, 283-5, 285-1) were sampled by the MG (Table 3.4.2). Regarding meiobenthos, six 10 cm^2 subcores were taken out of one MG box at each of these nine stations. These were processed as follows: two cores were prepared for quantitative morphological analysis of meiofaunal diversity and fixated with formaldehyde (4-8 %). One of these was split into 5 layers (0-1 + water, 1 - 3, 3 - 5, 5 - 10, 10 - 15 cm), the other one was taken as a bulk (0 - 5 cm + water). Another bulk core (0 - 5 cm + water) was reserved for molecular analysis of nematode diversity (conservation with ethanol 80 %). The last three cores were processed for analysis of chemical and physical parameters. One core for stable isotope analysis was split into two layers (0 - 1, 1 - 2 cm). One core was prepared for analysis of phytopigments (layers: 0 - 1, 1 - 2 cm, rest), and the last one for organic matter and sediment structure (layers: 0 - 1, 1 - 2, 2 - 3, 3 - 4, 4 - 5 cm, rest). These three cores were kept deep-frozen (-20 °C).

In addition, four multicorer stations (MUC6: 57 mm inner diameter of tubes) were sampled: one (288-4) near an old post-disturbance MG station (183), one (274-2) near an old MG reference station (197), and two deeper stations in the surrounding (260-4, 265-3). The obtained cores were treated as follows: Some cores of each haul were used for community analysis. Of these the upper 5 cm of sediment were taken as a bulk (0 - 5 cm + 5 cm supernatant water) and fixed with 4 - 8 % formalin. One further core for community analysis was sliced from 0 - 1 cm (+ water), 1 - 2 cm, 2 - 3 cm, 3 - 4 cm, 4 - 5 cm, 5 - 10 cm, 10 - 15 cm and fixed with 4 - 8 % formalin. One core was sliced similarily (but without water) for sediment and phytopigment analysis. Slices were frozen at –20 °C. Two cores of station 265-3 were processed for small-scale analysis. The upper 3 cm (plus 2 cm water) and the layer from 3 - 5 cm were cut into six cake-shaped pieces of equal size. Three non-adjacent pieces were taken for community analysis and preserved with 4 - 8 % formalin. One piece was taken for sediment and phytopigment analysis and stored at –20 °C.

All organisms sampled quantitatively with the MUC6 and MG will be sorted and counted on major taxa level at the lab of the Marine Biology Section of Ghent

University. Nematodes will be identified down to genus level at the Marine Biology Section of Ghent University.

Tab. 3.4.1: ANT-XXIII/8 (2007) and ANT-XXVII/3 (2011) multicorer (MUC6) stations in the Larsen region with quantitative meiofauna samplings.

	2007				2011			
Station	Drop no.	Latitude	Longitude	Depth cable	Drop no.	Latitude	Longitude	Depth cable
B South	PS69/700-8	65° 54.98' S	60° 20.54' W	422	PS77/246-3	65° 54.95' S	60° 20.43' W	424
	PS69/700-9	65° 54.95' S	60° 20.88' W	417	PS77/246-4	65° 54.95' S	60° 21.49' W	395
	PS69/702-4	65° 55.12' S	60° 19.96' W	427	PS77/246-5	65° 54.99' S	60° 20.70' W	419
	PS69/702-7	65° 54.49' S	60° 21.37' W	405	PS77/247-3	65° 55.12' S	60° 19.83' W	428
	PS69/702-8	65° 54.95' S	60° 20.95' W	410	PS77/247-4	65° 55.15' S	60° 20.01' W	425
B Seep	PS69/706-5	65° 26.09' S	61° 26.48' W	819				
	PS69/706-6	65° 26.10' S	61° 26.53' W	820				
	PS69/709-5	65° 26.09' S	61° 26.51' W	819				
	PS69/709-7	65° 26.07' S	61° 26.48' W	818				
	PS69/709-8	65° 26.07' S	61° 26.49' W	818				
B Seep Ref					PS77/250-3	65° 25.66' S	61° 26.03' W	800
					PS77/250-4	65° 25.32' S	61° 25.70' W	775
B West	PS69/710-2	65° 33.03' S	61° 36.98' W	277	PS77/233-4	65° 32.99' S	61° 36.94' W	277
	PS69/710-3	65° 33.04' S	61° 37.18' W	281	PS77/233-5	65° 32.97' S	61° 36.94' W	278
	PS69/710-7	65° 33.03' S	61° 37.01' W	275	PS77/235-4	65° 32.96' S	61° 36.88' W	276
	PS69/710-8	65° 33.03' S	61° 37.00' W	283	PS77/235-5	65° 33.01' S	61° 36.96' W	280
	PS69/710-9	65° 33.07' S	61° 37.06' W	288	PS77/235-6	65° 33.01' S	61° 37.00' W	279
B North	PS69/715-2	65° 6.39' S	60° 45.04' W	308				
	PS69/715-4	65° 6.44' S	60° 45.07' W	307				
	PS69/718-1	65° 6.33' S	60° 45.17' W	306				
	PS69/718-3	65° 6.43' S	60° 44.93' W	303				
	PS69/718-5	65° 6.40' S	60° 45.60' W	304				
A South	PS69/723-1	64° 56.07' S	60° 38.57' W	242	PS77/226-9	64° 56.00' S	60° 38.63' W	235
	PS69/723-2	64° 56.06' S	60° 38.58' W	242	PS77/226-10	64° 56.01' S	60° 38.61' W	237
	PS69/725-7	64° 56.01' S	60° 38.69' W	232	PS77/231-4	64° 56.06' S	60° 39.03' W	223
	PS69/725-9	64° 56.04' S	60° 38.93' W	242	PS77/231-5	64° 56.16' S	60° 38.66' W	236
A RobIsl					PS77/254-4	65° 00.19' S	59° 25.83' W	290
					PS77/254-5	65° 00.08' S	59° 25.91' W	292
Larsen C1					PS77/237-8	66° 09.75' S	60° 13.20' W	355
					PS77/237-9	66° 09.66' S	60° 13.05' W	355
Larsen C2					PS77/239-8	66° 16.62' S	60° 15.51' W	399
					PS77/243-4	66° 15.79' S	60° 14.69' W	390

Preliminary results

LARSEN: It is expected that some change took place in the Larsen A and B areas during the last four years. This might be more dramatic in the Larsen A area, since an ROV video showed a significant shift in the macro-epibenthic community at station 'A South'. However, since extraction of meiofauna out of the sediment has to be done in a standardised way in the lab, no preliminary results are available for the meiobenthos for now.

BENDEX: Due to the chosen method of disturbance by bottom trawling only epi-macrofauna could be effectively removed during BENDEX. Meiofauna might just have been whirled into the water column during trawling operations and re-settled afterwards. Hence, regarding meiofauna bottom trawling might not have adequately simulated a real iceberg disturbance event. According to the data of Lee et al. (2001) seven years could be a too long time interval to assess the process of meiobenthic succession after a disturbance event of this spatial extent. However, since the removal of epi-macrofauna by bottom trawling was quite effective as shown by an ROV video survey, the environment and the currents situation directly over the seafloor probably has changed. This might well have affected the meiofaunal composition seven years after the disturbance event. No preliminary results are available for the meiobenthos which has to be processed in a standardised way in the home institutes.

3.4.4 Macrobenthic soft-bottom in- and epifauna

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Objectives

LARSEN: Macroecological investigations on the impact of disintegrating ice shelves to the marine ecosystem in the Larsen A and B areas east of the Antarctic Peninsula started in 2006/2007 during ANT-XXIII/8, twelve and five years, respectively, after the ice shelf collapsed, (Gutt et al. 2011). The majority of the sampled and directly observed macrobenthos could be attributed to the old oligotrophic ice-covered situation. The meiobenthos seemed to respond faster to the change in environmental conditions but did not yet reach a new equilibrium. Sediment parameters also showed that the system was still in a transitional phase. In addition, first hints of a species turnover were found to be interpreted as a response to the drastical changes in the environmental conditions following the ice shelf collapse. The main aim during the Larsen-survey was to study different components of the ecosystem, mainly benthic, compare these with the results from 2006/2007 and identify changes in the structure and functioning of this Antarctic ecosystem under extreme environmental stress. Being a follow-up study most of the core-stations sampled in 2006/2007 had to be revisited and a variety of different sampling equipment was deployed at the same spot in order to obtain a synoptic view covering a broad variety of ecosystem components. Two additional (new) stations off the northern margin of Larsen C (South of Larsen B) were selected in order to search for the origin of recruits to be expected in the formerly ice shelf covered Larsen A and B embayments. The comparison between results from 2006/2007 and those from ANT-XXVII/3 should answer the following key questions: (1) Can any changes between 2007 and 2011 be found (2) Did the fauna associated to the old oligotrophic situation diminish? (3) Did pioneer species increase in abundance and in terms of species richness? (4) Is the area south of Larsen B a potential home of parental stocks for recruits in the Larsen A/B?