The Expedition ANTARKTIS XXI/2 (BENDEX) of RV "Polarstern" in 2003/2004

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with contributions of the participants

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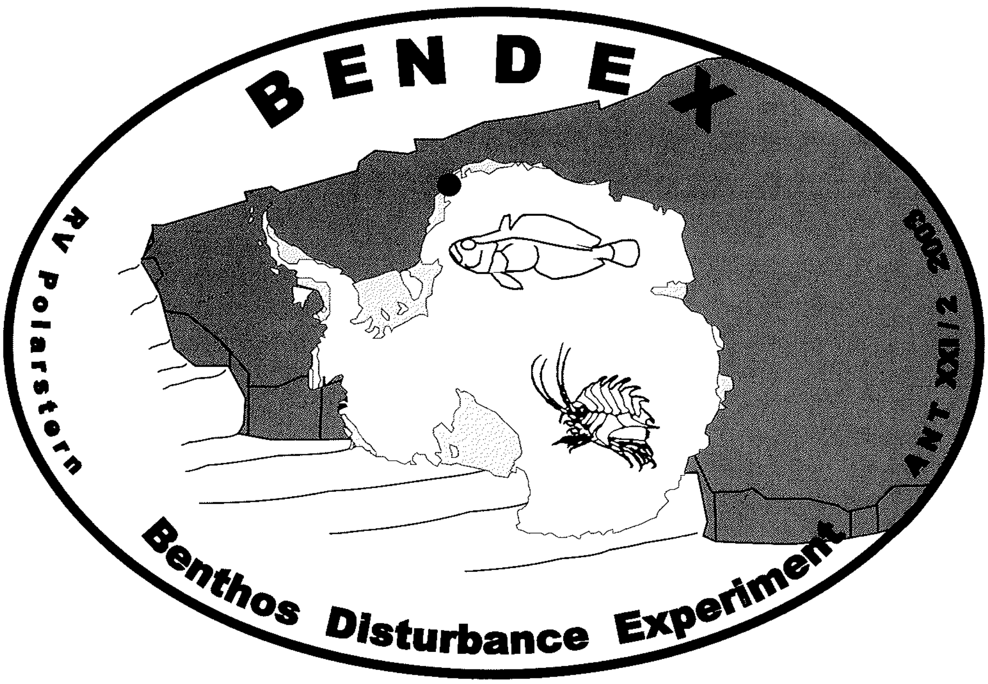
BENDEX
RV Polarstern
ANT XXI/2 2003
Benthos Disturbance Experiment

1. Introduction

1.1 Objectives of the cruise (W.E. Arntz)

One of the outstanding results of the international „Polarstern" expeditions EASIZ (Ecology of the Antarctic Sea Ice Zone) I-III has been the insight that iceberg strandings play an important role in structuring benthic biodiversity at the seafloor. We know from these studies that about 5% of the total shelf area of the eastern Weddell Sea is disturbed by iceberg scour. Within some topographically distinct areas which in this report are referred to as „iceberg restplaces", up to 50% of the seafloor may be affected by this kind of perturbation. Iceberg scour inflicts substantial damage, often destruction, on the established communities of the endo- and epifauna and of demersal fish. In the course of recovery, which is assumed to be a very slow process as compared with time scales in temperate or tropical regions, it is possible to distinguish different successional stages of recolonisation although these cannot yet be placed in an absolute temporal sequence. There may also be various alternative states during this process.

As iceberg scour disrupts or destroys older and more mature community stages, it creates space for taxa which as „pioneer species" initiate recolonisation of the affected areas, thus giving way to a gradual recovery of the community. Various hypotheses in the literature have attempted to describe the effect of such processes on biodiversity. The general result seems to be an enhancement of diversity on larger spatial scales due to the co-existence of a variety of different stages which all have their respective set of species. This may be the case, however, only for intermediate scour disturbance, and may not work if the impact scale is altered into one or the other direction, e.g. by a further increase of iceberg scour under continued global warming conditions. An alternate (and presumably shorter) way to study these processes is to cause artificial disturbance of different intensity at the seafloor.

Beside its effect on biodiversity, the time scale of the process of recolonisation and recovery after the disturbance may be considered an important question, because in comparison with communities at lower latitudes it illustrates the vulnerability and resilience of the polar ecosystem. This parameter is, as is biodiversity, of increasing importance in the context of the Antarctic Treaty and the Madrid Protocol, because conservation measures can be developed only considering these stability properties of the ecosystem.

The main programme of the BENDEX cruise ANT XXI/2 thus intended to

- Quantify the dynamics of the shelf ice edge and the movements of icebergs using satellite remote sensing, helicopter and shipboard observation. The shelf ice edge was measured from helicopters and compared with former measurements during EASIZ I-III. Iceberg displacement was quantified in determined „restplace" areas from helicopters, by deployment of Argos buoys and by the vessel's radar.

- Describe undisturbed areas as a basement measure of the status quo ante. These areas will serve later as control sites.
- Inflict an artificial mechanical perturbation similar to iceberg scour by heavy trawling on one of these sites, to follow recolonisation and succession in the next decade.
- Recover artificial hard-bottom substrates deployed during ANT XV/3 off Kapp Norvegia. (This turned out to be impossible due to thick packice cover).
- Compare results on temporal and spatial succession in this area, in particular with regard to biodiversity, dominance and structural complexity, with published and own results from other marine ecosystems (shelf areas of the North Atlantic Ocean, Mediterranean, Humboldt Current upwelling, Arctic deep sea).
- Deduce (as a final goal) more general rules concerning the resilience of benthic marine ecosystems, and identify indicators of vulnerability, pioneer species, ecosystem engineers and other keystone species which may be helpful for conservation management.

This main research programme represents a medium term approach and will last at least 10 years. After subjecting the „benthos garden" community to artificial disturbance, this site is to be revisited in more or less regular time intervals (ideally every second year) to register successional patterns and exchange moorings for the registration of biotic and abiotic variables.

To make optimal use of RV „Polarstern" and to consider the needs of other international and national groups working on the Antarctic shelf mostly within the frame of the EASIZ programme, the main programme was combined with the following associated programmes:

- Pelago-benthic coupling, trophic structure and energy flow under polar spring conditions
- Scale-related biodiversity studies of high Antarctic benthos communities in comparison with those from the Arctic
- Taxonomic biodiversity studies to complement the inventory of high Antarctic benthic species
- Phylogenetic and biogeographic relationships and genetic variability of sub- and high Antarctic fauna (including Bouvet)
- Studies on invertebrate life histories, reproductive strategies and meroplanktonic larvae along the latitudinal gradient (includes study at Bouvet)
- Availability of fish as food for seals and seal foraging in Drescher Inlet
- Reaction of seals to acoustic gear (Drescher Inlet)
- Adaptive competence of Teleostei: material for the study of temperature adaptation of Zoarcidae and Nototheniidae (includes Bouvet)
- Chemical ecology: material for the study of natural marine products
- Measurements of atmospheric trace gases
- Deployment of Argos buoys on drifting icebergs for AWI's physical division
- Relief of Neumayer station.

Except for the biodiversity and biogeography study around Bouvet Island, all work was planned to be carried out between Atka Bay and Drescher Inlet, with a focus on the iceberg restplace areas between Atka and Kapp Norvegia (Fig. 1).

1.2 Summary review of results (W.E. Arntz)

- Benthic Disturbance Experiment (BENDEX)

Despite heavy sea ice conditions, which restricted most work to a limited area around the Austasen iceberg restplace (see Itinerary), the BENDEX experiment was initiated successfully. An area of 1000x100 m was trawled repeatedly to remove the epibenthic macrofauna and create defaunated bottoms (see Figs. 7 & 8), which are now ready for recolonisation from a known starting point. In a parallel approach, Argos buoys were fixed on stranded icebergs, providing another set of temporal and spatial coordinates for defaunated areas once the bergs are remobilised by gales, tides and currents. These experiments will remove the uncertainty connected with all work carried out hitherto as to the exact time and locality of recolonisation processes after iceberg scour. In addition, undisturbed control areas and iceberg tracks with a variety of successional stages were sampled for fish, macro- and meiofauna, and photographed using ROV and photosledge, to document different patterns of recolonisation and characteristics of areas without detectable disturbance.

In the experimentally disturbed track, trawl catches shortly after the removal of the fauna revealed a much higher incidence of various *Trematomus* species than in undisturbed areas. This is probably due to dislocated infauna and damaged epifauna, which may provide additional food to the fish; possibly also to small motile immigrants, which tend to colonize defaunated areas rapidly. Analyses of the samples taken after the disturbance event will provide more detailed information.

Using the helicopters, another attempt was made to measure recent changes, both advances and retreats, of the shelf ice edge in the Kapp Norvegia region since the EASIZ III cruise in 2000. Whereas at one site a considerable advance by almost 2 km was registered burying a benthic station that had still been sampled in 1996, larger break-offs leading to iceberg calving were observed at other sites.

- Biogeography and biodiversity

The studies on biodiversity and biogeography on the high Antarctic Weddell Sea shelf were hampered to some extent because of the concentration on one experimental site and – due to the early season – because of unusual amounts of thick pack ice in the area of study, which largely confined sampling to depths around 300 m. However, visual methods (ROV and photosledge) yielded very interesting information from iceberg restplaces and the shallow „Hilltop" area, there were spectacular finds in deep water, and the epibenthic sledge caught a variety of unknown, mostly small, species.

Furthermore, sampling and photosledge work around Bouvet Island and at the Spiess Seamount were very successful.
ROV and photosledge transects, in connection with current measurements, showed that the distinct heterogeneity of epibenthic assemblages on the eastern Weddell Sea shelf is at least partly caused by differences in currents. „Hilltop", a shallow, isolated hill with depths between 60 and 150m northeast of Kapp Norvegia, is a conspicuous example of small-scale patchiness and zonation. West of Atka Bay rather poor assemblages with a dominance of motile species occur next to very rich suspension feeder communities, whereas at the Austasen iceberg restplace the benthos is characterized by thick sponge spicule mats with few large live sponges.
Sampling at the four stations on the Bouvet shelf increased the number of benthic species registered for this area considerably, especially in the amphipod and mollusc taxa. Lithodid crabs (*Paralomis* sp.) were not found around Bouvet but at the Spiess Seamount. Stalked crinoids („sea-lillies") were detected for the first time at about 1500 m depth on the southeastern Weddell Sea continental slope. All trawl and epibenthic sledge catches yielded a rich material for molecular species separation and phylogenetic work, food web analyses by means of stable isotopes, and for chemical ecology.

- Life strategies and physiology

Reproductive strategies of benthic species could be studied during ANT XXI/2 in late spring and early summer, thus enabling a comparison with the EASIZ cruises in late summer and autumn. There does not appear to be a general synchronisation with the spring and summer phytoplankton blooms, instead there rather is a broad variety of strategies. Spawning and hatching of all three dominant Antarctic shrimps was observed, including the deep-sea caridean *Nematocarcinus lanceopes* whose larvae were caught for the first time (in surface waters!). Deployment of a Dutch Lander provided the first evidence that meroplanktonic larvae are very scarce on the high Antarctic continental shelf.

The physiologists investigated temperature adaptations of sub- and high Antarctic fish on the cellular level in the context of potentially high sensitivity to global warming. The influence of temperature changes on the more important energy-consuming metabolic processes was measured in isolated liver cells. When hepatocytes were provided with sufficient oxygen and energy, no obvious shifts in cellular energy allocation were detected within the temperature range of 0-15°C in all fish species. Temperature sensitivity of cellular oxygen consumption, however, differed greatly with respect to life style and latitudinal origin: cells of benthic high Antarctic species are least tolerant of warmer temperatures with oxygen uptake rates lowest at 0°C. Hepatocytes of bentho-pelagic sub-Antarctic species showed minimum oxygen uptake between 4 and 6°C and a less steep exponential incline of oxygen consumption with temperature. In this light, it is comprehensible to find the sub-Antarctic benthic eelpout *Pachycara brachycephalum* only in the warmer deep-water layers of the otherwise typically high Antarctic region in the Weddell Sea, where they were caught for the first time.

- Pelago-benthic coupling
The early season of the BENDEX cruise also turned out to be favourable for planktonic and benthic work in the water column and at the seafloor, particularly to study pelagobenthic coupling. The awakening of the pelagial in spring was followed for three weeks at a fixed station, while two major transects of water column and sediment sampling contributed additional data. Due to a powerful plankton bloom favoured by calm, sunny conditions in the mixed layer the copepods, which during the first days had remained mostly in diapause, began to feed and reproduce. Initially a large share of the algae produced in the euphotic zone sedimented on the sea floor without having passed the pelagic food chains.

- Seal ecology related to their food
There was a close cooperation between the seal group and the fisheries biologists at Drescher Inlet. Fish (mainly *Pleuragramma antarcticum*, the Weddell seals' staple food) continued diel vertical migrations even under midnight sun conditions, and the seals adapted their foraging trips to these migrations. Using a Japanese video camera attached to a seal's back, substantial concentrations of organisms were detected not only in the pycnocline and at the seafloor (mainly fish), but also underneath the shelf ice (hydrozoans, crustaceans) where they form a kind of „inverse benthos" assemblages, which may also attract fish. For the first time, measurements of seal underwater sounds were made under the fast ice of the Drescher Inlet, providing AWI's Acoustic Project Group with data to be used in the planned automatized registration of warm-blooded animals.

- Further work
Beside these main lines of work, many other studies were carried out including measurements of air chemistry, photographic documentation of the fauna, deployment and retrieval of moorings and Argos buoys, relief of Neumayer station, etc. As a whole, the BENDEX cruise has been a full success despite very difficult ice conditions. Seasonally it has complemented previous cruises, and regionally it has included Bouvet Island, which was almost a white spot on the biogeographic maps. For the first time, a large-scale manipulation of a benthic assemblage has been induced to improve the study of recolonisation, and new methods and approaches have been introduced into the seal ecology studies at the Drescher Inlet. The scientists would like to thank Captain Udo Domke and his crew for their competent and engaged support, and the excellent working and living atmosphere on board.

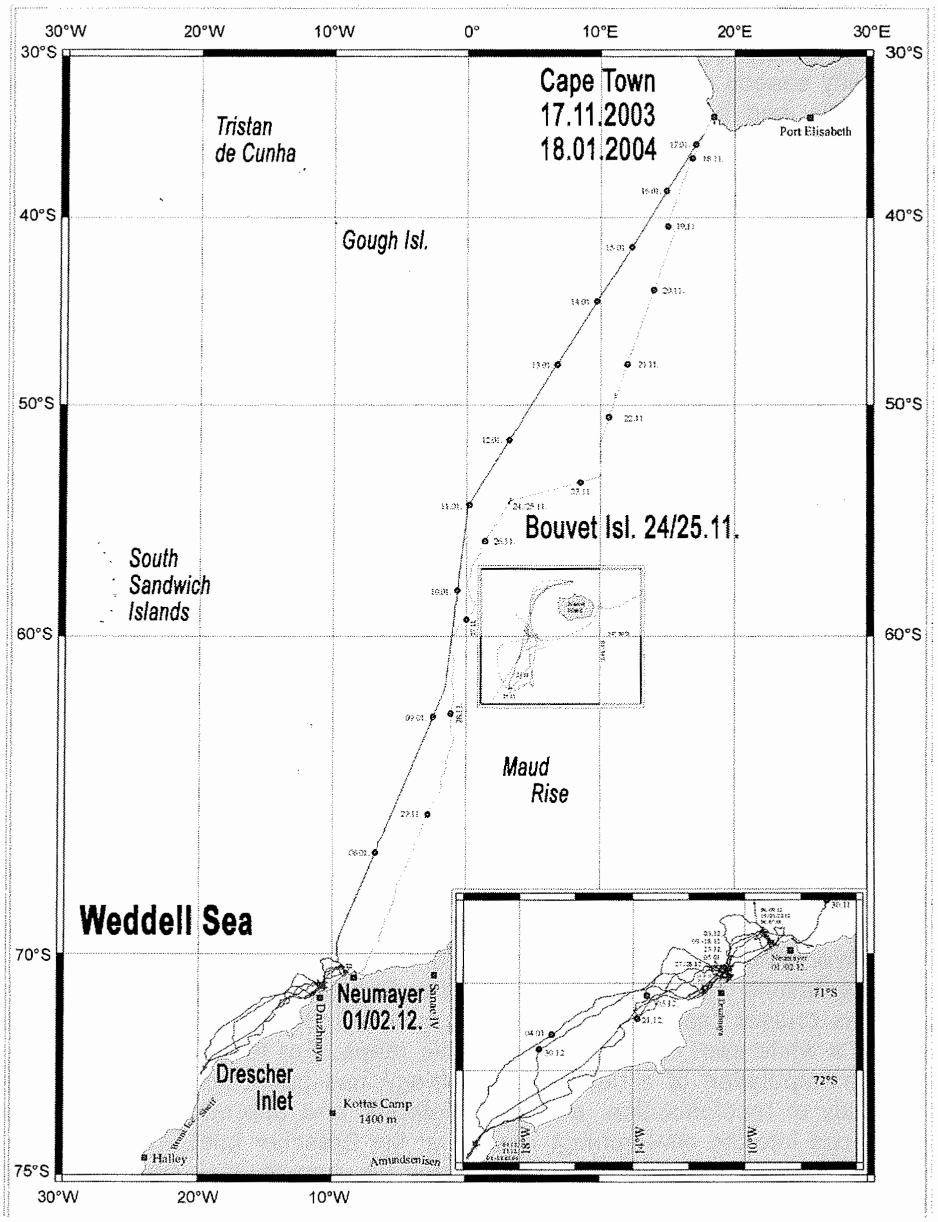

Fig. 1 Cruise track of PFS "Polarstern" during ANT XXI/2

1.3 **Itinerary** (W.E. Arntz)

RV „Polarstern" left Cape Town on Monday, 17 November 2003 with 47 marine researchers from 11 countries and 44 crew, enforced by 2 meteorologists, 4 helicopter crew, and 6 guests, and loaded heavily with gear and equipment for work at sea and on the ice. During the first days, the vessel encountered some swell which had been left by a recent gale, but from Wednesday to Friday the sea came to rest allowing for a quiet unpacking of scientific materials. A short storm interval towards the weekend caused no harm, and on Sunday a search was started for a lost mooring of AWI's physical oceanographers, which ended successfully although only the transmitter and two floats were found. The voyage proceeded towards Bouvet, meeting with the first icebergs already at 40°S and crossing the Antarctic Convergence at 53°S. Marine biological work was begun off Bouvet on Monday. Four Agassiz trawls (AGT) were deployed between 100 and 550 m depth, yielding a varied fauna which considerably increased the faunal records for the Bouvet region. The photo sled took images at these depths, which largely confirmed the trawl results, but among the baited traps only the amphipod type was successful whereas the fish and stone crab traps failed. Luckily, the physiologists were able to carry out the temperature tolerance experiments with fish caught in the AGT.

The continuation towards Atka Bay was again extremely calm, and as large ice concentrations could be avoided using satellite ice charts (Fig. 2), „Polarstern" surprisingly reached Atka Bay as early as 1 December, finding the shelf ice edge free of ice. Our logistic guests moved ashore, Neumayer Station was relieved on the following two days, various gear was boarded, and the vessel proceeded towards Drescher Inlet along a coastal polynia and through moderately thick packice, still under favourable conditions. The only work done on this leg was the deployment of a mooring in the area where the benthos disturbance experiment was planned. On 5 December, „Polarstern" arrived at Drescher. When the nocturnal fog had cleared, the temporary Drescher seal station was unloaded by helicopter and installed on the shelf ice close to the inlet, and the seal biology group left the vessel.

The ship then turned NE again, sailing in the coastal polynia and gradually encountering more severe ice conditions. The prevailing north easterlies increased the ice pressure, whereas occasional winds from southerly directions were too weak to reverse this situation. The major effect of the worsening ice conditions was that work could not always be done where it had been planned. This was the case, e.g. with the experimental area for the disturbance experiment, which had to be abandoned because of the ice but also because it presented the "wrong" benthic assemblage. Instead, a large ice-free lagoon was chosen close to the Austasen iceberg restplace, about half way between Atka and Drescher. Work aiming at the pelago-benthic coupling, which had begun at the originally foreseen site on 6/7 December with a large hydrographic and plankton transect, was continued in this lagoon. The transect was repeated on 20/21 December, and the awakening of the Antarctic water column in spring was followed over three weeks.

Parallel to the water column and sediment work, the core investigation of cruise XXI/2 started. During the benthic disturbance experiment (BENDEX) the

benthic fauna in an area of 1000x100 m was wiped out by means of repeated trawling, thus giving way to recolonisation with a known starting point. Bottom trawling and sampling with different gear at the experimental site was complemented by sampling at undisturbed control sites, as well as by UW video and camera documentation in the cleared area and the surroundings. The experiment was concluded successfully whereas biodiversity work planned to proceed simultaneously in this area was hampered to some extent by the fact that, due to the ice conditions, sampling had to be restricted largely to depths around 300 m. A single haul at 1500 m resulted in the find of several mature females of the deep-sea shrimp *Nematocarcinus lanceopes* whose larvae had been found in surface waters, and in the detection of stalked crinoids („sea-lillies"). Visual methods were also applied at the „Hilltop", a small mount created by icebergs and reaching up to 60 m below the sea surface, which reveals a great faunal diversity and a distinct zonation. However, many areas remained inaccessible due to thick pack or fast ice cover, including the site where hard substrates had been deployed six years before for colonisation.
Work in the Austasen restplace lagoon was interrupted from 24 to 26 December due to a strong gale of up to 12 Bft, which did not move the vessel in the pack ice but made work on deck impossible, thus providing an unexpected Christmas break. Trawling, sampling and visual documentation at Austasen and Hilltop were resumed on 27 December and finished on 29 December. "Polarstern" then once again turned toward Drescher Inlet, accomplishing some work on the way, and arriving on 30 December. The seal biologists had been working successfully on Weddell seal diving & foraging ecology, using data loggers and a Japanese camera installed on the seals' backs. This work was combined on the first days of January with 24-h pelagic trawling in different water depths off Drescher Inlet to account for food availability to the seals, revealing that seal foraging is finely tuned to the vertical migrations of their food. In addition, acoustic measurements were taken of seal vocalisation under water by means of hydrophones installed under the fast ice of the inlet.
On 3 January 2004 the temporary Drescher Station was retrieved, the seal biologists taken on board, and the vessel started the return towards Atka Bay. Near Austasen various baited traps and a mooring were collected, the water column work was finished, and some final UW images taken. At the original experimental site, another mooring was retrieved but the baited traps had to be left behind because of the ice. As Neumayer reported thick pack ice covering Atka Bay and we encountered difficult ice conditions on the way, the Captain decided to exchange materials and mail with the station via helicopter from 15 nm distance in order to minimize the loss of time and fuel. In the night of 8/9 January, „Polarstern" left the pack ice belt at 69°40'S, finding extremely calm conditions in open water. On the way back towards Bouvet Island the vessel crossed an extended iceberg belt at about 58°50'S. On 11 January the last field work was done at the Spiess Seamount, 120 nm west of Bouvet, where some stone crabs were found of the type we had expected at Bouvet Island. The return to Cape Town was again favoured by calm sea and, on the last 3 days, sunny weather, and „Polarstern" arrived on schedule at 6:00 h on 18 January 2004, after a 9-week cruise.

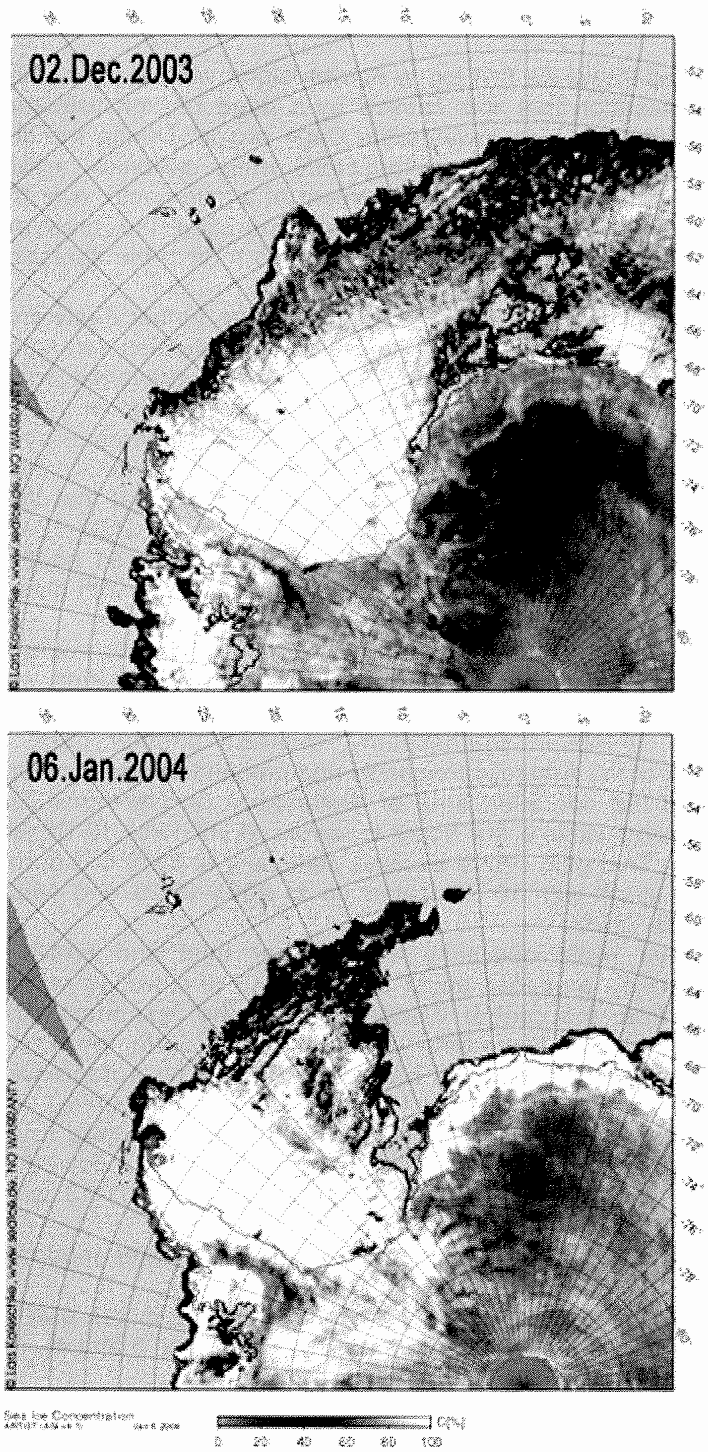

Fig. 2 Development of sea ice cover between Dec 2[nd] '03 and Jan 6[th] '04.

1.4 Weather conditions during ANT-XXI/2 (H.-G. Hill, H. Sonnabend)

When sailing from Capetown the first leg to Bouvet Island was accompanied by a calm synoptic situation that was caused by a ridge of high pressure extending from the Subtropic high towards the Cape region. During the first week the Subtropic high proceeded southeasterly while cyclonical activity increased over the Scotia Sea with the development of a gale centre over the central Weddell Sea. According to this synoptic situation the pressure gradient increased and caused northwesterly gale up to 9 Bft in the operation area of "Polarstern" near Bouvet Island.

The depression moved towards Kapp Norvegia and than further eastwards followed by an intensifying wedge of high pressure. This situation remained for the next days and moderate southwesterly winds prevailed while "Polarstern" was proceeding to Neumayer and passing on to Drescher Inlet.

The calm period was interrupted in the first week of December by a depression that had developed leeward of the Antarctic Peninsula and moved eastwards to Kapp Norvegia. "Polarstern" working in this area at that time observed northeasterly gales on 2003-12-05 and again on 2003-12-07. Subsequently a ridge of the polar high intensified and introduced another period of soft winds but occasionally fog patches and calm hours with glossy sea.

A westward crossing eddy passed along the ice edge with some hours of easterly gales. However, a remarkable change of the synoptic situation was introduced on 2003-12-21 off the coast of Patagonia. Starting from this point a depression built up. It moved southeasterly, received another push of development leeward of the Antarctic Peninsula and proceeded towards Kapp Norvegia. It reached the operation area of "Polarstern" on Christmas Eve when the wind increased within a few hours to severe storm force 12 Bft with gusts up to 80 knots. That gale centre became stationary at 60°S 5°E during the next days. Thus storm with 10 Bft lasted up to 2003-12-26 and winds about 7 Bft up to 2003-12-29.

During the next days while operating at Drescher Inlet and finally at Neumayer, a calm period prevailed under the influence of a wedge of high pressure extending from the central Weddell Sea to the Southeast. That synoptic situation continued in general during the way north towards a position west of Bouvet Island but was brought to an end by a depression which had started to develop near the Falkland Islands and moved into southeasterly direction. North of it a northwesterly gale Bft 8 occurred in the ship's operation area on 2004-01-11. That depression was followed by another one causing again northwesterly gale Bft 8 on 2004-01-13 when "Polarstern" was sailing to Capetown.

The final stage of the cruise was accompanied by fresh, later moderate westerly winds under the influence of the Subtropical high.

In summary the wind conditions during the working period in the eastern Weddell Sea were dominated by moderate easterly winds (Figs. 3 and 4).

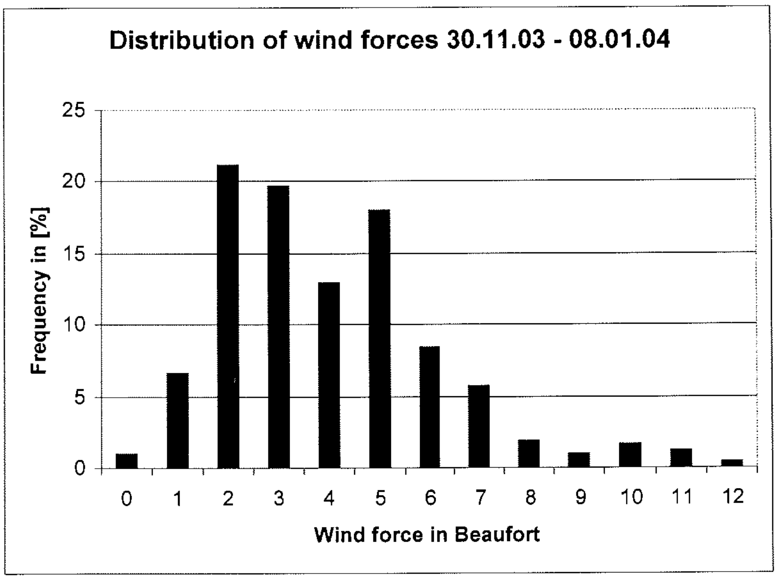

Fig. 3 Frequency of wind force between Nov 30th '03 and Jan 8th '04

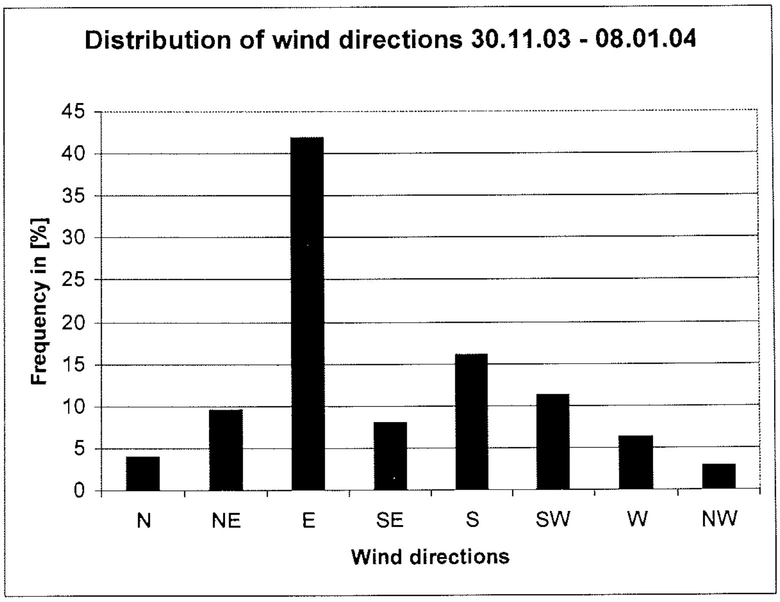

Fig. 4 Frequency of wind direction between Nov 30th '03 and Jan 8th '04

2. Results

2.1 Response of benthic systems to disturbance

(R. Knust, E. Brodte, W. Dimmler, D. Gerdes, J. Gutt, K. Mintenbeck, M. Potthoff, A. Rose, H. Schulz)

Objectives

Iceberg strandings, which regularly occur in the eastern Weddell Sea and other shallow Antarctic regions as well as in the Arctic, play an important role in structuring benthic biodiversity at the seafloor (see also reports EASIZ I-III). From the EASIZ studies carried out to date we know that about 7% of the total shelf area of the eastern Weddell Sea has been disturbed by iceberg scouring during the last 15 years. Within topographically distinct areas ("iceberg cemeteries" or "iceberg restplaces"), almost 50% of the seafloor is affected by this kind of perturbation/disturbance. Iceberg scouring inflicts substantial damage, often destruction, of the established benthic-demersal communities. In the course of recovery, which is assumed to be a very slow process as compared to time scales in temperate or tropical regions, it is possible to distinguish different successional stages of recolonisation, although these cannot yet be placed in an absolute temporal sequence. As iceberg scouring disrupts or destroys older and more mature community stages, it creates space for taxa which as „pioneer species“ initiate recolonisation of the devastated areas, thus giving way to a gradual recovery of the community. Various hypotheses have attempted to describe the effects of these processes on biodiversity, e.g., the „intermediate disturbance hypothesis“; and the „mosaic cycle hypothesis“. The general result seems to be an enhancement of diversity on larger spatial scales due to the co-existence of a variety of different stages, which all have their respective set of species. This may be the case, however, only for intermediate disturbance, and may not work if the impact scale is altered into one or the other direction, e.g. by a further increase of iceberg scour intensity under continued global warming conditions. The time scale of the process of recolonisation and recovery after disturbance will illustrate the vulnerability and resilience of the polar ecosystem as compared to communities in lower latitudes.

During the expedition ANT XXI/2 two long-term field experiments were started to create an initial situation which allows to calibrate succession during recolonisation over longer periods:

- BENDEX: An artificial mechanical perturbation was inflicted under controlled conditions in a limited area to simulate an iceberg scour mark.
- Non-invasive disturbance study: 8 grounded icebergs were equipped with transponders in order to determine the moment and the exact position when they start floating, thus providing a pristine sediment for recolonisation.

2.1.1 The benthos disturbance experiment BENDEX

(R. Knust, E. Brodte, W. Dimmler, D. Gerdes, J. Gutt, K. Mintenbeck, M. Potthoff, A. Rose, H. Schulz)

Objectives

To set a time stamp for recolonisation processes an artificial mechanical disturbance experiment was carried out under controlled conditions in a limited area (100 x 2000m) to simulate effects of grounding icebergs on benthic communities. The study area is situated on the southeastern Weddell Sea shelf in water depths of 255 to 310 m and will be re-sampled in the next years with non invasive methods (photo and video) and by box corers in order to follow the early recolonisation stages.

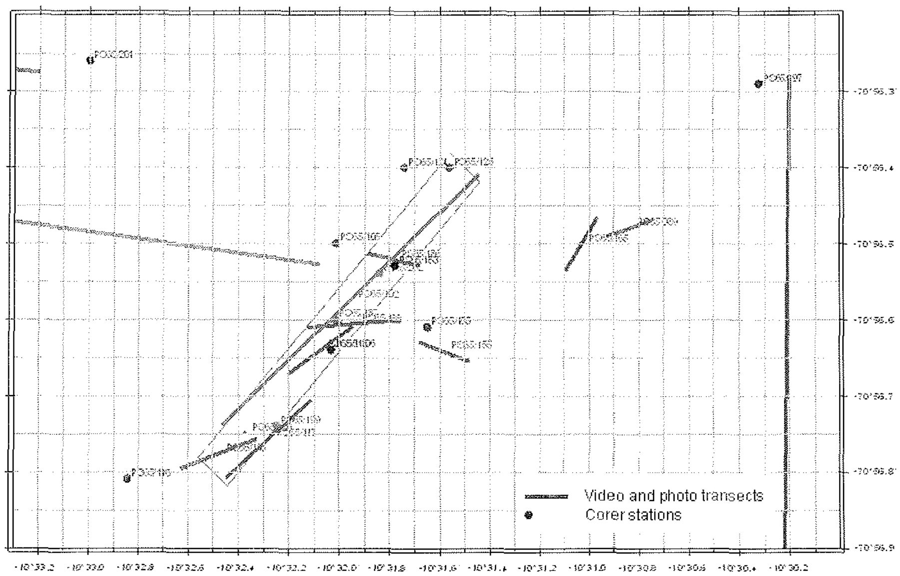

Fig. 5 Pre- and post-disturbance sampling at the BENDEX site west of the Auståsen iceberg bank.

Work at sea and preliminary results

- Pre-disturbance survey

Imaging methods: The first visual check for a representative benthic community started with two series of short stations with 20 photographs each (nos 42-44 and 53-55). Both were situated west of Atka Bay at the outer shelf edge (440m depth) and close to the slope of an inner shelf depression (320-400m depths). Unexpectedly, no sessile suspension feeder communities were found at these sites, although this fauna is well known from the westerly adjacent shallower banks. Instead, mobile organisms such as fish, sea urchins, shrimps and elasipode holothurians were dominant. Beside these forms the poorly sorted sediments showed only patches of debris and were almost devoid of any visible life. Another series of stations (nos. 86-89, 118) (Fig. 5), at water depths between 255 and 310m west of the Auståsen iceberg bank showed that towards the shallower depths close to the grounded icebergs and the shelf ice edge, a much richer community existed. This was dominated by an intermediate abundance of large hexactinellid sponges, compound ascidians and various kinds of bryozoans. Since this result was confirmed by a long ROV transect (stn 102), it was decided to use this site for the disturbance experiment.

Corer sampling: Before the experiment the pre-disturbance state of the meio-, macro-, and megabenthic communities was carefully evaluated by various gear. The quantitative analyses based on multibox corer samples, in case of meiofauna also on additional giant box corers. The multibox corer was equipped with a UW-digital colour camera, which provided additional helpful high quality pictures from the communities sampled. The pre-disturbance sample series consisted of 5 multibox corer (45 cores in total) and 2 giant box corer stations. 33 MG cores were used for macrofauna analyses, 5 cores were taken for chemistry and 7 for meiofauna analyses. The giant box corer provided samples for meiofauna and chemical analyses.

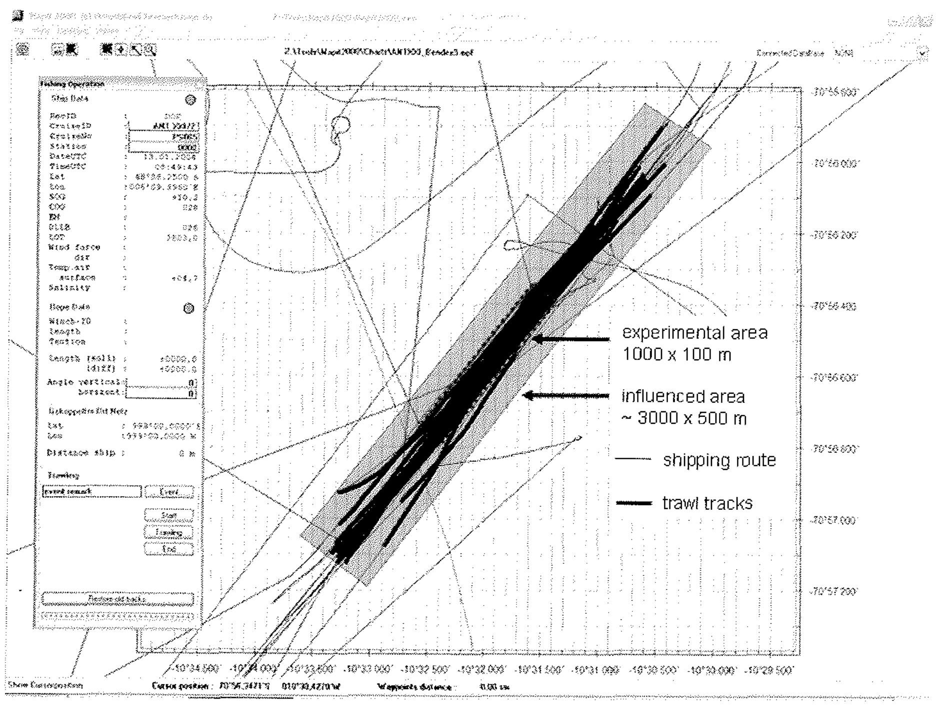

Fig. 6 Position of the experimental plot and of the disturbing bottom trawl tracks according to the online-GSI system.

- The disturbance experiment

The disturbance experiment was carried out by means of a modified bottom trawl. The trawl was equipped with a 400 kg tickler chain and the otter boards were adjusted to drive the gear with maximum contact to the sea bottom. In total 11 hauls were taken to disturb an experimental plot of approximately 100 x 1000 m. The tracks were plotted by an online GIS system, the position of the gear was calculated from the ship's position (DGPS data) and from the length and tension of the cables. The first four hauls were taken with a closed net. Due to the enormous biomass caught of up to 38 t per haul and the difficult handling of these catches, the following seven hauls were carried out with an open cod-end. The position of the experimental area and the trawl tracks are shown in Fig. 6.

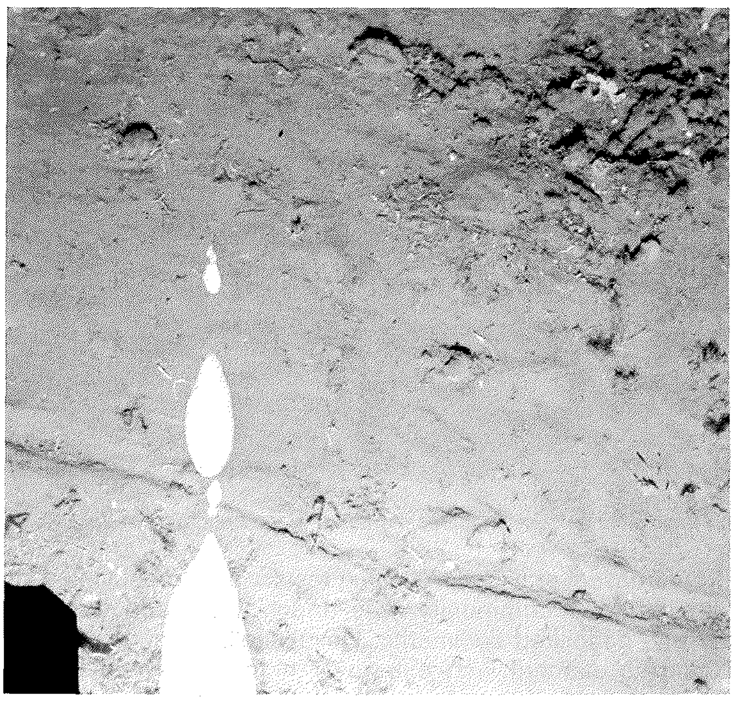

Fig. 7 Typical bott ... ıpact marks inside the experimental plot.

- Post-disturbance ...

Imaging methods: ... ıce effects were evaluated visually at nine photosled stations (... 47, 155, 165, 186, 188, 189, 198, 200) and at two ROV stations (s ... 35) inside and outside of the experimental plot. Inside the artificiall ... d area abundance of the sessile fauna was obviously reduced. L ... y a very small number of sessile animals were visible. Many photos ... he plot showed the typical impact marks of a bottom trawl as cau ... tickler chains, otter boards and rollers. Inside these tracks no sessil ... auna elements could be identified (Fig. 7, Fig. 8). Around these areas the abundance of hexactinellid sponges lying on their sides was high. Outside the disturbance area all sessile animals were covered by a clearly recognizable layer of sediment and the benthic community did not differ from that described from the presurvey. At stn 165 a high turbidity in the near bottom water was registered. A total of approx. 710 70mm photographs have been taken for the pre- and postsurvey, each representing 1m^2.

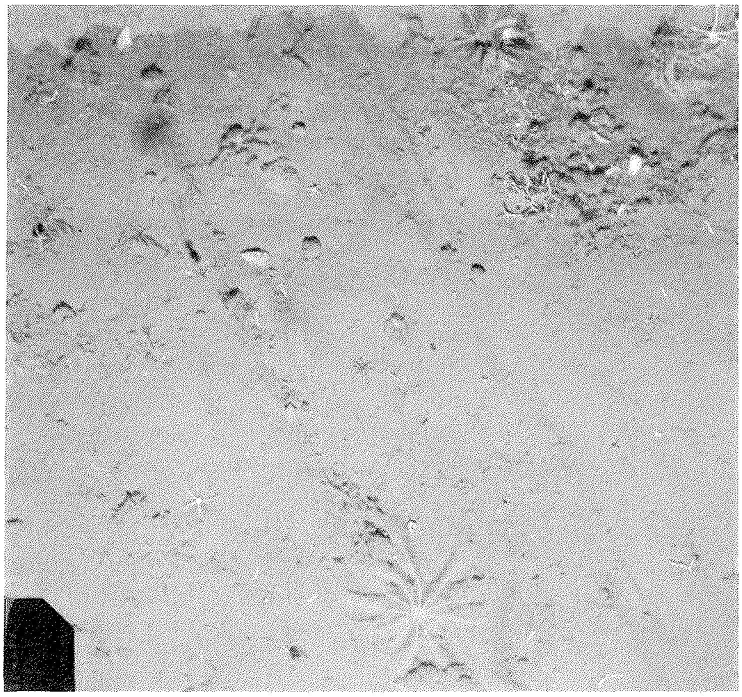

Fig. 8 Impoverished sessile epibenthic fauna in the bottom trawl tracks.

The first ROV transect provided the same results as the photosled. In the last third of the plot the community was much less affected by artificially suspended and deposited sediments. Hexactinellid sponges were the most obvious faunistic element with extremely high concentrations of sponge spicules in-between. At the end of the video transect two natural ice scours were observed. As is typical for this area the pioneers were polychaetes and the bryozoan *Melicerita obliqua*. The second ROV transect (stn 335) was carried out between grounded icebergs in order to compare the effect of the artificial with natural disturbance (Fig. 9). Over the entire transect length of 1,8km the benthic community showed various kinds of successional stages of recolonization with varying species being dominant: *Primnoisis antarcticus, Primnoella* sp., *Stylocordyla borealis, Thouarella/Dasystenella, Melicerita obliqua, Oswaldella sp.* and mobile invaders. Less abundant were compound and solitary ascidians, and various other kinds of bryozoans. Hexactinellid sponges, e.g. *Rossella nuda, Scolymastra joubini, Rossella racovitzae*, being indicator species for an undisturbed assemblage were very rare and occurred only in small patches. An example of such an assemblage from stn 91 is shown in Fig. 10. In contrast to earlier video observations in the same area the proportion of recent iceberg scours was low. In one part of the transect the sediment was flattened by an iceberg creating parallel tracks. At two to three additional sites the sediment was piled up generating a three-dimensional seascape (see Fig. 9).

Fig. 9 ROV sea-bed image at stn 335. The microbathymetry and the benthos are obviously affected by ice-scouring.

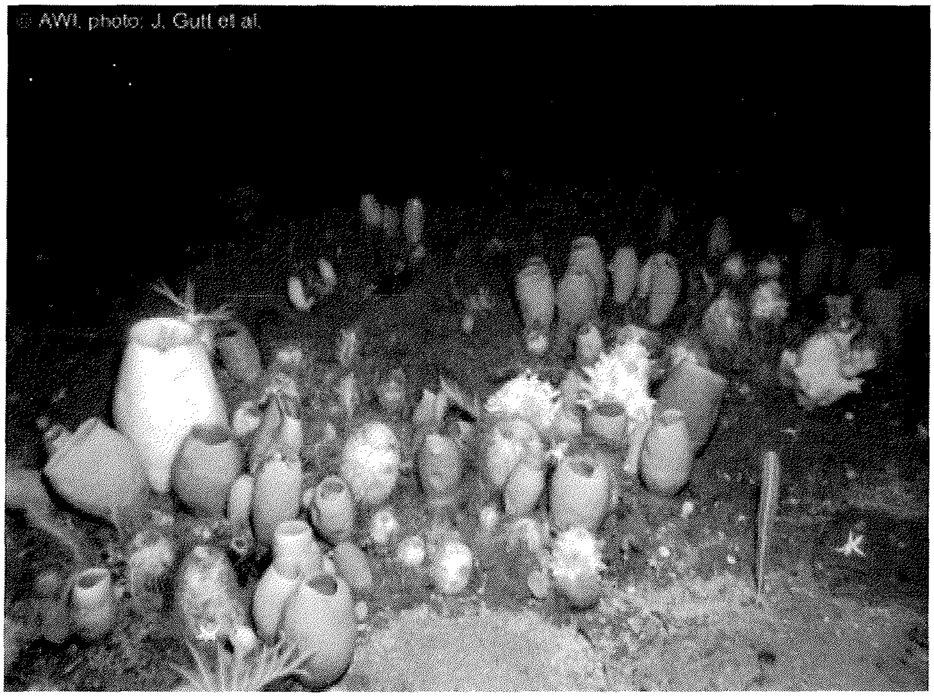

Fig. 10 Benthic community dominated by glass sponges (stn 91), indicating a long period without iceberg disturbance.

Corer sampling: The post-disturbance survey resulted in 34 MG cores (four stations) and 1 giant box corer from the central and marginal parts of the experimental plot. From the MG cores 22 were considered for macrofauna analysis, 8 for meiofauna and 4 for sediment chemistry. The giant box corer provided samples for meiofauna and chemistry analyses. Additionally three reference stations were sampled west and east of the experimental plot in order to better describe the communities on a larger scale adjacent to the disturbed area. From these stations 22 MG cores were obtained, 15 of which were taken for macrofauna analysis, 5 for meiofauna analysis and 3 for sediment chemistry; at station 201, meiofauna and chemistry samples were taken from the same core.

Bottom trawl sampling: One week after the end of the disturbance event, the experimental site was revisited to study the demersal fish fauna. Two bottom trawl hauls were taken within the experimental plot. The species composition of the fish community within the experimental plot resembled the composition typical of disturbed areas on the shelf of the Weddell Sea (Fig. 11) as found during previous expeditions. These preliminary results indicate a relatively quick response of the demersal fish fauna to disturbance events.

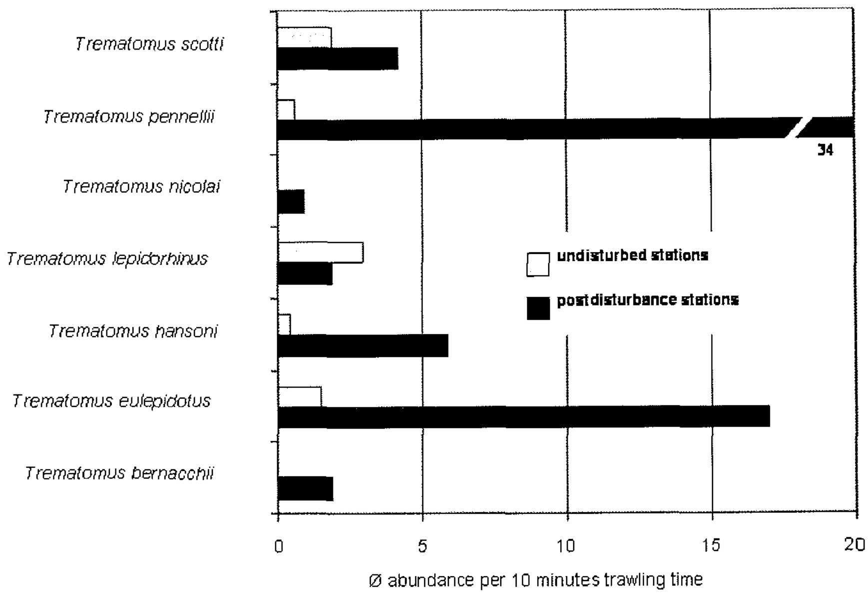

Fig. 11 Species composition within the genus *Trematomus* in undisturbed and experimentally disturbed areas.

2.1.2 **Non-invasive disturbance study** (J. Gutt, M. Potthoff)

Objectives

A non-invasive approach to follow recolonization of the sea floor after iceberg impact was the deployment of ARGOS and IRIDIUM transmitters on grounded icebergs. The aim was to test ecological hypotheses and assess the resilience of a benthic system that is maybe less anthropogenically affected than any other comparable system in the world. It is expected that within the maximum lifespan of the transmitter batteries of 2 years the icebergs will start floating again and, as a consequence, the exact position and time when the devastated seafloor will become available for recolonization is registered. Icebergs had to be chosen according to the following criteria; 1. They do not belong to a concentration of grounded icebergs (iceberg bank or restplace). In such areas the probability is high that another iceberg will disturb the same area again. Such superimposed events might be difficult to distinguish when benthic succession is followed and analyzed. 2. They had to be of a shape that allows the assumption that they did not yet stay for a long period in that place and will start drifting in the near future. Many icebergs that were checked for their usefulness in this context had plenty of cracks and looked as if they would disintegrate in place. 3. Large icebergs being more than 1km long were not considered. It is unlikely that their entire subsurface is in contact with the seafloor. In order to get most precisely the exact position of that area where the iceberg is in direct contact with the sea floor the transmitters have a tilt sensor, which allows a better localization of the desired position. Small icebergs of less than 200m length were also excluded since the affected area would perhaps be too small.

Work at sea and preliminary results

After landing by helicopter on the iceberg a hole approximately 1m deep and 14cm in diameter was drilled to put the 1.5m long cylindrical transmitter housing in. In order to avoid melting two white wooden plates were mounted around the transmitter. One transmitter was deployed in the Auståsen region and one off Kapp Norvegia. When the icebergs start floating again the data collected will be used by a project of Physical Oceanography for which additional 6 transmitters were deployed on drifting icebergs. Unfortunately no more transmitters could be deployed due to weather and ice conditions and due to a low abundance of suitable icebergs in the working areas. A photosled station (no. 267) close to a grounded iceberg with transmitter showed a high percentage of disturbed community although this iceberg was situated far outside the Auståsen iceberg bank. The undisturbed patches were dominated by the demosponge *Cinachyra barbata*, and early stages of recolonization in-between showed relatively high abundances of two typical pioneers, the sponge *Iophon spatulatus* and the gorgonian *Primnoisis antarcticus*.

2.2 Adaptation to isolation and glacial cycles

2.2.1 Adaptive competence of Teleostei

(F. Mark, C. Bock, E. Brodte, T. Hirse, R. Knust, N. Koschnick)

Objectives

Temperature is one of the main abiotic factors determining the biogeography of poikilothermal fish. Latitudinal distribution of fish populations is thus mainly defined by their tolerance towards temperature, i.e. eurythermal fish inhabit wider latitudinal ranges than stenothermal fish. In polar Teleostei, temperature adaptability differs between high-Antarctic and sub-Antarctic animals. Apart from restrictions of the cardiovascular system, temperature adaptability of an organism might be defined on a rather low, e.g. cellular level by temperature induced shifts in the energy allocation to the metabolic processes of the cell. We compare the temperature sensitivity of the cell's energy consuming processes such as protein, RNA and ATP synthesis, as well as ion regulation between different fish species. Furthermore, the effect of temperature on protein synthesis and lipid metabolism will be investigated by incubation experiments with high-Antarctic fish. Molecular analysis of tissue samples will be used to specify temperature adaptability of selected fish species.

Work at sea

Animals were collected with Agassiz- and bottom trawls and fish traps near Bouvet Island and from stations at Atka Bay, Auståsen and Drescher Inlet. Samples for molecular analysis of various tissues were taken from anaesthetized fish directly after catching and were deep-frozen in liquid nitrogen for further analysis at the AWI. Live specimens of sub-Antarctic and high-Antarctic fish were maintained in an aquarium for several days before experimentation. For studies on cell energy metabolism, fish hepatocytes were isolated, counted and stored in a buffered salt solution at 0°C until further analysis. Oxygen consumption of liver cells was measured at different temperatures and specific metabolic cell inhibitors were added to determine the amount of specific cell processes on the overall energy demand of the cells. In a second approach isolated liver cells were incubated with ^{13}C-labelled phenylalanine or acetate at different temperatures for the study of temperature dependent protein and lipid synthesis, respectively. Samples were taken 2, 4 and 6 hours after the addition of the tracers, washed and immediately frozen in liquid nitrogen. The incorporation of ^{13}C isotopes will be measured in these samples with NMR spectroscopy at the AWI.

Preliminary results

Table 1 summarizes the collected fish species and tissue samples taken for molecular analyses. ^{13}C-labelled incubation experiments were performed at 0°C, 3°C and 6°C on liver cells from the high-Antarctic fish *Trematomus pennellii* (Table 2). First results of the hepatocyte experiments indicate that hepatocytes of sub-Antarctic fish clearly differ from high-Antarctic fish in terms of oxygen consumption, but at sufficient ambient oxygen concentrations the cellular energetic balance is maintained over the temperature range 0 - 15°C.

Fig. 12 presents the results of oxygen consumption measurements of hepatocytes of the sub-Antarctic fish *Lepidonotothen larseni* at different temperatures. The cellular preferential temperature appears to be located between 4 and 6°C, where oxygen uptake is lowest. After the addition of metabolic inhibitors the amount of specific energy consuming processes in the cell was determined. Fig. 13 depicts the cellular energy budget over the range of temperatures. Fig. 14 shows cellular oxygen consumption of the high-Antarctic fish *Trematomus eulepidotus* hepatocytes. Here, oxygen consumption is lowest at 0°C, but the cellular energy budget does not show any obvious effects of temperature (Fig. 15).

Tab. 1 Fish species of which tissue samples were taken for molecular analysis (muscle, blood, gills, liver, heart, spleen)

Main taxa	Species	Station	N° of individuals
Artedidraconidae	Artedidraco orianae	121, 276	5
Artedidraconidae	Artedidraco shackeltoni	39, 265	7
Artedidraconidae	Dolloidraco longedorsalis	283	5
Artedidraconidae	Histiodraco velifer	121	1
Bathydraconidae	Cygnodraco mawsoni	121, 247, 265, 276	6
Bathydraconidae	Gymnodraco acuticeps	39, 247	3
Channichthyidae	Chaenodraco wilsoni	259	1
Channichthyidae	Chionodraco hamatus	247, 336	2
Channichthyidae	Chionodraco myersi	259, 274, 280, 292	10
Channichthyidae	Cryodraco antarcticus	259, 292	3
Channichthyidae	Pagetopsis macropherus	39	1
Channichthyidae	Pagetopsis maculatus	259	1
Nototheniidae	Pleuragramma antarcticum	329	7
Nototheniidae	Trematomus bernacchii	245, 259	4
Nototheniidae	Trematomus eulepidotus	245, 253, 259, 265	5
Nototheniidae	Trematomus hansoni	39, 247, 248, 259	12
Nototheniidae	Trematomus lepidorhinus	248, 253, 259, 265	7
Nototheniidae	Trematomus nicolai	39, 245	3
Nototheniidae	Trematomus pennellii	121, 245, 259	10
Nototheniidae	Trematomus scotti	245, 265, 276	7
Zoarcidae	Pachycara brachycephalum	289	2

Tab. 2 Number of ^{13}C-labelled experiments.

Species	Incubation temperature	Acetate	Phenylalanine
Trematomus pennellii	0 °C	4	4
Trematomus pennellii	3 °C	4	3
Trematomus pennellii	6 °C	4	4

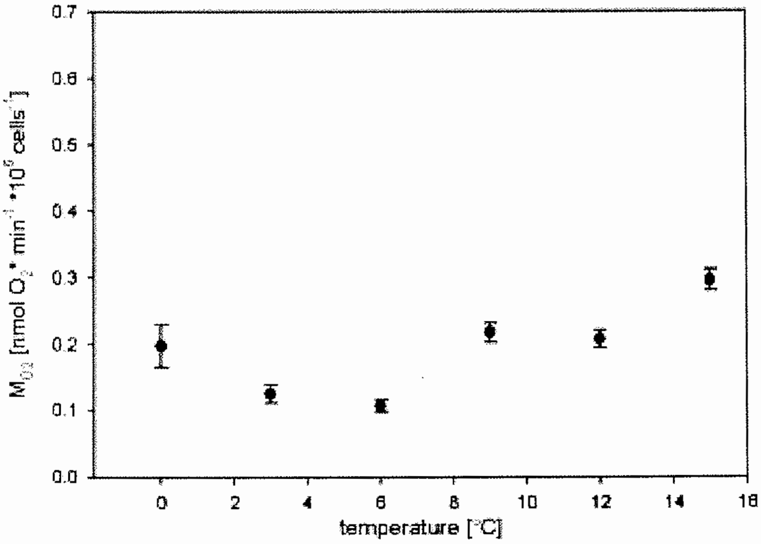

Fig. 12 Hepatocyte respiration of the sub-Antarctic fish *Lepidonotothen larseni*

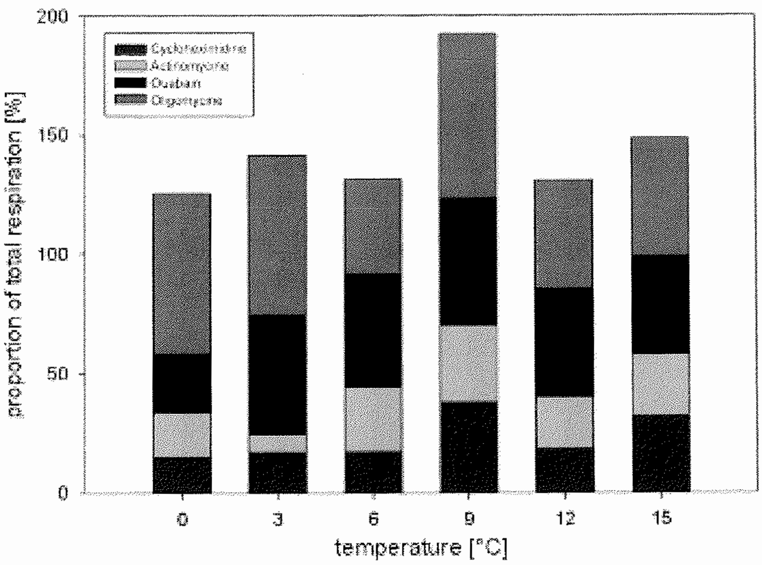

Fig. 13 Cellular energy budget of *Lepidonotothen larseni*.
Used inhibitors were mainly effective on protein synthesis (cycloheximide), RNA synthesis (actinomycine), Na^+-K^+-ATPase (ouabain) and ATP-Synthetase (oligomycine).

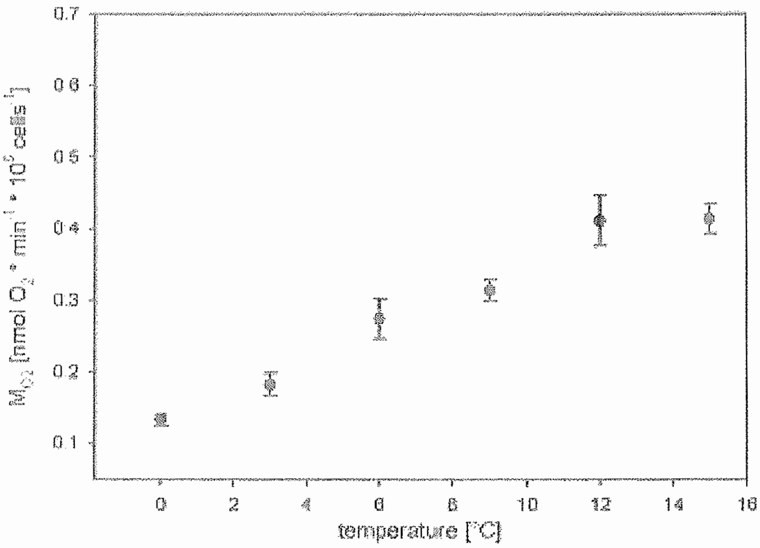

Fig. 14 Hepatocyte respiration of the high-Antarctic fish *Trematomus eulepidotus.*

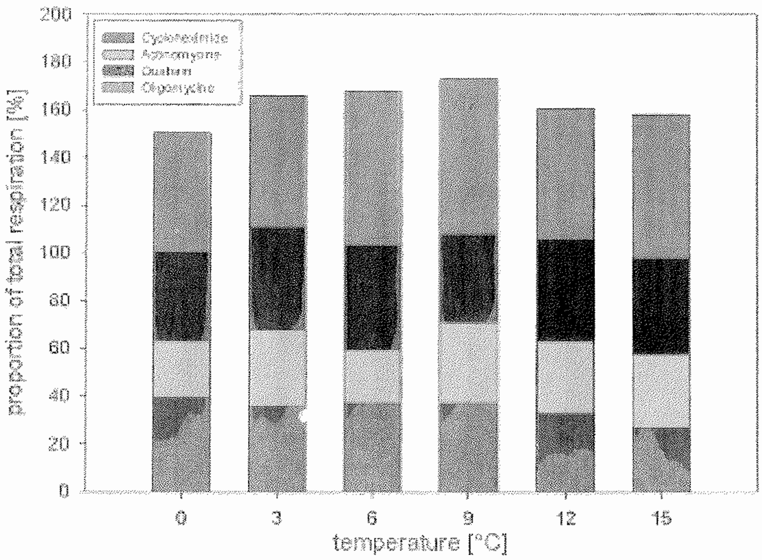

Fig. 15 Cellular energy budget of *Trematomus eulepidotus.*
Used inhibitors were mainly effective on protein synthesis (cycloheximide), RNA synthesis (actinomycine), Na^+-K^+-ATPase (ouabain) and ATP-Synthetase (oligomycine).

2.2.2 Zoogeography of demersal fish species

(K. Mintenbeck, E. Brodte, R. Knust)

Objectives

The fish community at Bouvet Island was one of our major targets during this expedition, as we expected an exchange with the Scotia Arc fauna (studied in 2002, ANT XIX-5) driven by the Antarctic Circumpolar Current. The second area of interest was the north-eastern Weddell Sea. From previous expeditions (e.g. ANT XV-3 and ANT XVII-3) we know that the shelf in this part of the Southern Ocean is clearly dominated by the perciform suborder Notothenioidei. This cruise provided the opportunity to extend the existing data base into austral spring.

Work at sea

Demersal fish were sampled by a bottom trawl (BT) and two Agassiz trawls of different size. At Bouvet Island a small Agassiz trawl (AGTsmall) with an opening width of 1.5 m was used, and on the northeastern Weddell Sea shelf the bottom trawl, the small AGT and additionally an AGT with 3.0 m opening width (AGT) were applied. Specimens were identified according to the appropriate literature, measured and weighed. Stages were determined for monitoring of reproductive state, sex and maturity. Stomachs, otoliths and tissue samples for genetics and stable isotope studies (for details see chapter "Trophic structure and energy flow of the Weddell Sea shelf ecosystem") were collected and preserved for later analysis.

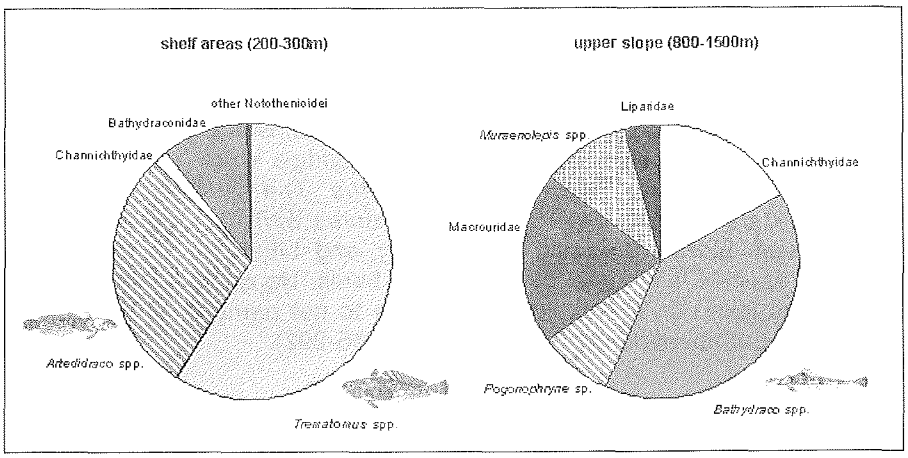

Fig. 16 Distribution of *Lepidonotothen larseni* and *L. kempi* (Nototheniidae) along the Scotia Arc (left map; data collected during ANTXIX-5, 2002) and at Bouvet Island (right map).

Preliminary results

At Bouvet Island the nototheniid *Lepidonotothen larseni* was highly abundant and the only species found between 130 and 250 m water depth. In one haul at 370m a single individual of *Lepidonotothen kempi* was caught besides *L. larseni*. Since both species are common constituents of the southern Scotia Arc fauna (ANT XIX-5) a dispersion via larval drift within the Circumpolar Current is very likely (Fig. 16).

Some juvenile *L. kempi* were caught with the BT close to the ice edge off the Drescher Inlet, in about 600m water depth (St. 65-292), too. This species has a lower concentration of anti-freezing glycopeptides than other notothenioids (Wöhrmann 1996). Thus it is restricted rather to the shelves of Subantarctic islands (Scotia Arc, Bouvet Island) and of the Antarctic Peninsula, as shown above. It has been reported, however, from the high Antarctic Weddell Sea by other authors as well, but always in warmer waters deeper than 500m.

The composition of the ichthyofauna in the north-eastern Weddell Sea is related to water depth (Fig. 17; only AGT and AGTsmall considered). In the shallow shelf areas (200-300 m water depth) we found fish of the suborder Notothenioidei only, predominantly of the genera *Trematomus* (mainly *T. eulepidotus* and *T. pennellii*; Nototheniidae) and *Artedidraco* (mainly *A. skottsbergi* and *A. shackletoni*; Artedidraconidae). *Chionodraco myersi* was the most common species of the family Channichtyidae, whereas the bathydraconids were represented by *Cygnodraco mawsoni*, *Gymnodraco acuticeps* and *Prionodraco evansii*. Compared to these AGT hauls the species composition of the BT hauls was similar except a slightly higher share of channichthyids.

On the upper slope off Kapp Norvegia (800-1500 m water depth) the Notothenioidei had a share of 65% in the fish fauna. The most abundant group was the genus *Bathydraco* (Bathydraconidae) with the two species *B. macrolepis* and *B. marri*. *Pogonophryne macropogon* was the only species of the family Artedidraconidae. The Channichthyidae were represented by *Dacodraco hunteri* and *Chionodraco hamatus*. The remaining 45% were composed of the families Macrouridae (*Macrourus whitsoni*), Muraenolepidae (*Muraenolepis marmoratus* and *M. microps*), and Liparidae. Altogether, the number of species was lower in the deeper hauls. No quantitative evaluable BT haul was taken on the upper slope owing to net damage at the seafloor and subsequent abandonment of trawling (St. 65-292).

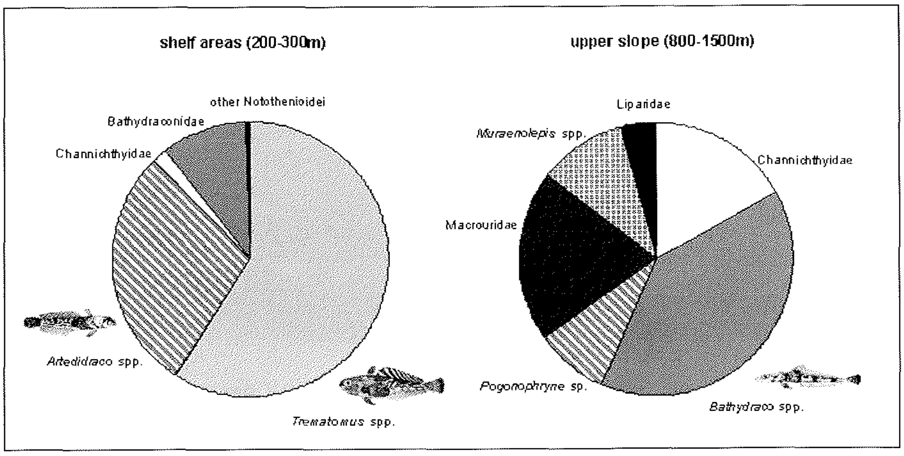

Fig. 17 Dominance of individuals [%] caught with the AGT and the AGTsmall in shallow areas (left figure) and on the upper slope (right figure) of the north-eastern Weddell Sea.

Members of the cosmopolitan family Zoarcidae (eelpouts) were scarce and caught neither by BT nor by AGT. Two individuals of *Pachycara brachycephalum* were caught with a fish trap (St. 65-288) in the Drescher Inlet at about 850m, and another small individual by the EBS southeast off Kapp Norvegia in 560 m water depth (St. 65-283). This juvenile *P. brachycephalum* was the smallest specimen ever found (M.E. Anderson, pers. comm.; SAIAB, Grahamstown). *Ophthylmolycus bothriocephalus* was also found in this EBS haul, as well as in one Rauschert dredge from the Drescher Inlet (St. 65-325; 460m).
Some species showed evidence of sexual dimorphism. Male *Chionodraco myersi* (Channichthyidae) have a distinctly higher first dorsal fin (D1) than females (Fig. 18 A). In the artedidraconids *Artedidraco orianae* (Fig. 18 B) and *A. shackletoni* the colouration patterns appear to be gender specific. Similar dimorphisms are known from other fish taxa (e.g. some North Sea species), but hitherto not from Antarctic fishes.

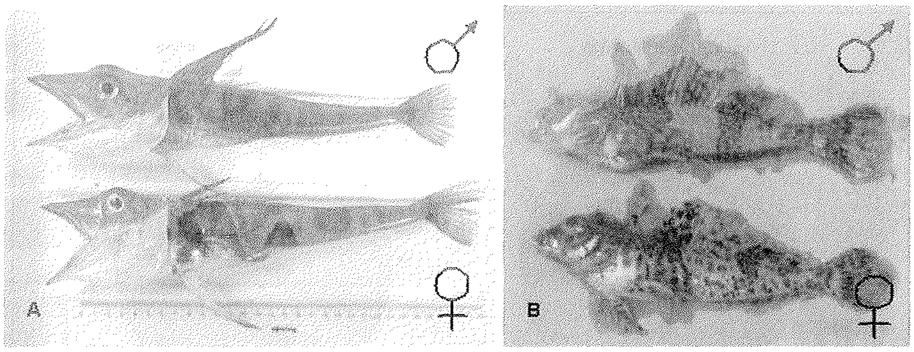

Fig. 18 Sexual dimorphism in *Chionodraco myersi* (Channichthyidae, A) and *Artedidraco orianae* (Artedidraconidae, B).

2.2.3 Reproductive strategies of Antarctic decapod crustaceans
(S. Thatje, M. Lavaleye, W.E. Arntz)

Objectives

The Antarctic realm is characterised by an impoverished decapod fauna, which on the high Antarctic shelf is represented by only five benthic caridean shrimp species. Out of these only *Notocrangon antarcticus*, *Chorismus antarcticus*, and the deep-sea shrimp *Nematocarcinus lanceopes* are regularly found. The reason for the impoverished Antarctic decapod fauna and the principal lack of reptant crabs, has been addressed to the failure of reptants to down regulate high $Mg2+$ concentrations in their haemolymph in the cold. Consequences are paralysing effects, which affect any kind of behaviour requiring activity, such as moult, reproduction and feeding. The particular success of a few caridean shrimp species to sustain polar conditions was addressed to their ability to regulate $Mg2+$ haemolymph concentrations. Furthermore, they evolved early life history adaptations in planktotrophic larval developments, which allowed them to cope with the mismatch of prolonged developmental times at polar temperatures and short periods of primary production. So far, only lithodid crabs from the Southern Ocean are known to be uncoupled from primary production, since they developed completely endotrophic (lecithotrophic) larval developments. Including their cold-stenothermality, this has been suggested a key factor for their successful radiation in the Southern Ocean.

Our aims were the study of:

- biogeographic and distributional limits of decapod crustaceans in the Weddell Sea (including Bouvet Island)
- taxonomic state of the art of the decapod fauna
- reproductive status of decapod species
- energy budgets in larvae (degree of endotrophy) and feeding types, and
- sampling for population genetics.

Work at sea

Decapod material has been obtained from waters off Bouvet Island and the high Antarctic Weddell Sea shelf using the AGT, the Rauschert dredge, the epibenthic sledge, and the stone dredge. Decapods were cleaned and identified in the laboratory. Material of both, adults and embryos was frozen at –20°C for later biochemical analyses (lipids, fatty acids, C, H, N) in Germany. Some material was fixed in 3-4% buffered formalin for morphology studies. Adult specimens of all species and from all sampling localities were fixed in absolute ethanol and stored at –20°C for later molecular analyses. Live material (especially ovigerous females) was maintained at constant temperature (approx. 0°C) in aquaria. Healthy adult specimens of *Notocrangon antarcticus*, *Chorismus antarcticus*, and *Nematocarcinus lanceopes* were obtained from samples taken on the Weddell Sea shelf. Ovigerous females of both *C. antarcticus* and *N. antarcticus* will be transported to the laboratory in Germany, whereas all ovigerous females of *N. lanceopes* died a few days after capture. The aim of the live material transport is the later study of nutritional changes in eggs throughout embryo development.

Larvae of *C. antarcticus*, *N. antarcticus*, and *N. lanceopes* were hatched on board and kept individually in 100ml plastic cups under constant conditions of temperature (0°C) and salinity (approx. 33.5-34). In addition, larvae obtained from the plankton, using the bongo and/or multinet, were maintained in individual cultures. Larvae were fed with ice algae obtained from the plankton hauls and/or melted sea-ice. Cultures were daily checked for dead or moulted larvae. Water was changed and food was supplied every second day.

Morphology samples were taken from all larval stages reared in the laboratory and preserved in 3-4 % buffered formalin. Subsequent samples for the study of elemental changes (C, H, N) and lipid and fatty acid contents throughout larval development have been taken. For this purpose, larvae were individually frozen at –20°C for later analyses in Germany. This experiment aims at the evaluation of the nutritional status of early decapod larvae under polar conditions. Additional larval cultures under absence of food shall reveal their resistance potential to starvation.

Specimens of the lithodid crab *Paralomis* cf. *formosa* were obtained from the Spiess Seamount. Three specimens were fixed in absolute ethanol and stored at –20°C for later morphology and molecular studies. The only ovigerous female obtained was maintained in the laboratory in order to study the larval developmental cycle of this species but died on the way home.

Preliminary results

- Species richness

The Spiess Seamount decapod fauna was characterised by the lithodid crab *Paralomis* cf *formosa*, which were obtained from different gear and also appeared on two underwater photographs taken at approximately 600m water depth. Out of the four specimens obtained (2 males and 2 females); one female showed recently extruded eggs.

The decapod fauna at Bouvet Island was surprisingly poor. Only three caridean shrimp specimens were obtained from the four AGT. They reveal two morphotypes, both apparently new to science.

On the high Antarctic continental shelf we caught the caridean shrimps *N. antarcticus*, *C. antarcticus*, and the deep-sea caridean *N. lanceopes* (the latter from approx. 800 to 1500 m water depth). Specimens of an unidentified caridean were obtained from the epibenthic sledge.
All species showed individuals in the stage of reproduction, including one female of the unidentified caridean bearing an egg batch close to hatching. The other caridean species released larvae at the very beginning of this cruise (beginning of December). At the same time recently extruded eggs were found in some females.
In the laboratory we observed the moulting and mating behaviour of *N. antarcticus*. The moulting process, surprisingly, just lasted about three minutes in the female, from rupture of the carapace to leaving the exuvia. A few abdominal flappings, as typically found in escape attempts, facilitated leaving the exuvia. The much smaller male showed conspicuous colouring in two parallel white stripes on the carapace and some white chromatophores on the abdomen and the tail fan. This colouring has been observed previously, but was not related to mating behaviour. Since other males did not show such feature and were obviously not interested in the moulting female the coloration may be an indication of an active reproductive stage in males The male was standing right next to the female during moult. Just before the female left the exuvia, the male crossed the abdomen of the female in a typical backward swimming behaviour (as in typical escape attempts). The sperm was released during this action. The female left the exuvia only a few seconds later.

- Larval development

The zoeal development of *N. antarcticus* (3 zoeal stages) was completed during this cruise. Rearing of larvae of *C. antarcticus* was finished in the second zoeal stage already, at the end of the cruise. Most interesting was the study of larvae of *N. lanceopes*. They are extremely large at hatching (>1.3 cm), but surprisingly primitive in morphology. The pereiopods are only visible as reduced buds; no pleopods and uropods are present. The second zoeal stage was reached during the expedition. The second zoea is bigger than the first one, but morphologically not advanced, indicating an extended planktotrophic larval development, which is unusual for a deep-sea and high latitude shrimp. The most conspicuous morphological differences, when compared to the first zoea, are the reduction of setae at the posterior margin of the telson (6 pairs instead of 7), and the size difference.
Since larvae of *N. lanceopes* depend on primary production their feeding strategy and especially possible resistance to starvation is of high scientific interest. In addition, larvae of *N. lanceopes* were obtained from surface water plankton catches, carried out in the coastal polynia and indicating a strong primary production dependence in early spring. We hope to elucidate this problem by elemental and biochemical analyses, which should especially allow for explaining the export strategy of planktotrophic larvae from the deep sea to the euphotic zone of the polynia.

2.2.4 Pelagic larvae and juveniles of benthic invertebrates in the near-bottom environment (M. Lavaleye, S. Thatje, G. Duineveld, W. E. Arntz)

Objectives

Thorson's research in the Arctic (1936-1950) led to the idea that there is a clear trend in the larval development of benthic invertebrates from tropical to polar seas. While in tropical regions a pelagic larval development is favoured, benthic invertebrates in the Arctic and Antarctic seas commonly have a direct development without a pelagic stage. The scarcity of pelagic larvae of benthic invertebrates in polar zones is now commonly known as "Thorson's rule". Several recent studies on gastropods, bivalves and polychaetes support this hypothesis. However, other studies have shown that in echinoderms the ratio pelagic development to direct development is similar in temperate and polar regions. The pelagic development of benthic species can be divided into a planktotrophic and lecithotrophic development, of which the latter seems to be more common in polar invertebrates. However, studies providing quantitative and/or qualitative data about pelagic larvae of benthic invertebrates in polar waters are still scarce. Therefore, our goal during this expedition was to try to quantify and identify these larvae in the Weddell Sea near the shelf ice. It was suspected from our own research in the North Sea that some larvae may live close to the bottom at a certain stage and can be resuspended with the tidal currents. That is why we tried to catch these larvae in the near-bottom water and over longer time periods during different current regimes, and to measure environmental factors such as currents, mass flux and turbidity. Our study also fits into the disturbance and recolonization research (BENDEX), forming the main project during this expedition, as the possession of pelagic larvae obviously can enhance the means and speed of distribution of a species for recolonization of disturbed benthic areas. Another possibility for enlarging the range of distribution of a benthic animal is its ability to swim. Personal observations of near-bottom sediment-trap samples from the deep sea showed that juveniles of benthic invertebrates were frequently found, e.g. of ophiuroids, crinoids, gastropods, bivalves and polychaetes. Bhaud et al (1999) also mention the presence of juvenile benthos in samples collected by plankton nets in the Ross Sea (Antarctica). It is often assumed that these juveniles were suspended accidentally because of turbulence or bottom currents (e.g. tidal currents). We think that the suspension of juveniles is often not accidental but intentional although triggered by turbulence or currents. It is well known that even some adult ophiuroids, crinoids and polychaetes can swim. Some bivalves can travel too, by making a mucous string or byssus thread (Beukema & de Vlas, 1989). Possibly some gastropods may have a similar mode of distribution. Therefore we also tried to quantify and identify suspended juveniles of benthic invertebrates. This study is a cooperation between the Royal Netherlands Institute for Sea Research (NIOZ) and the Alfred Wegener Institute for Polar and Marine Research (AWI).

Work at sea

For the near-bottom quantitative sampling of larvae and juveniles of benthic invertebrates two different instruments were used, namely the ALTRAP (Autonomous Lander for in-situ larval studies) and the Giant Water Box, both

of NIOZ design. The lander is a free fall system that can work autonomously at the bottom of the sea for more than 6 months until a maximum depth of 6000 meters. Two acoustic releasers, a central ballast weight of 300 kg, and 13 glass spheres are the basic parts of the lander that enable the recovery. A radiobeacon, flashlight, large orange flag and Argos buoy are attached to enhance location after the lander has come to the surface. The built-in water sampler, the main instrument of the ALTRAP, is specially designed to also catch animals that have swimming and sensing abilities with which they may escape from normal plankton pumps. It consists of a vertical moving barrel, which when released in its upper position works as a guillotine and encloses a volume of 25 litres of water in a split second. A piston then drives the water through one of the 12 filters. This action can be repeated multiple times (70 times or more) dependent on the stored energy of the battery spheres (NiCa). The filters with a pore size of 100 μm are cylindrical and have a relatively large surface to avoid quick clogging in situations of high particle concentrations in the water column. They can be selected randomly and the samples may be preserved by injection of a formaldehyde ethanol mixture. Barrel and piston are actuated by means of hydraulics. All actions and filter selections are fully programmable through a PC interface. Furthermore, the ALTRAP lander has a sediment trap (Technicap PPS 4/3) with its opening two meters above the bottom, a current meter (FSI 3) at 0.5 m above bottom, and two Optical Backscatters (Seagate) at 0.5 and 2 m above bottom for turbidity measurements. It is also equipped with a time-lapse analog video-camera, that takes pictures of the bottom, the near-bottom water and the animals that are attracted by a bait in front of the camera for <= 3h. Additionally also amphipod traps were attached to the lander for other research.
The Giant Water Box is a water-sampler that catches 1000 liters of near-bottom water (0.5 - 2.5 m above bottom). It is lowered with a cable to the seafloor. During the descent the water can flow freely through the square vertical tube. When the bottom-contact touches the seafloor the upper and lower valves will close off the tube. On deck the water is tapped and filtered over a sieve with pore size of 100 μm. The filtrate was preserved in 70% ethanol. The Giant Water Box was used as a backup for and for comparison with the ALTRAP lander, because of its simplicity and large volume. The near-bottom water collected by the GWS was also used for chemical analyses by other scientific groups.

Preliminary results

The ALTRAP lander was successfully deployed four times, three times off Auståsen at a depth of 390 m, and one time off Drescher Inlet at a depth of 510 m. All deployments had a duration of approximately 3 days. Per deployment 150 l of water were filtered over every of the 12 filters in a time sequence, this makes a total of 7200 l filtered during the expedition. The samples were not analyzed on board but Copepoda and Amphipoda were noticed, which proves that the device indeed catches fast swimmers. The sediment trap caught noticeable amounts of faecal pellets and particles during all deployments, and the content will be analysed for mass flux, swimmers, phytoplankton, C, N, and Si. During the third deployment, however, the trap was still open upon recovery, as we had to break off the deployment

because of a forthcoming storm. The video camera shot a total of about 6 hours of footage. It showed a score of animals, like clouds of euphausiaceans, amphipods, isopods, fish, sea-urchins, starfish, gastropods and sea spiders. Of one giant sea spider the walking speed was calculated as 7m/hour at a temperature of -1.9 °C.
The results of the current meter are shown in Fig. 19 (Auståsen) and Fig. 20 (Drescher Inlet). These show the presence of a clear tidal current. Surprisingly, comparing the two stations, a large difference between the Auståsen and Drescher Inlet station is noticeable. The current speed at Drescher Inlet is much lower with peaks hardly reaching 10 cm/sec than at Auståsen where peaks of over 20 cm/sec were measured. On top of that the tidal cycle at Auståsen seems to be daily while that at Drescher Inlet is twice a day. The results of the turbidity sensors are shown in Figs. 21 and 22. It shows that the sensor at 0.5 m above the bottom almost always measured a much higher particle load of the water than the sensor at 2m height. During the last deployment at Auståsen the readings of the 2 m sensor overlapped and are sometimes higher than the one at 0.5 m. This could be caused by sinking particles (faecal pellets) out of the euphotic zone where the spring bloom was developing quickly (personal observations J.Michels & A Pasternak).
In total 19 plankton samples were collected with the GWS. During the first samples colourless copepods with no gut content were caught of which we suspect that they were still hibernating near the bottom. Later on still fair amounts of Copepoda and nauplii were caught but now very lively, colourful and with gut contents. This result correlates with the development of the spring bloom in the euphotic zone. A quick survey of the samples showed that in almost all catches one or a few larvae of several species of polychaetes were present. Very few other large larvae were seen. Other organisms seen included Appendicularia, Chaetognatha, Pteropoda (*Limacina* spec.), and algae. During the last catch at Auståsen the 50 μm sieve used to condense the filtrate was clogged by the amount of algae, another indication that algae of the spring bloom already reached the bottom in high concentrations.

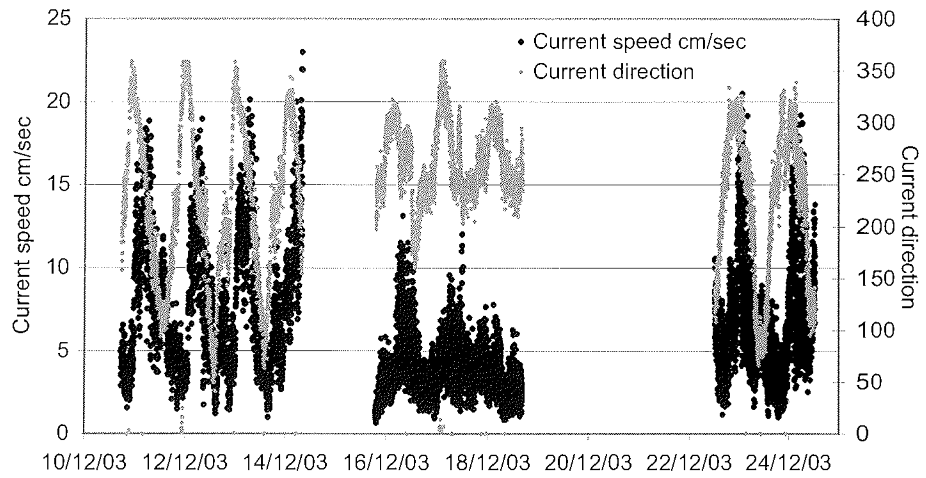

Fig. 19 Current speed (cm/sec) and direction (degrees) at 0.5 m above the bottom, measured during the three ALTRAP deployments at the Auståsen station at a depth of 390m.

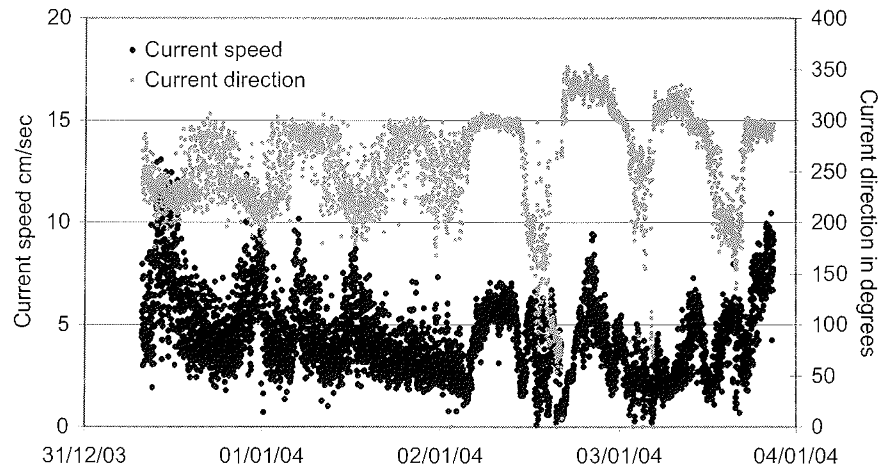

Fig. 20 The current speed (cm/sec) and direction (degrees) at 0.5 m above the bottom, measured during the ALTRAP deployment at the Drescher Inlet station at a depth of 500 m.

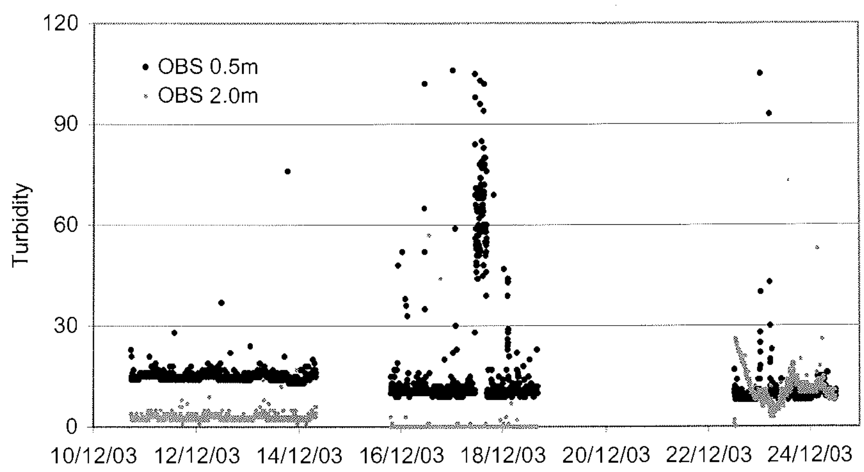

Fig. 21 The relative turbidity (optical backscatter) at 0.5 m and 2 m above the bottom, measured during the three ALTRAP deployments at the Auståsen station at a depth of 390 m.

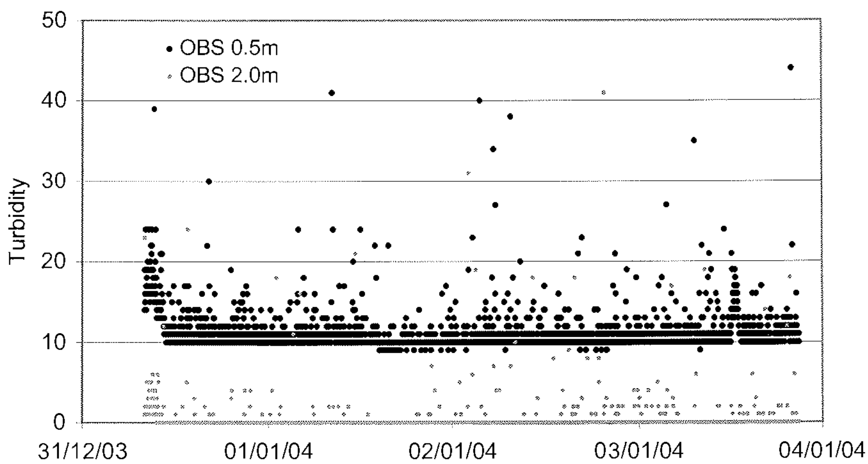

Fig. 22 The relative turbidity (optical backscatter) at 0.5 m and 2 m above the bottom, measured during the ALTRAP deployment at the Drescher Inlet station at a depth of 500 m.

2.3 Weddell Sea food web and bentho-pelagic coupling

2.3.1 Multidisciplinary spring bloom study (D. Gerdes, J.-M. Gili, E. Isla, M. Lavaleye, J. Michels, A. Pasternak, A. Rodríguez y Baena, S. Rossi, B. Vendrell, T. Brey)

Objectives

This project developed by chance during the cruise. Ice conditions forced the expedition to work west of the Auståsen iceberg restplace most of the time. This geographical restraint led to the establishment of one semi-permanent "plankton" station, which could be sampled over a 28 day period, starting around the onset of the phytoplankton bloom. From the large amount and variety of physical, chemical, and biological data measured we intend to synthesize a detailed picture of bloom development, of the reaction of the pelagic system to the bloom, and of the dynamics of the accompanying vertical transport.

Work at sea

The permanent station was sampled between 09 Dec. 2003 and 05 Jan. 2004. During this time, the following gear were deployed: One mooring with sediment trap and current meter, a lander with sediment trap, current meter and plankton suction pump (3 deployments), CTD rosette (16 sampling dates), In Situ Pump (12 sampling dates), Multinet (15 sampling dates), Bongo net (12 sampling dates), Giant Water Sampler (4 sampling dates), and two sea ice samples.

Preliminary results

During the observation period a strong bloom developed, which was dominated by diatoms initially, but shifted to *Phaeocystis* after a few days. A significant part of the phytoplankton seemed to sediment at the beginning of the observations. The maximum of zooplankton abundance was found deeper than that of *Phaeocystis* concentration. Some of the dominant copepods were found inactive and close to the sea bottom initially, but reacted to the bloom with a delay of a few days, after which grazing rates increased and reproduction of almost all of the species started. Production of fecal pellets by zooplankton by that time might have contributed significantly to the vertical flux. A strong gale around Christmas lowered the thermocline, but did not destroy the bloom, although it might have caused increased sedimentation rates a few days later (Fig. 23).

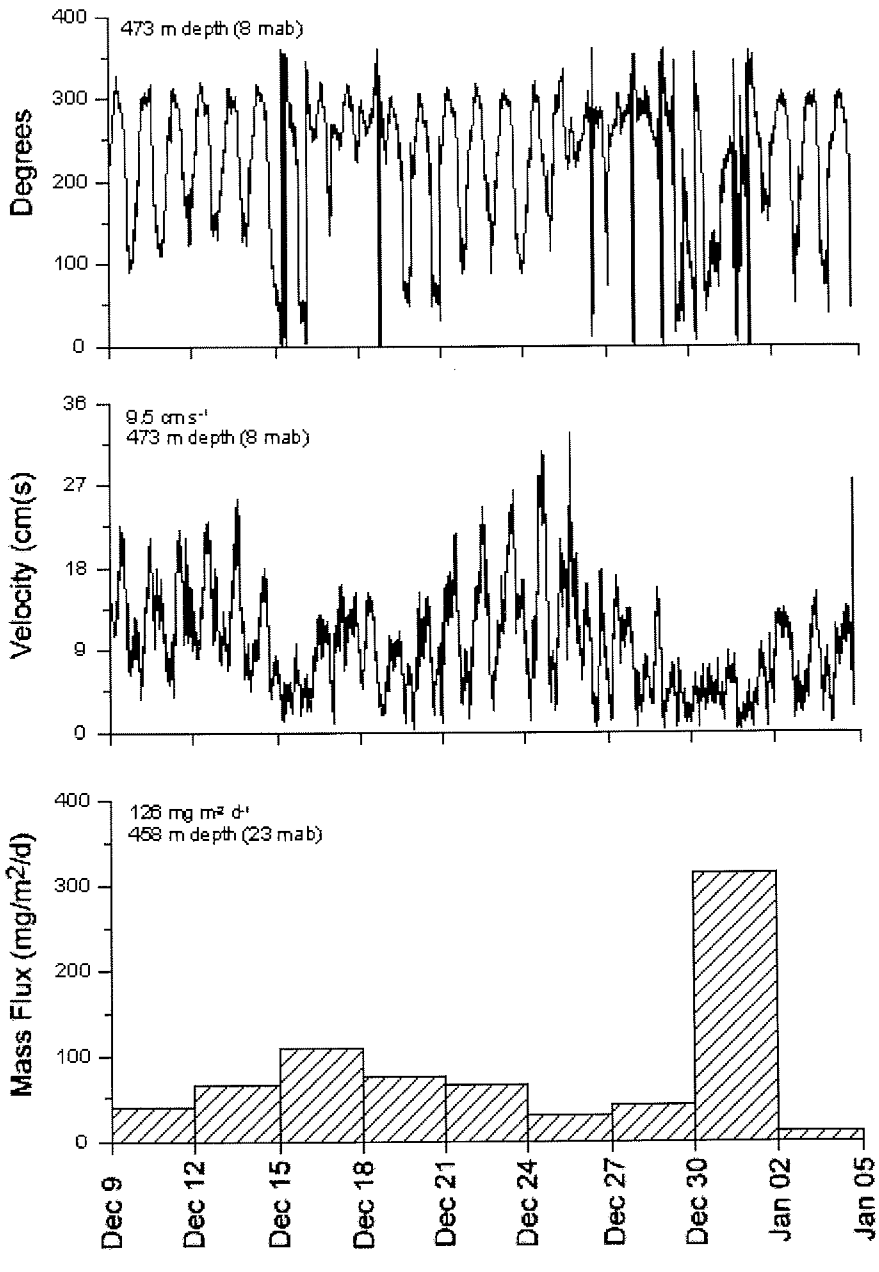

Fig. 23 Mooring recordings between Dec 09 and Jan 05 at the permanent Station.

2.3.2 Trophic structure and energy flow of the Weddell Sea shelf system

(T. Brey, U. Jacob, R. Knust, K. Mintenbeck, O. Heilmayer, K. Beyer)

Objectives

High Antarctic marine ecosystems are taxonomically diverse, structurally complex, and quite variable in time and space. Therefore the food web structure or even a balanced trophic model of such a system is a challenging task. To disentangle the trophic structure of the Weddell Sea shelf system, our intentions were:

- to identify the major trophic groups
- to identify the major energy flows
- to quantity energy flow.

The stable isotopes $\delta^{15}N$ and $\delta^{13}C$ are proxies of trophic relationships, with $\delta^{15}N$ reflecting the trophic position of a consumer and $\delta^{13}C$ reflecting the basic food sources of the whole community. These isotope signatures are used to identify the trophic position of major components of the shelf system. Regarding the high-Antarctic Weddell Sea, previous stable isotope ratio studies on the trophic position of pelagic organisms, benthic invertebrates and vertebrate top predators identified trophic relations within limited sub-systems of the whole network.

The standard metabolic rate of an organism reflects overall energy flow through this organism, because

$$\text{Consumption} = \text{Production} + \text{Respiration} + \text{Excretion}$$

Therefore information on oxygen consumption of major components adds to the knowledge of energy flow through the whole system. These data will be used to construct balanced flow models of Antarctic communities using the ECOPATH/ECOSIM software.

Work at sea

For stable isotope analysis, invertebrates and fishes were collected from bottom trawls, Agassiz trawls, dredges and benthopelagic trawls in the study area. Small organisms were sampled completely, whereas from macro- and megafaunal specimens body wall pieces or muscle tissue samples were taken for analysis. Penguin feathers and seal fur were collected in the Drescher Inlet and kindly provided by J. Plötz and H. Bornemann. All samples were kept frozen at –30°C until further analysis at home.

Respiration rates were determined in crinoids, holothurians, and fish. Life specimens of the crinoid *Anthometra adriani*, the holothurian *Echinopsolus acanthocola* and three species of notothenioid fish (*Artedidraco shackletoni, Trematomus pennellii, Trematomus eulepidotus*) were kept in aquaria in a cooling container at 0°C. Animals were kept in respiration chambers 48 hours prior to measurements to minimize handling stress. Experiments were carried out with filtered seawater in an intermittent flow (when oxygen saturation falls <70-75%, then flush with fresh water and start a new measurement cycle) system. Oxygen saturation was determined by micro optodes. Constant mixing in the respiration system (chambers and tubes) was assured by using peristaltic and Eheim pumps, which caused a circulation flow. An additional empty chamber (containing only water) served as a control in every experiment.

Preliminary results

We collected a further 1088 stable isotope samples from Weddell Sea shelf organisms, thus increasing the total amount of data to 1506 referring to 61 different taxa. The isotope signatures measured so far indicate that in the high Antarctic Weddell Sea the benthic part of the food web is much more complex than the pelagic one. The distance from phytoplankton to pelagic top predators (seals) is about 2.5 trophic levels, whereas the distance to benthic top predators is about 3.5 trophic levels. The benthic top predators are the fleshy ribbon worms (nemerteans), followed by demersal fish and benthic amphipods.

All animals used for respiration experiments, *Anthometra adriani* (9 ind.), *Echinopsolus acanthocola* (6 ind.), *Artedidraco shackletoni* (3 ind.), *Trematomus pennellii* (3 ind.), and *Trematomus eulepidotus* (3 ind.), took the transfer from the aquarium to the respiration chambers apparently well. After three to four consecutive measurement cycles, invertebrates were frozen for later determination of dry weight (DW) and ash-free dry weight (AFDW). In fish total and standard length and wet weight were determined.

In the fish species, raw data (not yet corrected for bacterial respiration) indicate lifestyle related differences in oxygen consumption. *Artedidraco shackletoni*, a demersal fish with a sluggish lifestyle has a lower oxygen consumption (≈ 250 µl O2/ 50g * h) than the more active demersal *Trematomus pennellii* (≈ 650 µl O2/ 50g * h). *Trematomus eulepidotus*, a demersal fish with an even more active bentho-pelagic lifestyle consumes about 1300 µl O2/ 50g * h.

2.3.3 The role of mesozooplankton in pelago-benthic coupling

(J. Michels, A. Pasternak)

Objectives

Zooplankton plays an important role within pelago-benthic coupling processes as their faecal pellets are a significant pathway of energy flow from the pelagial to the benthal. Our knowledge of pelago-benthic coupling in shallow Antarctic coastal waters, however, is extremely limited and the role of zooplankton within these processes is not yet fully understood. Our work focussed on the dominant mesozooplankton species and included: estimation of vertical distribution, abundance and population age structure; determination of feeding and fecal pellet production and sinking rates; respiration and reproductive activities of the dominant copepod species; determination of lipid, C, N and stable isotope contents.

Work at sea

A multiple opening-closing net equipped with 5 nets of 100 µm mesh size was used for the quantitative sampling of mesozooplankton. The multinet was towed vertically, sampling the standard layers of 0-50m, 50-100m, 100-200m, 200-300m and 300m-bottom. Based on these samples species composition, abundance, biomass, age structure and vertical distribution of the dominant species will be analysed (Table 3).

Tab. 3 Stations where specimens were collected for various experiments and future analyses.

Species	Stage	Ingestion rate	Assimilation rate	Reproduction rate	Lipid content	C/N content	Stable isotope content	Respiration rate	Faecal pellet production rate	Faecal pellet sinking rate
Calanus propinquus	Female	128-1, 129-1, 130-1, 243-1, 244-1, 287-1, 318-1, 319-1, 320-1	128-1, 129-1, 130-1, 243-1, 244-1, 287-1, 318-1, 319-1, 320-1	128-1, 129-1, 130-1, 193-1, 257-1, 258-1, 305-1, 306-1	112-1, 113-1, 114-1, 171-1, 172-1, 271-1	098-1, 099-1, 100-1, 128-1, 129-1, 130-1, 243-1, 244-1, 287-1	071-1, 072-1, 073-1, 193-1	048-1, 071-1, 072-1, 073-1, 257-1, 258-1	128-1, 129-1, 130-1, 208-1, 209-1, 210-1, 211-1, 243-1, 244-1, 287-1, 318-1, 319-1, 320-1	271-1
	Male	318-1, 319-1, 320-1	318-1, 319-1, 320-1			098-1, 099-1, 100-1			318-1, 319-1, 320-1	
	Copepodite stage V	128-1, 129-1, 130-1, 243-1, 244-1, 318-1, 319-1, 320-1	128-1, 129-1, 130-1, 243-1, 244-1, 318-1, 319-1, 320-1		098-1, 099-1, 100-1, 112-1, 113-1, 114-1, 137-1, 138-1, 142-1, 143-1, 171-1, 172-1, 271-1, 305-1, 306-1	071-1, 072-1, 073-1, 128-1, 129-1, 130-1, 243-1, 244-1	071-1, 072-1, 073-1, 193-1	071-1, 072-1, 073-1, 257-1, 258-1	128-1, 129-1, 130-1, 243-1, 244-1, 318-1, 319-1, 320-1	
	Copepodite stage IV					071-1, 072-1, 073-1, 098-1, 099-1, 100-1	071-1, 072-1, 073-1, 193-1	071-1, 072-1, 073-1, 318-1, 319-1, 320-1		
Calanoides acutus	Female	128-1, 129-1, 130-1, 243-1, 244-1, 287-1	128-1, 129-1, 130-1, 243-1, 244-1, 287-1	071-1, 072-1, 073-1, 098-1, 099-1, 100-1, 128-1, 129-1, 130-1, 208-1, 209-1, 210-1, 211-1, 264-1, 287-1	098-1, 099-1, 100-1, 112-1, 113-1, 114-1, 137-1, 138-1, 142-1, 143-1, 171-1, 172-1, 180-1, 181-1, 208-1, 209-1, 210-1, 211-1, 264-1, 271-1, 305-1, 306-1	071-1, 072-1, 073-1, 128-1, 129-1, 130-1, 243-1, 244-1, 287-1	193-1	048-1, 071-1, 072-1, 073-1, 257-1, 258-1	098-1, 099-1, 100-1, 112-1, 113-1, 114-1, 128-1, 129-1, 130-1, 243-1, 244-1, 257-1, 258-1, 264-1, 287-1	
	Copepodite stage V	128-1, 129-1, 130-1, 243-1, 244-1, 287-1	128-1, 129-1, 130-1, 243-1, 244-1, 287-1		071-1, 072-1, 073-1, 098-1, 099-1, 100-1, 112-1, 113-1, 114-1, 171-1, 172-1, 180-1, 181-1, 208-1, 209-1, 210-1, 211-1, 264-1, 271-1, 287-1, 296-1, 296-2, 305-1, 306-1	071-1, 072-1, 073-1, 098-1, 099-1, 100-1, 128-1, 129-1, 130-1, 243-1, 244-1, 287-1	071-1, 072-1, 073-1, 193-1	071-1, 072-1, 073-1, 257-1, 258-1	128-1, 129-1, 130-1, 243-1, 244-1, 287-1	
	Copepodite stage IV				208-1, 209-1, 210-1, 211-1	071-1, 072-1, 073-1, 098-1, 099-1, 100-1	193-1	071-1, 072-1, 073-1		

Species	Stage	Ingestion rate	Assimilation rate	Reproduction rate	Lipid content	C/N content	Stable isotope content	Respiration rate	Faecal pellet production rate	Faecal pellet sinking rate
Metridia gerlachei	Female	128-1, 129-1, 130-1, 243-1, 244-1	128-1, 129-1, 130-1, 243-1, 244-1	071-1, 072-1, 073-1, 098-1, 099-1, 100-1	071-1, 072-1, 073-1, 098-1, 099-1, 100-1, 112-1, 113-1, 114-1, 137-1, 138-1, 142-1, 143-1, 171-1, 172-1, 180-1, 181-1, 208-1, 209-1, 210-1, 211-1, 243-1, 244-1, 264-1, 271-1	071-1, 072-1, 073-1, 098-1, 099-1, 100-1, 128-1, 129-1, 130-1, 243-1, 244-1	071-1, 072-1, 073-1, 193-1	257-1, 258-1	071-1, 072-1, 073-1, 098-1, 099-1, 100-1, 128-1, 129-1, 130-1, 243-1, 244-1	
Rhincalanus gigas	Female			264-1, 271-1, 305-1, 306-1	180-1, 181-1, 208-1, 209-1, 210-1, 211-1	098-1, 099-1, 100-1	193-1	257-1, 258-1		
	Male					098-1, 099-1, 100-1				
	Copepodite stage V					098-1, 099-1, 100-1				
Paraeuchaeta antarctica	Copepodite stage V				137-1, 138-1, 142-1, 143-1, 180-1, 181-1	071-1, 072-1, 073-1	071-1, 072-1, 073-1, 193-1			
	Copepodite stage II						193-1, 208-1, 209-1, 210-1, 211-1			
Other mesozooplankton taxa										
Euphausia crystallorophias	Furcilia						112-1, 113-1, 114-1, 137-1, 138-1, 142-1, 143-1, 152-1, 153-1, 193-1, 208-1, 209-1, 210-1, 211-1			
Polychaeta							071-1, 072-1, 073-1, 208-1, 209-1, 210-1, 211-1			
Ostracoda							071-1, 072-1, 073-1, 193-1, 208-1, 209-1, 210-1, 211-1			
Chaetognatha							193-1, 208-1, 209-1, 210-1, 211-1			

For the experimental and biochemical work, live specimens were caught from the upper 0-200m and 0-300m layers by means of a Bongo net (100 µm mesh size). Experiments on feeding, defaecation, respiration and reproduction rates were conducted on board in a cooled container (0 ± 0.07 °C). The food offered in the experiments was the natural phytoplankton suspension obtained from CTD rosette samples (0-50m). In some feeding experiments the CTD rosette water was enriched with phytoplankton from the Bongo net. Chlorophyll *a* samples were collected to determine food concentration at the beginning and at the end of each experiment. Samples for analyzing food size preferences were collected, too. A pilot observation of sinking rates of the faecal pellets produced by copepods was performed in a tall glass cylinder. At each plankton station, CTD rosette water was filtered for subsequent analyses of chlorophyll *a*, POC and PON.
The greater part of all zooplankton investigations was conducted at a 'permanent station' near Auståsen where a mooring was installed. In the period between the 9th and the 28th of December 2003, 16 sampling series were collected. Additional mesozooplankton studies were performed in the Drescher Inlet for three days.

Preliminary results

At the beginning of the observation period the large copepods *Calanoides acutus* and *Calanus propinquus*, which usually overwinter in deeper layers, were caught from the deep near-bottom layer. *C. acutus* was inactive, had empty guts and small lipid sacs, and the females had semi-ripe and ripe gonads. *C. propinquus* was more active and the guts of some specimens contained food, but the gonads of most females were unripe. *Metridia gerlachei*, a third dominant and large copepod, was distributed throughout the upper 300 m of the water column. This species had food in the guts and ripe gonads. Respiration rates of the deeper dwelling *C. acutus* were lower than those of their counterparts in the upper layer. Most likely the specimens found in the deeper water layers were the remaining part of the overwintering stock that should have ascended to the surface by that time. Later, no copepods of this species were found in the deep catches anymore.
During the first days of work at Auståsen diatoms dominated phytoplankton biomass. The mesozooplankton consisted mainly of copepods, clearly dominated by the large *C. acutus*, *M. gerlachei* and *C. propinquus*. Among *M. gerlachei* only females were found, while among *C. acutus* and *C. propinquus* both specimens of the copepodite stage V and females were present. Almost all female *C. acutus* and *M. gerlachei* contained eggs, but <10% of the *C. propinquus* females. However, many *C. propinquus* males as well as females with attached spermatophores were found. This indicates that the reproduction period had also started in this species. In the following days, phytoplankton sank through the water column down to about 200m. *Phaeocystis* sp. colonies appeared and became more and more abundant, but copepods seemed to avoid the upper 100m layer, where the biomass of the *Phaeocystis* dominated phytoplankton was highest. By that time, almost all of the copepod guts contained food, and copepods had accumulated noticeable lipid stores. After Dec 18th the younger copepodite stages (CI-CIII) of *C. acutus*, *C. propinquus* and *M. gerlachei* increased in numbers. The

zooplankton population appeared unaltered after the strong storm between Dec 24th and 27th, although the characteristics of the pycnocline changed conspicuously (see Isla et al., this report).
Feeding and reproductive activity of the dominant copepod species increased with the developing phytoplankton bloom. For example, the initial mean daily egg clutch per female increased from 13.9 to 30 in *C. acutus*, and from 13.5 to 39 in *M. gerlachei*. Feeding activity increased, too, as indicated by an increased rate of faecal pellet (FP) production (from 33.5 to 66 FP d^{-1} between Dec 9th and 27th). According to our preliminary estimates faecal pellets sank 56 m d^{-1}, with a peak value of 112 m d^{-1}.
The phytoplankton community in the second sampling area at Drescher Inlet differed considerably from that at Auståsen. Whereas the latter was dominated by *Phaeocystis* sp., diatoms prevailed in the former. Mesozooplankton composition did not differ greatly from that at Auståsen but *C. propinquus* was more, and *M. gerlachei* less abundant. The percentage of reproducing *C. propinquus* was very low (4%), most likely because either reproduction of this species was just starting or had peaked already. Examination of the gonad maturity stages will clarify this question.

2.3.4 Benthic-pelagic coupling under polar spring conditions

(J.M. Gili, E. Isla, E. Rodríguez, A. Rodríguez y Baena, S. Rossi, N. Teixidó, B. Vendrell, D. Gerdes, W.E. Arntz)

Introduction and objectives

In recent years the paramount role of benthic suspension feeders in energy transfer processes in littoral and shelf ecosystems has become evident. Because of their abundance, certain benthic suspension feeders communities capture large quantities of particles and may directly regulate primary production and indirectly secondary production in littoral food chains.
Recent studies on certain Antarctic littoral benthic suspension feeders have suggested the period of winter inactivity may last only a few weeks. Many suspension feeders use alternative food sources to phyto- and zooplankton, i.e., the "fine fraction" of matter or microplankton, which may be a reason for the success of these organisms in Antarctica and elsewhere. Sediment resuspension and lateral advection may also play a role. Efficient food assimilation and continuous food supply by resuspension processes also during winter might have caused the development of suspension-feeder dominated, very diversified, high biomass and tridimensionally structured communities on the Antarctic shelf.
Our main objective was to test some hypotheses on the mechanisms of ecological success of benthic Antarctic suspension feeder communities. The research plan was based on recent work in the Antarctic benthos, mostly during the previous EASIZ "Polarstern" cruises. Aspects related to the trophic ecology of suspension feeders and environmental conditions, which facilitate the processes of energy transfer between benthic and water column systems, was emphasized. In particular we asked the following questions: Is the formation of organic matter (export primary production) in the photic zone

significant for suspension feeders? What do we know about the fate of this organic material and what is available in near-bottom waters or at the sea floor? Which processes are responsible for the availability of food to suspension feeders (vertical transport, resuspension or lateral advection)? Which is the role of bacteria in the diet of benthic organisms and how do these influence growth and production of microbial communities near the bottom? To what extent are the abundance, reproduction and patchiness of suspension feeder communities a consequence of biological and environmental factors which facilitate the development of benthic communities? To answer these questions an integrated and multidisciplinary approach was required. One of the aims of the project was to coordinate the information from different surveys and analyses to obtain a comprehensive and integrated view of Weddell Sea shelf ecosystems.

The main objectives of the project were to:
- characterize the environmental and biological features along the water column and near the bottom which provide conditions for the development of rich benthic suspension feeder communities.
- evaluate the processes of matter transfer (organic and inorganic particles) from the water column to near-bottom water layers and the sedimentary pathways.
- quantify the availability of food resources for benthic suspension feeders and their different patterns of acquisition.
- study trophic ecology of two selected species and the impact of benthic suspension feeder communities on the microbial loop.
- study the spring effect on the feeding, reproduction and demographic features of benthic suspension feeder communities.

A: Water column characteristics

Objectives
Many important processes that influence the structure and function of benthic suspension feeder communities depend on physicochemical characteristics of the water near the seabed. Therefore, one of the objectives of the benthic-pelagic coupling proposal was to determine water column characteristics near the seabed during austral spring and to compare them with autumn data (EASIZ III). This comparison was carried out through measurements of temperature, salinity, turbidity, nutrients, pigments, proteins, lipids, carbohydrates, and microorganisms. Estimates of POC and BSi mass balances and fluxes from the photic zone by means of natural radionuclide (^{238}U, ^{234}Th, ^{210}Po, ^{210}Pb) analysis in selected samples will provide additional insight in Weddell Sea bentho-pelagic coupling.

Work at sea
34 CTD casts were performed at a permanent station (M) and along a 5-station transect (T) (Fig. 24). Each cast registered salinity, temperature, fluorescence, and turbidity; in addition, water samples were taken at different depths for chemical and radiochemical analyses.

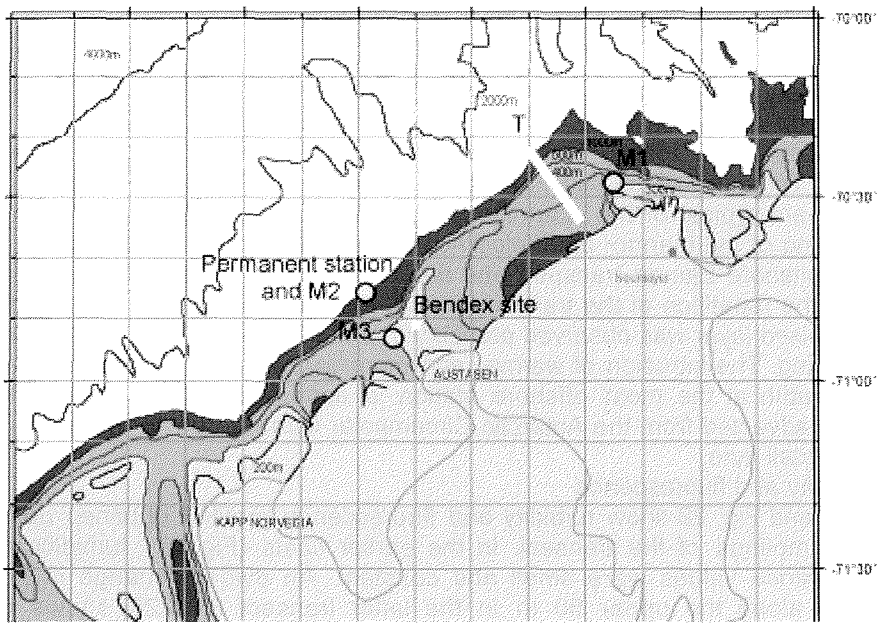

Fig. 24 *Sampling locations on the Weddel Sea shelf. T: Transect.*

Turbidity and fluorescence will be calibrated with the results of Chlorophyll-a and suspended particulate matter to be measured in the laboratory back on land. Whenever possible, the CTD casts were coupled with *in-situ* pumping at the base of the photic layer (12 deployments), at the fluorescence peak and close to the bottom (2 deployments). These large volume-filtering devices allow the collection of different size particles (> 70 mm; and > 0.7 mm) for the analysis of selected radionuclides (^{234}Th, ^{210}Pb and ^{210}Po) and major components (POC and PON) upon return to the laboratory.
The permanent station was meant to track the development of a phytoplankton bloom and operated during 16 days within a 27-day period. The transect in the region off Auståsen was intended to measure temporal variations in the physicochemical characteristics of the water column and also to compare them with the results obtained under autumn conditions during the expedition ANT XVII-3 (EASIZ III). CTD casts were performed down to 5 - 1 metre above the bottom (mab) and were coupled with *in-situ* pumping at the base of the photic layer at 6 of the 10 stations. The distance between stations was approximately 2 nautical miles over a region with a depth range between 350 and 500 m. Sediment samples were also taken at each station.
Three moorings equipped with sediment traps and current meters were deployed at a reference station in Atka Bay (M1) and at the BENDEX experimental site (M2) to obtain information about particle fluxes and carbon transport in the region (Fig. 24). Two moorings (M1 and M2) collected samples during a 30-day period and the third (M3) will sample for one year in the vicinity of the BENDEX site. All moorings were equipped with a current meter 8 mab and a sediment trap 23 mab. M1 had an additional sediment trap 228 mab. Samples were preserved at 4°C for later C, N, and BSi analysis.

Depending on the amount of the sample, aliquots were removed for radio-analytical measurement of ^{234}Th, ^{210}Pb and ^{210}Po fluxes.

Preliminary results

- Temperature and salinity

Temperature and salinity profiles of the transect are shown in Fig. 25 and Fig. 26. Temperature and salinity values in the upper 50-100 m of the water column are typical of the Antarctic Superficial Water (ASW) (Fig. 25). The deepening of the thermo- and haloclines close to the shelf-ice edge could be due to onshore Ekman transport and deep convection in the coastal polynya. During the repetition of the transect (Fig. 26) a reduction in the salinity of the upper mixed layer was observed probably due to the input of fresh water from ice melting. The intrusion of warmer and more saline water registered below 250m depth at the most offshore station is apparently Warm Deep Water (WDW) advected from the Antarctic Circumpolar Current due to the action of the Weddell gyre.

- Turbidity and fluorescence

Fig. 27 and Fig. 28 show turbidity and fluorescence profiles obtained during both samplings of the transect. In the earlier casts (Fig. 27), turbidity and fluorescence values were small and constant. An evident change in both profiles along the upper 50 m in the latter transect (Fig. 28) shows the occurrence of a phytoplankton bloom. The rest of the water column showed no changes after two weeks.

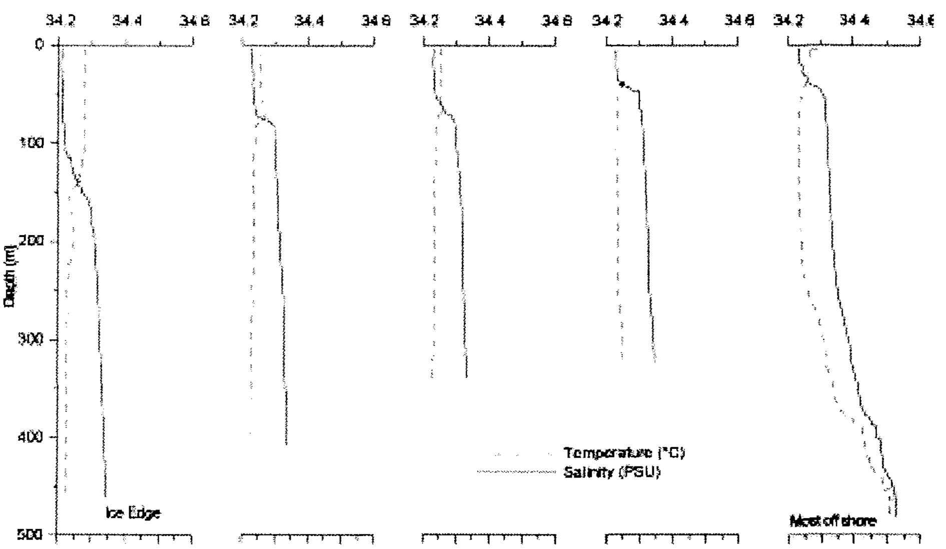

Fig. 25 Temperature and salinity profiles at transect stations during Dec 6-7. (Transect location see Fig. 24)

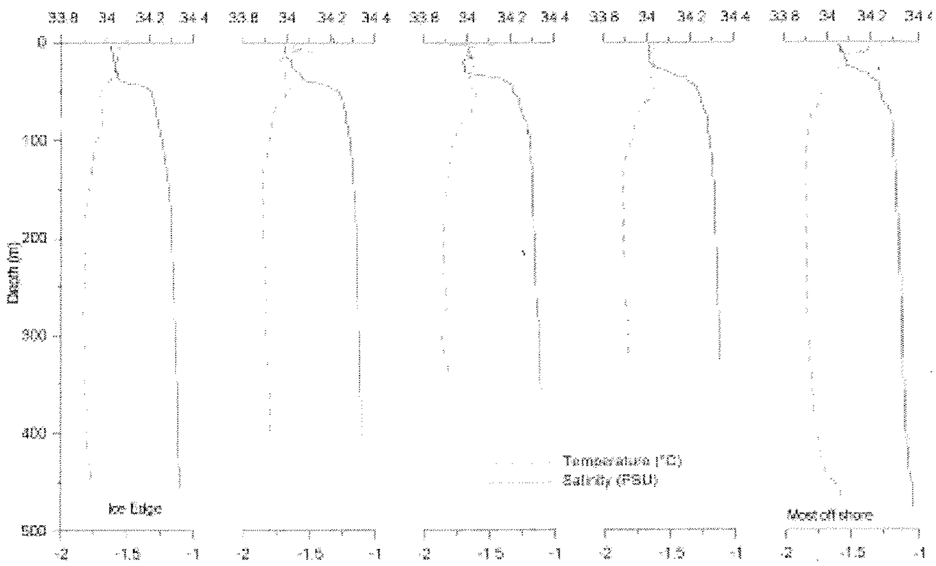

Fig. 26 Temperature and salinity profiles at transect stations during Dec 19-20. (Transect location see Fig. 24)

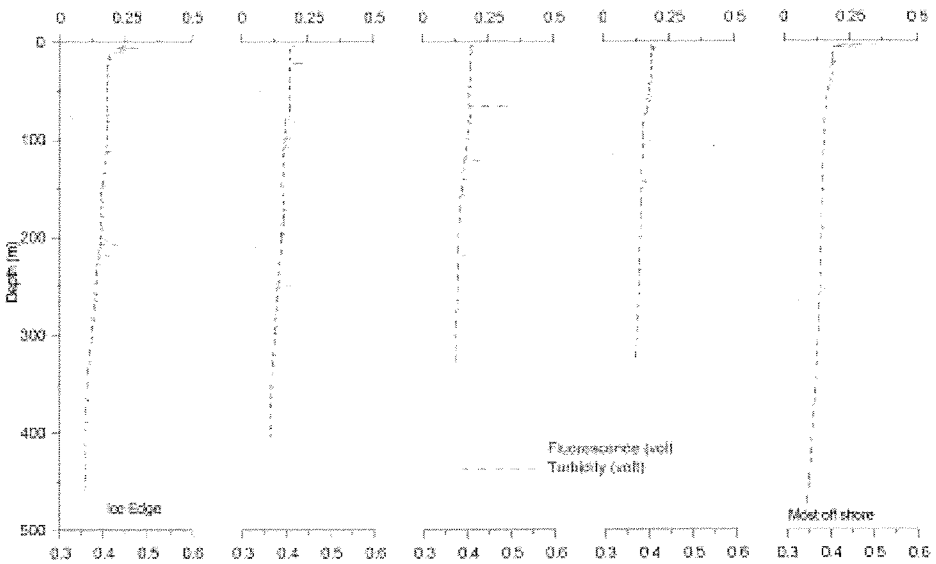

Fig. 27 Turbidity and fluorescence profiles at transect stations during Dec 6-7. (Transect location see Fig. 24)

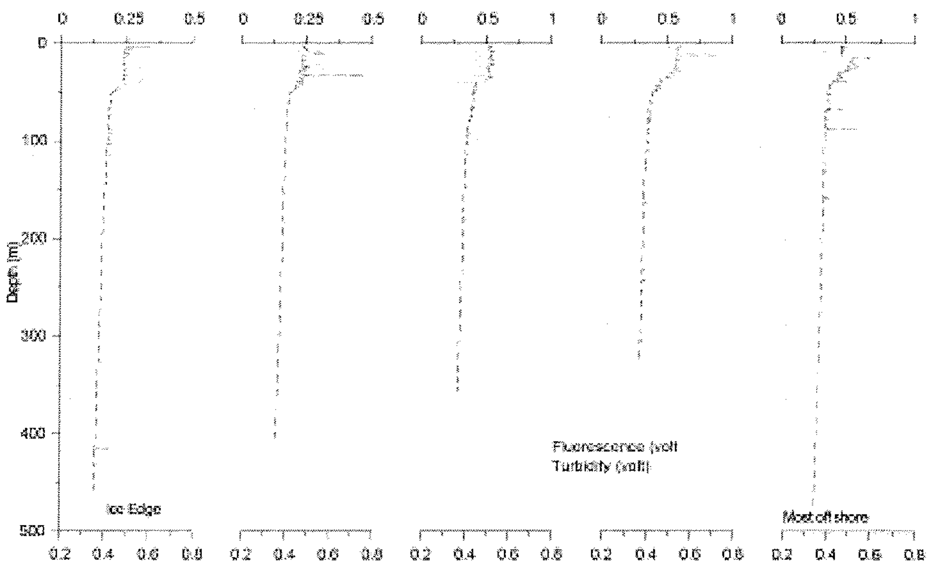

Fig. 28 Turbidity and fluorescence profiles at transect stations during Dec 19-20. (Transect location see Fig. 24)

- Radionuclides (bloom)

High variability in the ^{234}Th profiles (e.g., Fig. 29) clearly confirms that ^{234}Th was not in "steady state" during the observation period. Additionally, given the partial availability of physical data (not sufficient for a 3D modelling of the water column), the basic assumptions for the application of a traditional 1D "non steady state" ^{234}Th export model could not be met. ^{234}Th and ^{238}U measurements will be coupled with information on hydrologic dynamics, nutrients and plankton community distribution, and ^{234}Th fluxes measured in sediment traps. The evolution of radionuclide/component ratios during the bloom period will be analyzed in particles of different size. Whenever possible, net POC export will be estimated using ^{234}Th/POC ratios in sinking particles collected by *in-situ* pumping at the base of the photic layer and eventually compared to trap estimates.

- Radionuclides (transect)

All six $^{238}U/^{234}Th$ vertical profiles display a ^{234}Th deficit in the upper water column during both sampling times, suggesting an export associated to sinking of biogenic particles. ^{234}Th deficit decreases with distance from the ice edge suggesting a positive correlation between particle export and coastal ice melting, and increases between transect 1 and 2, indicating the possible role played by the developing phytoplankton bloom in enhancing ^{234}Th scavenging onto sinking particles. (Data will be validated only after final radiochemical analyses). 6 $^{210}Pb/^{210}Po$ (and 3 ^{226}Ra) vertical profiles will help completing the picture already outlined by the above-mentioned couple of radiotracers.

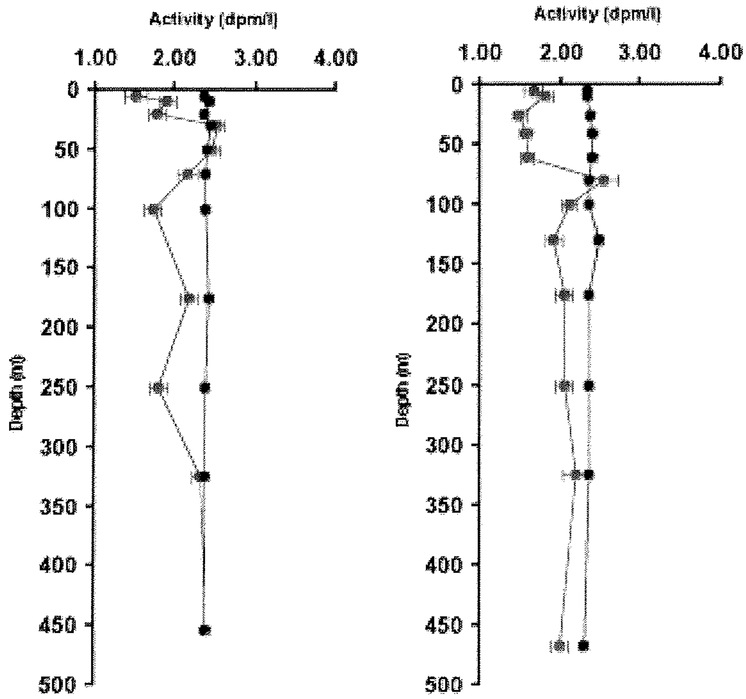

Fig. 29 ^{234}Th profiles at stations 177 (Dec 16) and 334 (Jan 05).

Net POC, PON and eventually BSi export will be estimated using non steady state modelling and component/radionuclide ratios in sinking particles collected by *in-situ* pumping at the base of the photic layer in each CTD deployment and compared with radionuclide fluxes in sediment traps.

- Radionuclides (experimental)

Live benthic organisms (sponges, isopods and amphipods) were collected during the cruise and could be shipped alive to IAEA-MEL premises (Monaco) in collaboration with C. De Broyer and F. Nyssen. Uptake and loss kinetics of selected metal radioisotopes (^{54}Mn, ^{57}Co, ^{65}Zn, ^{110m}Ag, ^{109}Cd, ^{203}Hg, ^{234}Th) will be determined in whole-body isopods (*Natatolana* sp.) and amphipods (*Uristes stebbingi* and *Orchomenella ultima*) during controlled laboratory experiments (-1°C). Results will give an insight on the organisms' metal metabolism and whether these Antarctic crustaceans play a substantial role in benthic geochemical cycling.

B: Water column biochemistry - Particulate Organic Matter

Objectives

One of the main objectives of this cruise was to compare food concentration and availability in the water column in the Weddell Sea with the previously recorded autumn data. Furthermore, short-time changes in these variables in the surface (beneath the ice) and in the near-bottom water layers was considered essential to understand benthic community trophic dynamics.

Food analyses of benthic suspension feeders (mostly cnidarians) revealed limited connection between the rain of larger particles sinking to the seafloor during the short Antarctic summer and the food of these organisms, and incubation experiments presented evidence for the use of the fine seston fraction by certain suspension feeders. The potential food analyses in the water column will be continued and refined, putting major emphasis on the quality of the food offer and the processes that make the food available to the benthos. A multidisciplinary approach will be undertaken considering seston quality analysis and processes above and at the seafloor. The three main questions were: 1) Are the biochemical characteristics (i.e. chlorophyll a, organic carbon, carbohydrate, protein and lipid concentrations) different in the same Weddell sea transect comparing data collected in two short time series? 2) Can we quantify food concentration (seston concentration and quality) differences between seston sampled near the ice sheet and in the water column near the seafloor? 3) Which are the main fractionate lipid contributors within the seston total lipids? Do these macromolecules reveal short-time changes in spring at the surface and in the bottom water?

Work at sea

Water was collected in Niskin bottles with the Bio-Rosette at 4 different depths at each station of the 6-7 and 19-20 December 2003 transects, picking up two samples (two Niskin bottles) from each depth to have two replicates of each depth point. Water was filtered using triplicates of each parameter and each depth with a 150mmHg pressure pump, using GF/F precombusted (450 °C, 5h) filters (0.4 µm porus) for the different parameters. These parameters were a) Chlorophyll a (500ml/filter), b) Organic Carbon and Nitrogen (1000ml/filter), c) Proteins (1500 ml/filter), d) Carbohydrates (1500 ml/filter), e) Lipids (5000 ml/filter), and f) Fractionate Lipids (5000 ml/filter). Filters were then immediately frozen at -27 °C to be processed on the ship or in the lab. Water samples very close to the bottom (0.5 metres above the surface) were taken with the Giant Water Sampler at the same stations of the transect.

Chlorophyll a and Phaeophytin a were extracted in the dark at 4 °C with 90% acetone and measured fluorometrically. Organic Carbon and Nitrogen content were determined with an Elemental Analyser (Carlo Erba). Proteins will be processed with the Lowry method. Total particulate carbohydrate concentration was measured according to Dubois et al. (1956). Extraction and quantification of the total lipids were performed according to the method of Barnes and Blastock (1973). Fractionate lipid extraction will be carried out according to Grimalt et al (1992) and Yruela et al (1990).

Preliminary results

- 6-7 December 2003 Transect

Carbohydrates: Seston carbohydrates were higher near the surface (5 and 25 meters depth) than in the mid column and in the near-bottom water samples, except at the last sampling point (Fig. 30). Concentrations were up to 5 times higher at these surface points, except at the first sampling station where the carbohydrate seston concentration was close to the 25m depth point.

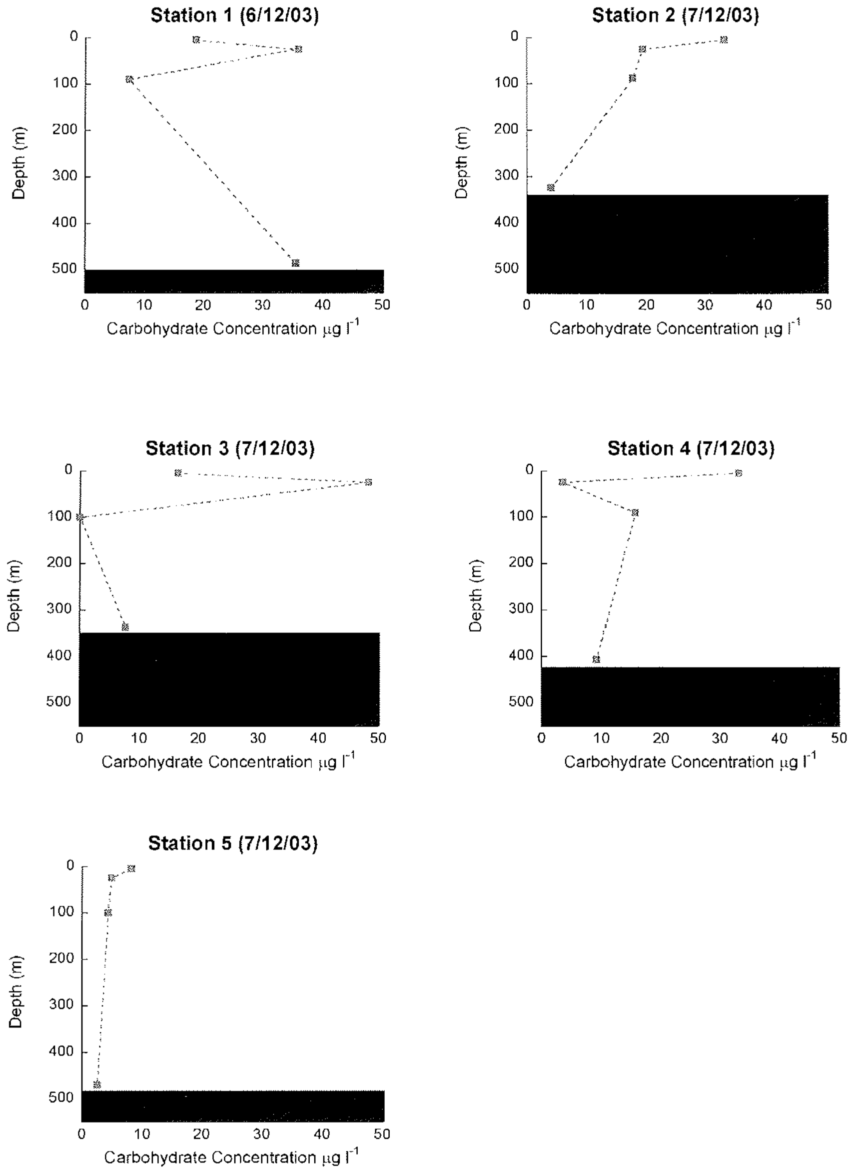

Fig. 30 Seston carbohydrate profiles at transect stations during Dec 6-7 (transect location see Fig. 24)

Lipids: Seston lipid concentration was almost undetectable near the bottom in the transect points three and five, while in the other transect points the distribution seemed to be more regular (Fig. 31). Except for the sampling point three, lipid concentration was higher near the surface (beneath the ice) than at 25 m depth.

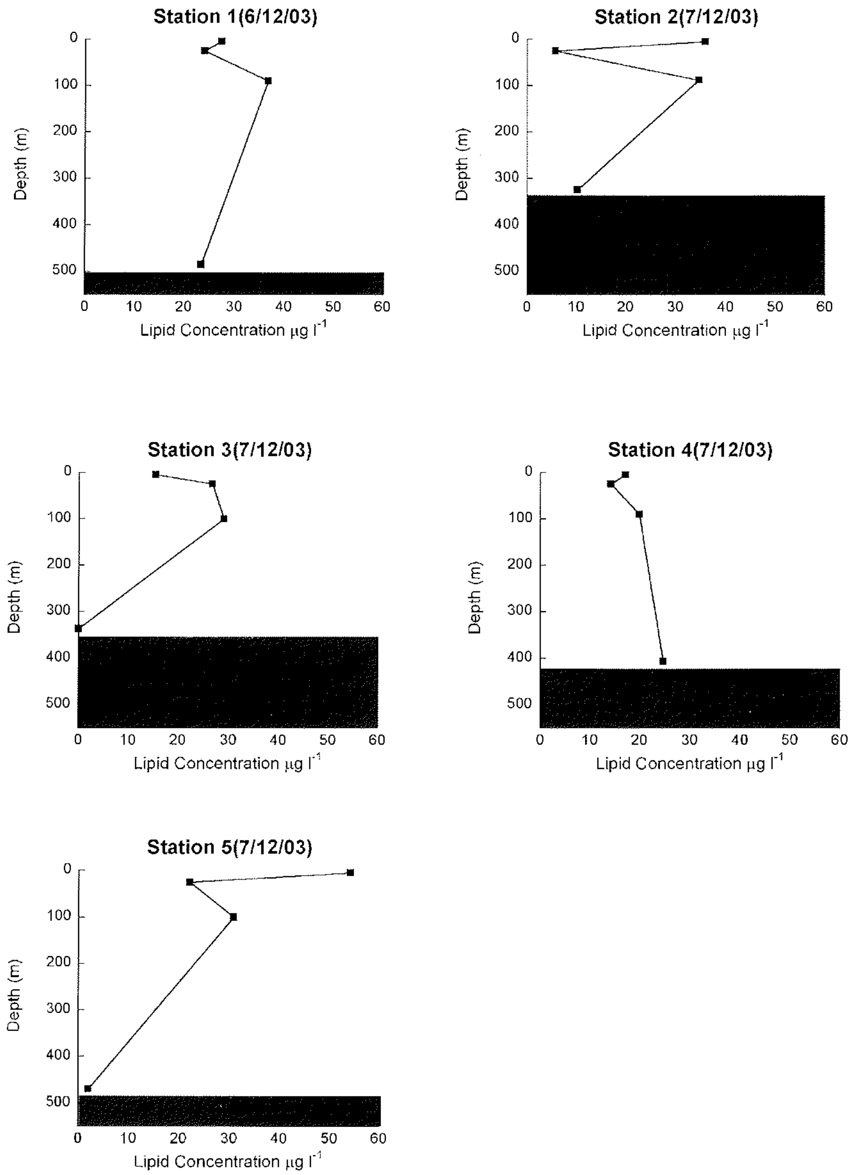

Fig. 31 Seston lipid profiles at transect stations during Dec 6-7 (transect location see Fig. 24)

- 19-20 December 2003 Transect

Carbohydrates: The more irregular situation detected in the carbohydrate concentration in the first transect completely changed in the second transect (Fig. 32). Concentrations near the surface (beneath the ice and 25 m depth) were up to 15 times higher than near the bottom samples (Bio-Rosette samples), and up to 4-5 times greater comparing the same points with the previous transect.

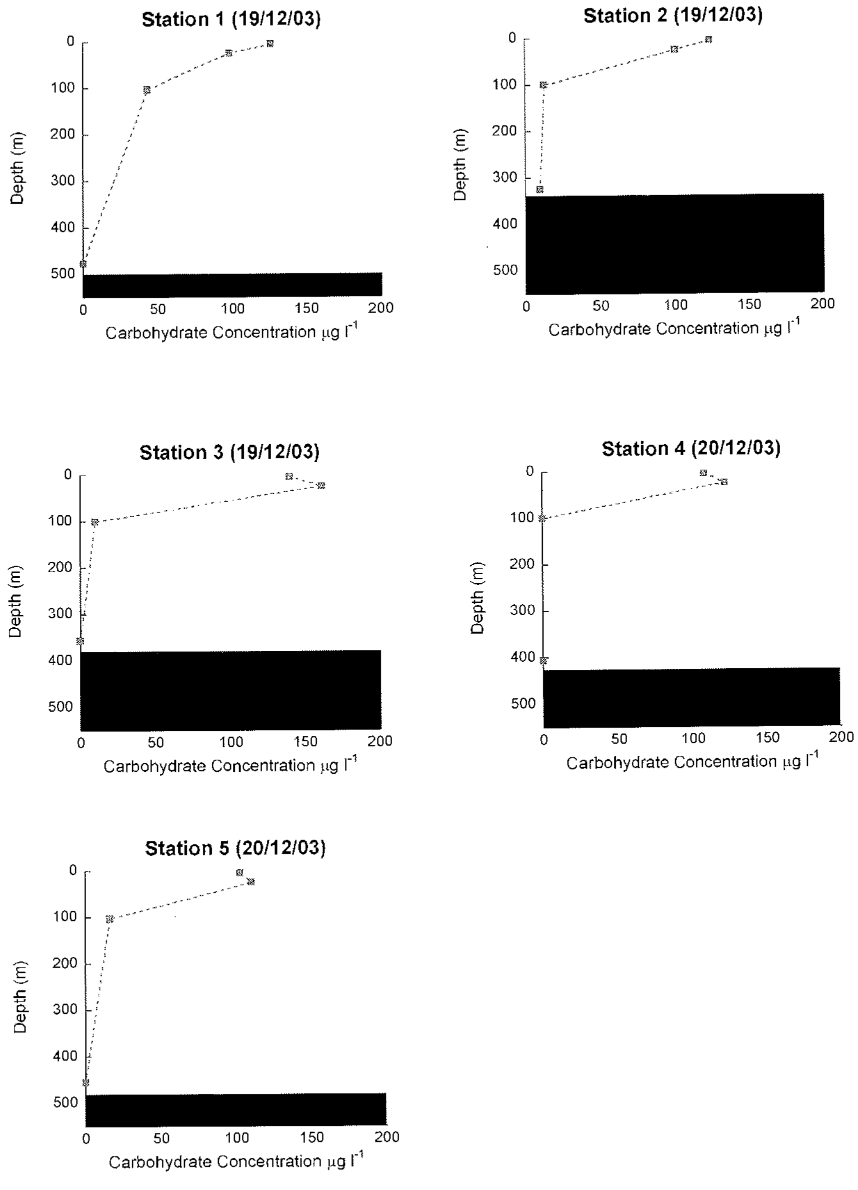

Fig. 32 Seston carbohydrate profiles at transect stations during Dec 19-20 (transect location see Fig. 24)

Lipids: Seston lipid concentration followed the same trends as carbohydrates in this second transect (Fig. 33). Near the surface, lipids were up to 8 times higher than near the bottom, and midwater sample values (100m depth) were close to the near bottom ones. All seston values (carbohydrates and lipids) were higher in the second transect compared with the first one.

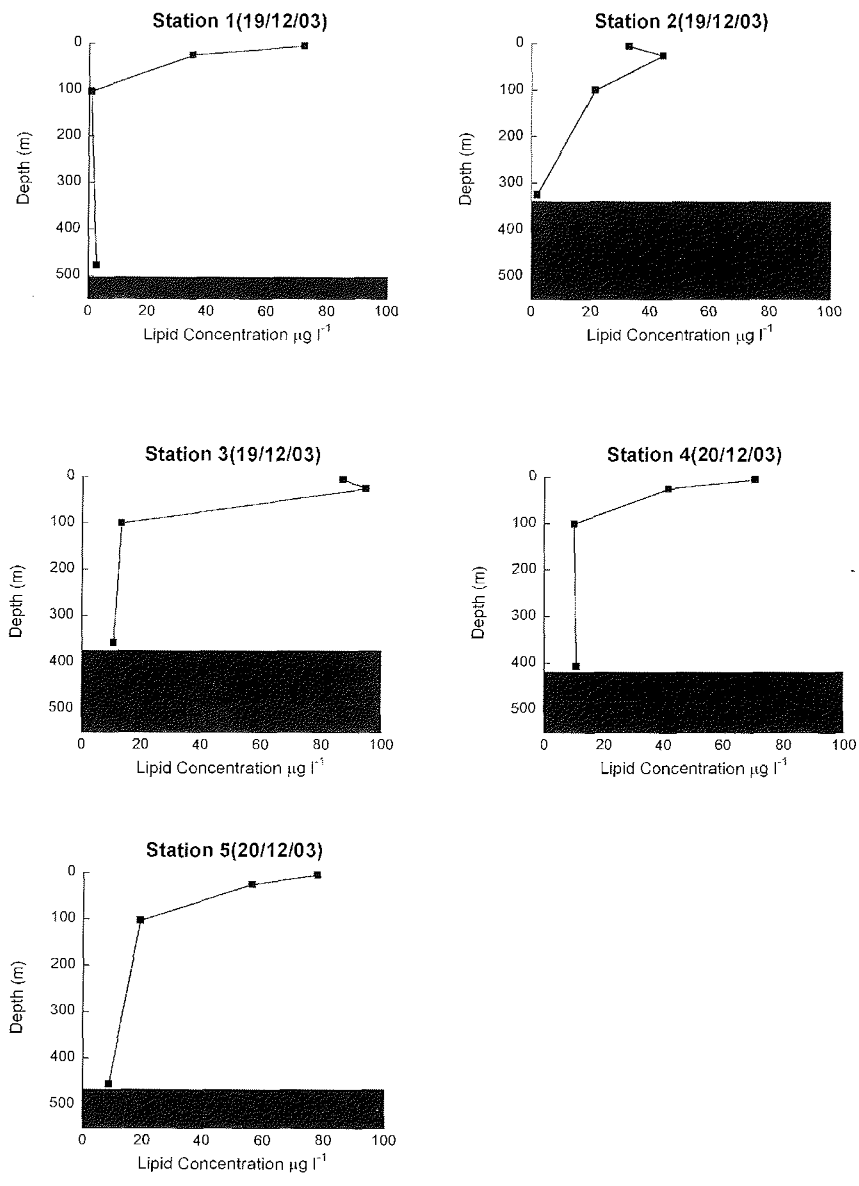

Fig. 33 Seston lipid profiles at transect stations during Dec 19-20 (transect location see Fig. 24)

- Giant Water Sampler

Carbohydrates and *lipids* were analyzed in the water samples of the Giant Water Sampler (GWS) (Fig. 34). Unfortunately, carbohydrates were not analyzed on board at point 3 (Fig. 34). Carbohydrates were higher very close to the bottom in the second transect compared to the first one. On the other hand, lipids were slightly lower in the second transect compared to the first one, but clearly higher in the bloom transect points analyzed (up to 4 times higher compared with the second transect).

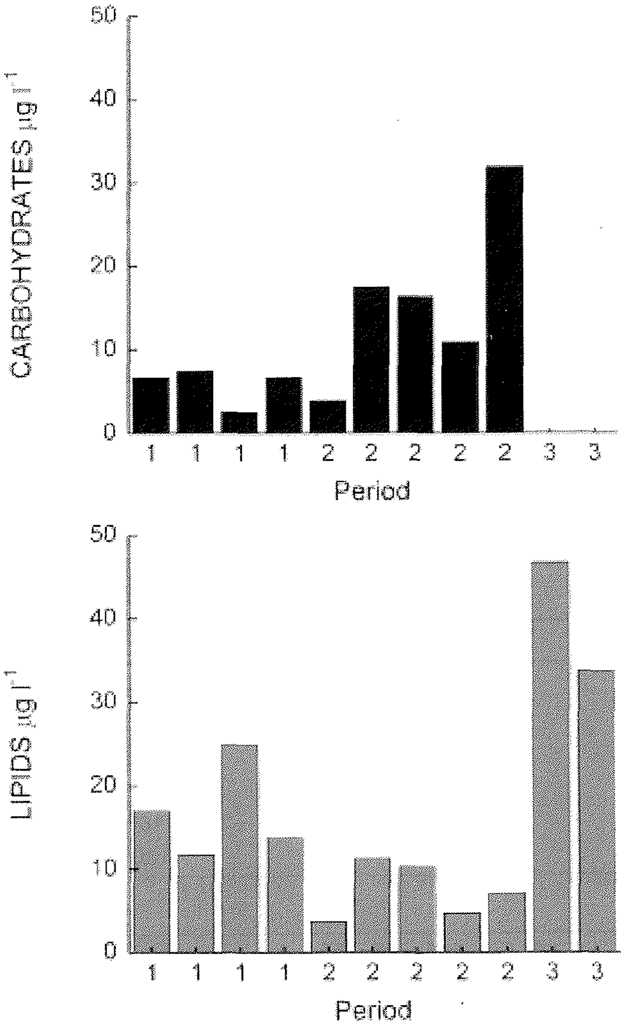

Fig. 34 Seston carbohydrate and lipid concentrations in giant water samples at transect stations ("1": Dec 6-7, "2": Dec 19-20, "3": "bloom transect" at Dec 22-23).

Considering both transects (6-7 December and 19-20 December 2003), carbohydrate and lipid seston were more abundant in near surface waters after the two weeks of primary production process. Near the bottom, the GWS showed a similar trend, although it seems that in the second transect lipid concentrations of the seston were slightly lower than in the first one. It seems that the phytoplankton rain from the ice sheet began after the 6-7 December transect, increasing significantly the material available for the benthic suspension feeders towards the end of the transect.

C: Biochemistry of Antarctic benthic organisms

Objectives

Energy budget studies are essential to benthic suspension feeding ecology. Enhanced lipid accumulation is assumed to be one option for invertebrates to counteract the effect of trophic crises (starvation), especially in strongly seasonal environments. Therefore we wanted to compare the total lipid, carbohydrate and protein content together with the lipid fraction of different benthic cnidarians in two different seasons (i.e. spring-summer during ANT XXI/2, and autumn-winter during ANT XVII/3) to check for different strategies.

Work at sea and preliminary results

Samples of several species were collected from bottom trawls and corers in the Weddell Sea and off Bouvet Island (Table 4). The gorgonians, sponges, bryozoans, ascidians, etc. were identified and immediately frozen (-27°C) until further analysis in the Instituto de Ciencias del Mar of Barcelona.

Tab. 4 Main taxa and no. of species collected for biochemical analyses off Bouvet Island and in the Weddell Sea during ANT XXI/2.

Taxon	Station number	N° Individuals
Bouvet Island		
	Station number	N° Individuals
Gorgonaria	10,19,30	59
Polychaeta	28	20
Bryozoa	19, 29	80
Holothuroidea	20	16
Ophiuroidea	20, 28, 29	180
Weddell Sea		
Porifera	90, 121, 148, 245, 265	110
Gorgonaria	121,174, 175, 245, 259, 265, 274, 276	182
Bryozoa	39	20
Crinoidea	109, 166, 175	60
Holothuroidea	109, 132	60
Ophiuroidea	39, 109, 121, 132, 173	83
Ascidiacea	132, 174	40

D: Sediment features

Objectives

Both suspended and settled sediment fuel the benthic community throughout the year, despite marked seasonality at the sea surface. Therefore, the analysis of sediment is one of the main objectives of the benthic-pelagic coupling approach.

Work at sea

22 surface sediment samples and 4 sediment cores were taken at the BENDEX experimental site and at the Auståsen iceberg restplace by means of giant and multibox corers.

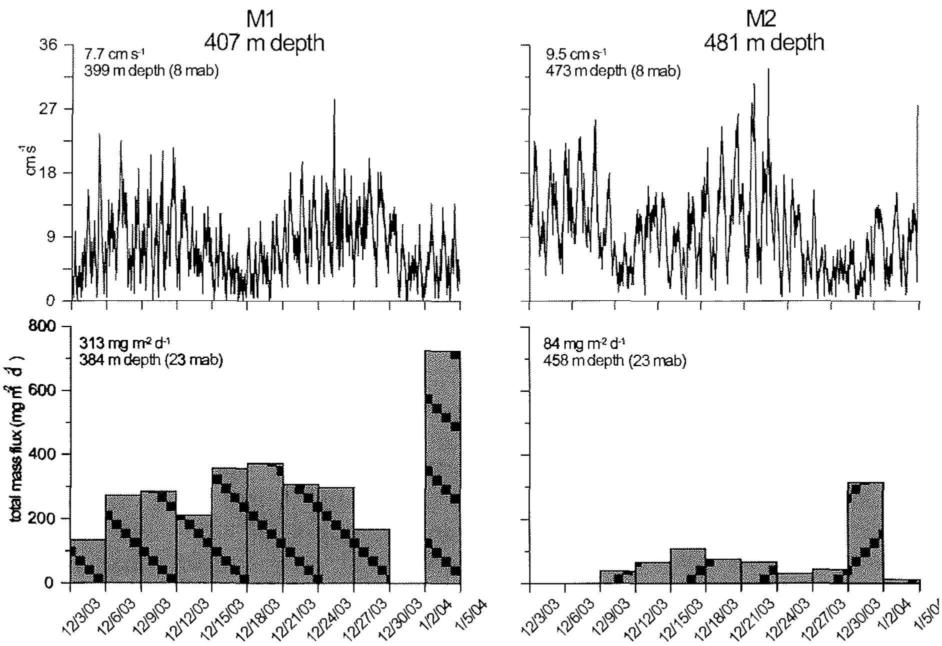

Fig. 35 Seston carbohydrate and lipid concentrations in giant water samples at transect stations ("1": Dec 6-7, "2": Dec 19-20, "3": "bloom transect" Dec 22-23).

Preliminary results

- Sea floor sediment

Seabed samples were mainly fine (lime) to coarse (sand) dark sediment, generally well mixed with sponge spicules. To complete the study of these sediments grain size, organic carbon, biogenic silica, and biochemical analysis will be analysed in the laboratory at the ICM in Barcelona. ^{210}Pb activity profiles will be determined in sediment cores to attempt assessing mixing and sedimentation rates, to be used to estimate burial rates of specific parameters (i.e. OC, BSi).

- Sediment flux and currents

Current velocity and direction at both sites showed an evident tidal variation with a 14-day period in velocity and 24 h in direction. The main direction at site M1 was NNE-SSW and NW-SE at site M2, where the average current was higher (Fig. 35).

Sediment flux peaks at both sites coincided with low current velocities. Average total mass flux near the sea floor was higher at site M1 (331 mg m^{-2} d^{-1}) than at site M2 (84 mg m^{-2} d^{-1}). Total mass flux at site M1 increased three times with depth from the upper (127 mg m^{-2} d^{-1}) to the lower trap, showing the contribution of lateral advection of resuspended particles. Further analyses remain to be done to elucidate the relationship between tides and total mass flux. Additionally, C, N, BSi, and faecal pellet analyses will be performed.

E: Feeding experiments with active filter feeders

Introduction and objectives

Sponges play an important role in the epibenthic shelf communities of the Weddell Sea. During the ANTXXI/2 cruise, feeding experiments were carried out with the sponge *Stylocordyla sp.*, an active suspension feeder, which was chosen for its abundance, and because these animals survive quite well in aquaria on board (Orejas et al, 2000). The main goal of these experiments was to study the diet of this species during the Antarctic spring-summer conditions, and to evaluate the community impact they have on the microbial loop and water characteristics in the bottom layers.

Work at sea

Sponge specimens were collected using bottom and AGT trawls and kept in aquaria filled with non-filtered seawater at –1°C, until the experiments began. Predation on the plankton fine fraction (bacteria, ciliates, eukaryotic picoplankton and phytoplankton) was mesured in 6h flow incubation experiments using plexiglass incubation chambers of 4.5 – 5 l volume. Predation will be calculated by the decrease in prey concentration in the sponge chamber relative to the control during the experiment. To determine bacterial activity, abundance and biomass, samples were collected at shorter intervals. All analyses will be carried out at the institute in Barcelona. Samples for histological analysis of *Stylocordyla sp.* specimens were fixed and preserved at 4°C for histological and microanalysis in Barcelona.

F: Water column nutrients

Objectives

One major objective of this cruise was to determine the significance of pelagobenthic coupling on the Weddell Sea shelf, where suspension feeder communities are well developed. Within this context, nutrient analyses of the water column were carried out along two transects, in order to evaluate and understand the decomposition rates of the organic particles sinking through the water column, instead of estimating the amount of those compounds which are removed by primary producers.

Work at sea

Samples were taken on different days from the five stations of the transect in the Weddell Sea. At each station, vertical profile data on temperature, salinity, depth and nutrient concentrations were taken. Temperature, salinity and depth profiles were taken from CTD casts. Triplicate samples from nutrient analyses were collected from selected depths at each sampling period (at 4 or 6 depths, depending on the station), using Niskin bottles attached to a Rosette sampler, from the bottom to the surface. All samples were gentil syringe filtered through 0,4 µm pore-size Whatmann GF/F filters. Those for ammonia, nitrite and phosphate were analysed immediately on board, while those for nitrate, silicate and DOC were frozen for posterior analysis in Barcelona. Nutrients were determined manually on board by using filtered samples which were to be quantified with a spectrophotometer with 5 cm cells.

Preliminary results

- First transect (Dec 6-7)

Concentrations of dissolved nutrients on the first Auståsen transect indicate that phosphorus and oxidized nitrogen forms increased slightly with depth along the water column profile. SRP concentrations varied within the range of 0.018 µmol and 0.032 µmol. The concentrations of phosphorus did not vary a lot all along the water column, although there was some variation visible at a depth of 100 m. Nitrite concentrations varied from 0.60 µmol to 1.93 µmol. Concentrations of nitrite showed diverse variations, most of which concentrated in depths around 100 m. Ammonia concentrations varied from 0.04 µmol to 1.89 µmol, and the pattern that most of the profiles followed showed a slight decrease of this molecule in the bottom layers. However, these maximum and minimum values were found only in a low number of depths, whereas normally, the majority of values ranged from 0.28 µmol to 0.93 µmol. The three values surpassing 1 µmol were found at superficial depths. The Giant Water Sampler was also used from the second to the fifth station of this transect, to provide samples from near bottom water layers. These were filtered and frozen for posterior analysis in Barcelona.

- Second transect (Dec 19-20)

Concentrations of the different inorganic nutrients measured varied somehow with respect to those found on the first transect. SRP concentrations were much more constant, and varied within a range of 0.03 to 0.04 µmols, showing in most of the cases a peak around more than 100 m depth. Nitrite concentrations, which were more constant, too, and also lower, varied from 0.17 µmol to 0.78 µmol, and did not show a clear pattern along the water column. Ammonia was found in significantly higher concentrations than in the previous transect, with values ranging from 0.28 µmol to 3.13 µmol. The highest values were found at superficial depths, although sometimes the maximum was more subsuperficial than superficial. Although ammonia concentrations tended to decrease in deep casts, the values found in the deepest ones were higher than those found at intermediate depths. Samples for nutrient analysis were also taken at the 5 stations from the Giant Water Sampler, so as to have nutrient values from the deepest water layers.

G: Water column picoplankton

Objectives

The objective of this study was to determine the abundance, biomass and heterotrophic activity of the picoplankton in the studied area of the Weddell Sea. The information provided by the collected samples will help to answer the question of whether there are substantial differences in the bacterial activities close to the bottom and those at surface layers. During the spring conditions, when stratification of the water begins and organic matter accumulates in higher water layers, higher activities should be expected in surface or subsurface layers.

Work at sea

At the 5 stations chosen for the transect, and at the two periods of sampling, samples for the determination of picoplankton abundance, biomass and activity were collected with Niskin bottles attached to a CTD-Rosette at the stipulated depths (4 or 6, depending on the station). Samples from the Giant Water Sampler were also taken for further analysis. Aliquots were fixed and frozen, for the posterior determination in Barcelona, of bacterial biomass and abundance, through flow cytometry, and also for bacterial production. Altogether, the whole set consisted of at least 186 samples for flow cytometry and 372 for bacterial activity – both estimations including replicates.

2.3.5 The Drescher Inlet pelagic fish community and vertical distribution patterns of *Pleuragramma antarcticum*

(K. Mintenbeck, E. Brodte, R. Knust)

Objectives

During EASIZ II (ANT XV/3, 1998) investigations in the Drescher Inlet indicated the existence of a relatively short and simple food chain. The fish fauna in the water column was mainly represented by the pelagic nototheniid *Pleuragramma antarcticum*. This species feeds on euphausiids, copepods and hyperiid amphipods and, in turn, is the major prey for the Weddell seals in the inlet. In 1998 the seals showed quite a consistent diving pattern, during daytime they made pelagic and benthic dives but during the night almost exclusively pelagic dives restricted to the upper water column. This diving pattern points towards diel vertical migrations of *P. antarcticum*. Therefore we intended to investigate changes in the vertical distribution of this species during the day to get a closer insight into the trophic and behavioural links within the pelagic food chain.

Work at sea

Trawling was carried out just outside the Drescher Inlet, which on our arrival was still covered by a thick layer of fast ice. A benthopelagic net (BPN) was used to investigate the composition of the pelagic fish fauna in the Drescher Inlet. Hauls were taken in the pycnocline (between 120 and 40 metres water depth) and close to the bottom at different day and night times (Table 5). The position of the pycnocline was determined by a CTD profile prior to trawling. The position of the net was monitored by a net sensor system. Fishes were determined, measured and weighed. Otoliths were collected for age determination, stomachs and muscle tissue were sampled for diet and stable isotope analyses, respectively.

Tab. 5 Trawling time and respective station no. for all BPN trawls.

Trawling Time	Pycnocline (~ 40-120m)	Above Ground (~ 450m)
08:00	St. 65-310	-
12:00	St. 65-312	St. 65-329
16:00	St. 65-299	St. 65-314
00:00	St. 65-322	-

Preliminary results

In terms of numbers, all pycnocline day time catches were dominated by nototheniid postlarvae and juveniles, with *Trematomus* spp. and *P. antarcticum* juveniles and postlarvae comprising the main part (Table 6). The family Channichthyidae was represented by *Chionodraco* sp. only.

Our data on the vertical distribution of *P. antarcticum* adults and juveniles are quite scattered, but they indicate that biomass in the pygnocline is high during the night and low during the day and vice versa close to the seafloor (Fig. 36). The size of fish found in the pycnocline at night and above the seafloor during the day was similar (Fig. 37), whereas the length distribution in the pycnocline at daytime shows a slight shift towards larger individuals. Thus, in the pycnocline abundance of potential prey for seals is lower during the day but on average fishes are bigger.

Tab. 6 Mean abundance and biomass per one hour trawling time in the pycnocline during daytime (St. 65-310, 65-312, 65-299).

Species	Ø Abundance	Ø Biomass [g]
Nototheniidae juveniles & postlarvae	118.1	117.8
Channichtyidae juveniles & postlarvae	0.7	1.2
Gymnodraco acuticeps	0.2	2.6
Pleuragramma antarcticum	23.6	669.1

These findings confirm a diel vertical migration pattern in *P. antarcticum* which, in turn, can explain the above mentioned diel diving pattern of the Weddell seals in the Drescher Inlet. The driving force behind the vertical migration of *P. antarcticum* is supposed to be the diel vertical migration pattern of their prey. We found high numbers of euphausiaceans in the daytime hauls close to the seafloor as well as high numbers of hyperiid amphipods in the pycnocline night hauls (St. 65-322). Analyses of stomach contents and stable isotope ratios of *P. antarcticum* will provide more insight into this part of the food chain in the Drescher Inlet.

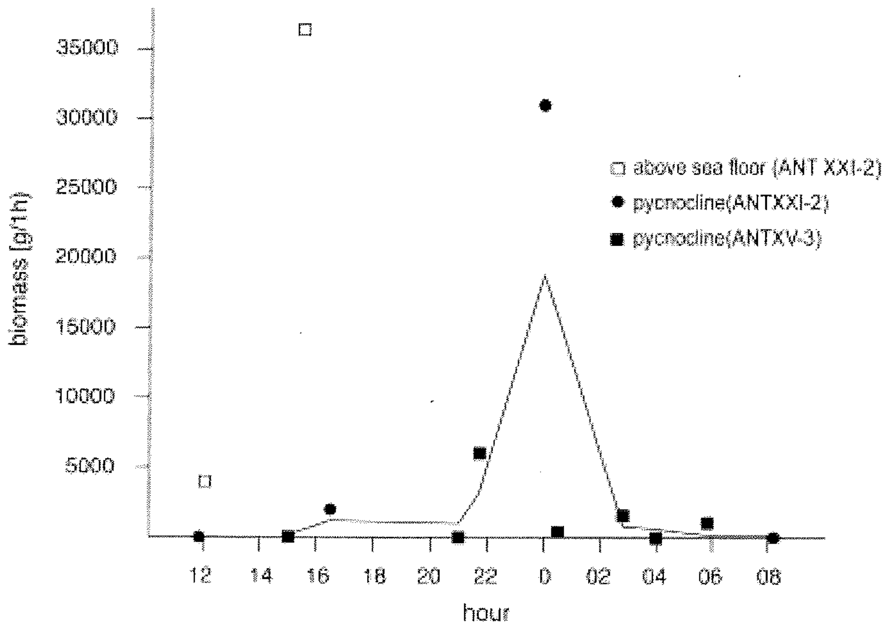

Fig. 36 Diel changes in the vertical distribution of *Pleuragramma antarcticum* (adults and juveniles; postlarvae are not considered). Biomass is expressed in g/ 1 hour trawling time. Combined data from ANT XV-3 and ANT XIX/2. Continuous line indicates mean biomass of *P. antarcticum* in the pycnocline.

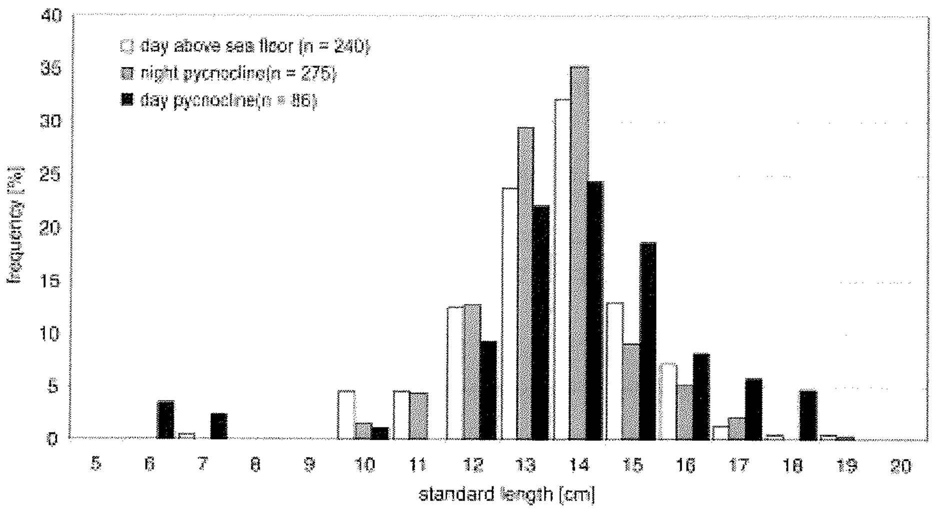

Fig. 37 Length distribution of *Pleuragramma antarcticum* in different water layers depending on time of day (data obtained at St. 65-314; 65-322; 65-299)

2.3.6 Foraging ecology of Weddell seals
(J. Plötz, H. Bornemann, N. Liebsch, Y. Watanabe)

Objectives
The Weddell seal, a fish predator, is adapted to exploit coastal shelf waters which are largely covered by fast ice for most of the year. Previous summer studies at Drescher Inlet showed that during a period of intensive ice break-up Weddell seals exhibited a diel pattern in foraging depths with day-time dives to the seafloor (400 m) and night-time dives well above the pycnocline (about 150 m). Complementary fishery data confirmed that *Pleuragramma antarcticum* were by far the most abundant fish, both in the upper water layer and close to the seabed. The spring campaign (4 Dec. 2003 – 3 Jan. 2004) extended our investigations on predator-prey relationships into a season characterized by unbroken ice and permanent daylight. For this study we conceived a new system of multiple micro-sensors and visual recording devices to obtain a more comprehensive picture of the spatial and temporal variations in the seals' diving behaviour and foraging success. Our study is complementary to studies of diel changes in distribution patterns of fish and of zooplankton included in this cruise report.

Work at Drescher Inlet
Non-lactating female Weddell seals of an estimated weight of 300 - 400 kg were immobilized for the attachment and retrieval of data logging devices. Two Telinject-blowpipe syringes, being placed cranio-dorsolateral of the seal's pelvic region, contained the initial dose of 'Hellabrunner Mischung' (HM). One syringe of HM contains 500 mg xylazine + 400 mg ketamine + 50 I.U. hyaluronidase in a volume of 4.5 ml. About 20 min after HM-injection, the seal was approached to test its reaction by acoustic stimuli. If the narcosis was not deep enough, small doses of xylazine, ketamine, and/or diazepam were administered by hand. The narcosis was reversed by the antidote yohimbine, given as 1% solution in a dose of 5 ml/100 kg body weight. To prevent seals from hyperthermia, the hind flippers were covered with snow. When seals were aroused after the first shot or when the syringe was placed inappropriately, the attempt of immobilization was terminated. In one seal we observed apnea which could not be reversed by antidote intervention. Of the total of 18 seals chosen for deployments, 7 animals were drugged once, and 3, 2 and 6 animals were drugged four, three and two times, respectively. Re-drugging was done in intervals of between 4 and 8 days.
Seals were deployed with the following types of devices: Inter Mandibular Angle Sensor (IMASEN), Multi Channel Logger (MCL), Digital Still picture Logger (DSL), Acceleration Logger (ACL). The IMASEN is a jaw-activity sensor based upon the Hall-effect, recording feeding events measured by mouth-opening angle at frequencies of up to 30 Hz. The MCL measures swimming speed, dive depth, temperature and ambient light levels as well as compass-heading and tilt-angles. The DSL is a camera which records still colour images at 30-s intervals and dive depth at 1-s intervals. The ACL measures swimming speed, dive depth and temperature at 1-s intervals, and 2-D accelerations at 1/16-s intervals.

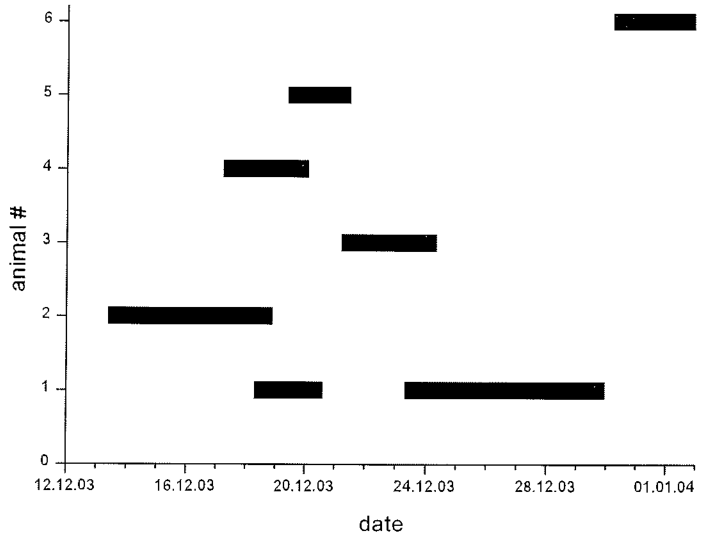

Fig. 38 Distribution of IMASEN and MCL data sets recorded for 6 Weddell seals over study period.

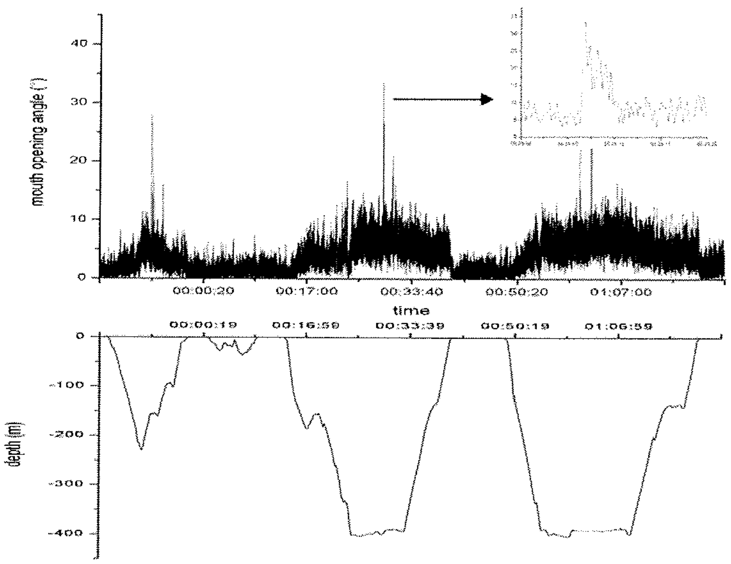

Fig. 39 Sequence of dive pattern and concomitant mouth-openings of a Weddell seal; arrow indicates details of a feeding event.

Preliminary results

IMASEN & MCL: From the 18 logging units recovered, 7 data sets of 6 seals were selected (Fig. 38) and analyzed for feeding events in relation to dive depth (Figs. 39 & 40) and time of day (Fig. 41). Clear changes in mouth-opening-angle over time (at least 10°), occurring under water, were counted as feeding events (Fig. 39). Foraging was most common in the upper parts of the water column. Of the total of 611 feeding events recorded in 219 dives, highest frequencies occurred at around 100 m water depth (Fig. 40). A moderate increase of feeding events appeared close to the seafloor in excess of 400 m. The seals were most active between 22:00 and 06:00 hrs, showing a maximum of feeding events around midnight (Fig. 41). Additional peaks of feeding events occurring in the afternoon hours were mainly caused by one seal which concentrated its diving activity over a depth range of 50 - 100 m during the day. Because of the limited amount of data obtained from this animal, its apparently high prey catch success does not constitute a representative sample of foraging characteristics observed in the other seals studied.

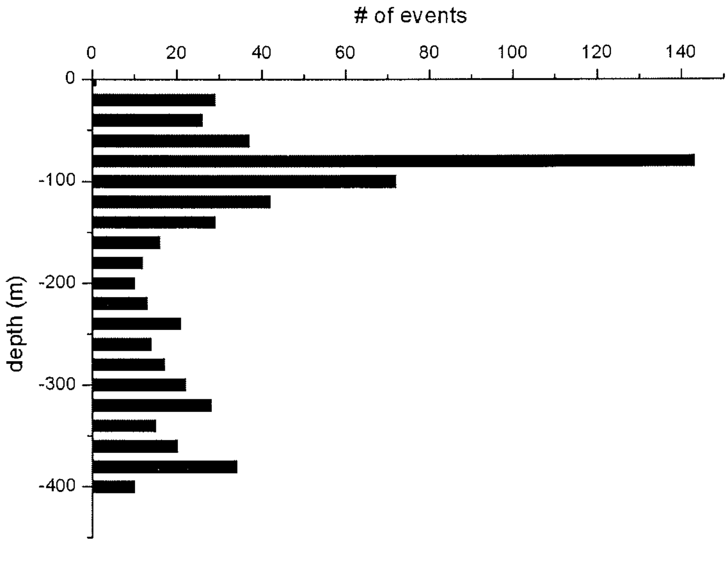

Fig. 40 Distribution of feeding events (n = 611; given in 20-m ranges) against depth of dives (n = 219) recorded for 6 Weddell seals.

DSL & ACL: 4 sets of visual (image) data and 5 sets of acceleration data have been obtained; the recording time ranged from 9 to 36 h and 75 to 167 h, respectively. The seals primarily foraged in two depth layers. These extended from the sea surface to 160 m where the DSL images showed abundant euphausiids and organic particles, and near the seafloor at about 400 m depth. A number of images documented that the seals moved adjacent to underwater ice cliffs and foraged underneath the shelf-ice at ca. 150 m depth, sometimes stretching their necks towards the ice presumably to catch cryopelagic fish. The images often showed aggregations of amphipods, isopods and possibly hydroids at the shelf-ice base (Fig. 42). During the dives underneath the shelf-ice, the seals' swim speed, swaying acceleration and surging acceleration changed simultaneously (Fig. 43). These changes might correspond to prey capture events.

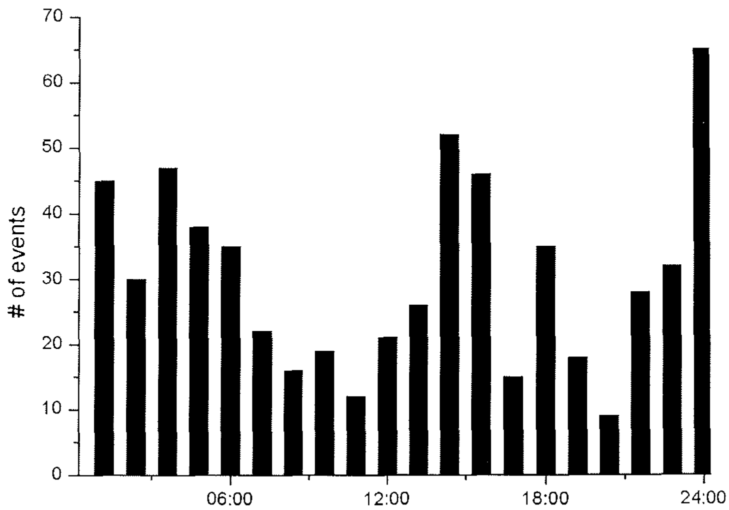

Fig. 41 Distribution of feeding events (n = 611) of 6 Weddell seals against time of day.

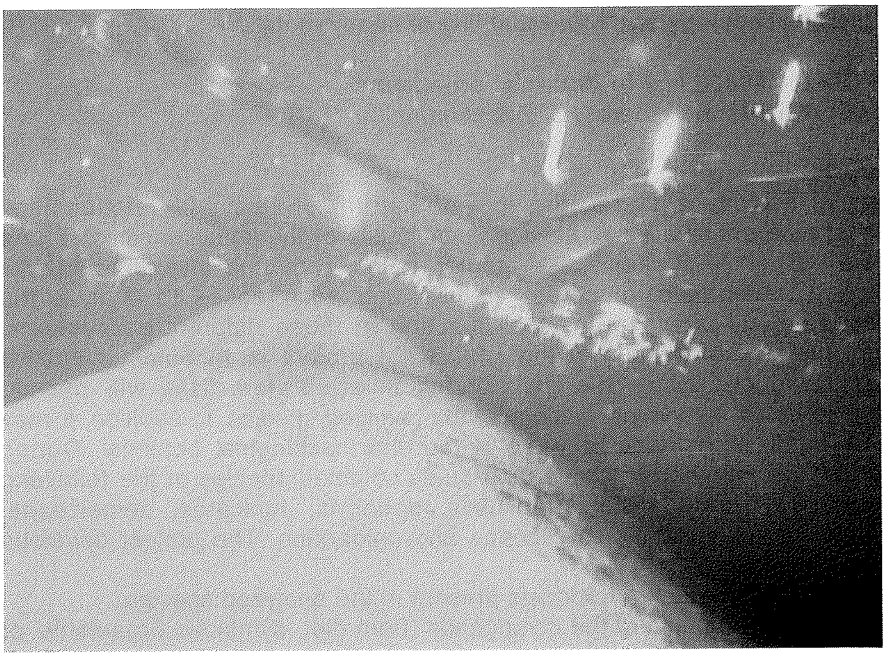

Fig. 42 A Weddell seal stretching its neck towards the underside of the ice shelf (see also text). The image was taken at 150 m depth, by a camera logger attached to the seal's back.

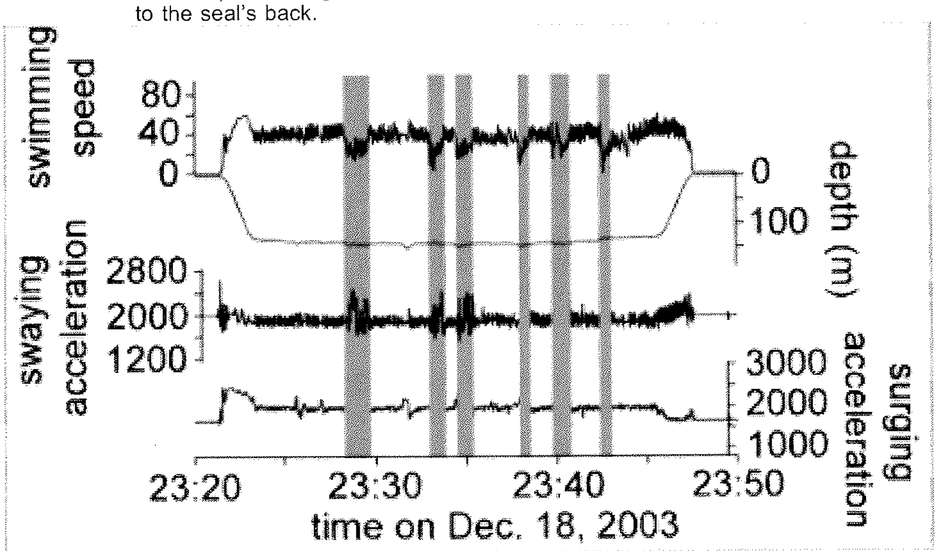

Fig. 43 Swimming speed, dive depth, swaying and surging accelerations recorded from a Weddell seal diving underneath the ice shelf. All parameters except for dive depth are relative values. The shaded areas highlight simultaneous changes of speed and acceleration.

2.4 Chemical ecology and bioavailability of heavy metals

2.4.1 Chemical ecology of Antarctic organisms

(C. Avila, M. Ballesteros, C. Debenham)

Objectives

Chemical ecology analyzes the role of natural products in relationships amongst different species or between individuals of the same species. There is a large diversity of chemical strategies found in marine invertebrates. We are trying to compare temperate, tropical and polar zones to analyze the bioactive natural products and their function in these different ecosystems. Within this frame, the aim of the ECOQUIM project is to obtain bioactive natural products from Antarctic benthic invertebrates. This will provide information on the chemical ecology of the involved species. In addition, it may also be useful to humans because of the pharmacological potential. During the cruise we intended to collect and study selected species of the following benthic invertebrate groups: molluscs, sponges, tunicates, nemerteans, echinoderms, polychaetes, bryozoans and cnidarians. The project develops five specific objectives:

1. to determine the natural products present in the analyzed species.
2. to establish the origin of the compounds (from diet, symbiotic organisms or by biosynthesis).
3. to localize the natural products in the organisms at histological, cytological and immunocytochemical levels.
4. to test the ecological role of the isolated compounds and extracts by using activity tests (deterrence and toxicity) against sympatric predators.
5. to analyze the antitumour activity of extracts and isolated compounds for their potential pharmacological use.

Our main objective during this cruise was to collect the material to develop the five mentioned points. In addition, we carried out some experiments on board within objectives 2 and 4. The Weddell Sea area is very rich in benthic invertebrates and it has been scarcely researched for the presence of natural products. For this reason, the probability of discovering species which possess bioactive compounds with pharmacological interest is very high.

Work at sea

Samples were collected in two different areas: Bouvet Island and the Eastern Weddell Sea. Samples were obtained from 54 stations by using different gear. In total, we obtained material from 16 Agassiz trawls, 13 Bottom trawls, 10 Rauschert dredges, 5 Epibenthic sledges, 4 Multinets, 4 Bongo nets and 2 Giant box corers. The samples ranged in depths between 0 and 1866 m. We described invertebrate species composition and abundances in the trawls. Specimens collected were taxonomically identified when possible, otherwise they were fixed in ethanol or formaldehyde for further identification. The material for chemical studies was frozen immediately at -30°C for further analysis. Some specimens were maintained alive in aquaria and tanks at about -1°C for experimentation on board. Experiments on board included biosynthesis by using labelled precursors in two species of opisthobranch molluscs and some feeding deterrence tests with different kinds of opportunistic predators against opisthobranch mantle tissue and shrimp controls. The focus of these experiments was on opisthobranch molluscs. This is because opisthobranchs show very peculiar characteristics and have a wide variety of chemical strategies (Avila, 1995). Also, we tried to obtain data and information on the reproduction of Antarctic opisthobranchs.

Preliminary results

During the cruise we collected enough material of the main invertebrate groups selected to further develop our work within the ECOQUIM project (Table 7). This material, which is now frozen at -30°C, will be analyzed, during the next three years, at the CEAB (CSIC) and other institutes involved. The approximate number of species collected for the different target groups, and the stations where they were collected are reported in Table 7. The expected number of species for each group has been achieved for most groups, although the amount of some of the samples is very small and may be a limiting factor for the chemical analysis. Some particular groups have been studied in more detail during the cruise, such as opisthobranch molluscs. Off Bouvet Island, 50 opisthobranch specimens belonging to 8 species were collected. Abundances and species richness of opisthobranch molluscs in the Eastern Weddell Sea are reported here. The total abundance was 227 (177 from the Eastern Weddell Sea and 50 from Bouvet Island), which is low compared to that reported from the ANTXV/3 cruise, where 331 opisthobranchs were collected (277 from the Eastern Weddell Sea and 54 from the Antarctic Peninsula). This fact could be related to both the low number of trawls and the restricted depth range of these trawls. Our results were also affected by the ice coverage as we could not sample at Kapp Norvegia. Many of our target invertebrate species occur there in higher abundances than in the areas we sampled.

Biosynthesis experiments were carried out in two previously studied species of opisthobranch molluscs in which we suspect chemical defenses are produced by the slugs. The results of the biosynthesis experiments will be available only after chemical analysis at the CEAB (CSIC), where the frozen samples will be transported. In total, 34 specimens of two opisthobranch species were used in two different sets of experiments.

Moreover, six feeding deterrence tests with two opisthobranch species were carried out against four different kinds of opportunistic predators by using shrimp controls. The tests provided very poor results due to the low availability of useful potential predators. The planned feeding deterrence tests using sponge extracts from the ANT XV/3 cruise were not carried out for the same reason. To further fulfil this objective, more tests will be done in the near future with the material collected during this cruise and the extracts and isolated compounds obtained.

The late spring-early summer conditions of this cruise allowed us to observe and to study for the first time the reproductive strategies of several species of opisthobranch molluscs, which showed very particular characteristics, and also to complete the data available for previously studied species. We followed the development in aquarium of several collected egg masses and juveniles.

Tab. 7 Frozen material from the different invertebrate groups collected for chemical analysis, with the approximate number of species and the number of species expected. Stations as in Annex table 3.2.

Taxon	Stations (PS65/...-1)	Approx. N° species	N° species expected
Sponges	019,029,039,090,109,121,132,145,148,161,166,173 174,175,232,233,237,245,248,253,259,265,274,276 278,280,284,292,297,307,308,324,325,326,336,339	21	15
Molluscs	019,028,029,039,109,121,132,144,148,161,166,174 232 233,237,245,248,251,253,259,265,274,276,279,280 281,292,293,336,339	18	15
Tunicates	019,029,039,090,121,132,148,161,166,173,174,175 245 248,253,259,265,274,276,278,280,297,336,339	15	15
Nemerteans	019,029,039,090,109,245,253,259,265,274,280,308 324,326,336,339	4	5
Echinoderms	019,020,028,029,039,090,109,121,132,144,148,166 173,174,175,245,253,259,265,274,280,283,307,325 336	20	15
Bryozoans	019,029,039,090,121,123,132,148,161,166,173,174 175,232,233,237,245,248,253,259,265,274,276,278 279,280,283,292,297,307,308,324,325,326,336,339	10	10
Cnidarians	039,090,121,132,161,166,173,174,175,237,245,248 253,259,265,274,276,278,279,280,292,297,308,324 325,336,339	10	10
Polychaetes	019,020,039,121,132,166,174,175,237,248,253,259 265,274,276,278,280,292,297,307,308,324,325,336 ,339	5	3
Others	039,090,109,121,132,148,161,166,173,174,175,237 245,253,265,259,274,276,278,280,292,297,308,324 325,326,336,339	6	5

Tab. 8 Preliminary data on abundances and species richness of opisthobranch molluscs collected in the Eastern Weddell Sea. Station numbers according to Annex table 3.2. Ak: Austrodoris kerguelenensis ; Bh: Bathydoris hodgsoni; Aa: Aegires albus; Tb: Tritoniella belli; Tc: Tritonia challengeriana ; Dsp: Doto spp; Nd: Notaeolidia depressa ; Nosp: Notaeolidia sp; Ba: Bathyberthella antarctica ; Pa: Philine alata; Nsp: Newnesia antarctica; Ca: Clione antarctica ; Sb: Spongiobranchaea australis; Lsp: Limacina sp; Ud: Unidentified dorid; Ua: Unidentified aeolid.

Station	Species																Total abundance	Number of species
	Ak	Bh	Aa	Tb	Tc	Dsp	Nd	Nosp	Ba	Pa	Na	Ca	Sb	Lsp	Ud	Ua		
PS65-039-1	1				1					1							3	3
PS65-072-1												1					1	1
PS65-073-1													1				1	1
PS65-090-1											1						1	1
PS65-109-1		1							1								2	2
PS65-113-1													1				1	1
PS65-121-1	6			1	1				2	2							12	5
PS65-132-1	3	1															4	2
PS65-138-1													1				1	1
PS65-144-1	1																1	1
PS65-148-1	1								1		1						3	3
PS65-161-1	1																1	1
PS65-166-1				1													1	1
PS65-174-1	1																1	1
PS65-208-1												1					1	1
PS65-232-1			1							2							3	2
PS65-233-1	2	1															3	2
PS65-237-1	1			1													2	2
PS65-243-1														1			1	1
PS65-245-1	8	1									2						11	3
PS65-248-1	8		1	1													10	3
PS65-251-1					1		1										2	2
PS65-253-1	13							1	1	1							16	4
PS65-259-1	9	1									1						11	3
PS65-264-1														1			1	1
PS65-265-1	10								1								11	2
PS65-271-1														1			1	1
PS65-274-1	12									1	1						14	3

Station	Species Ak	Bh	Aa	Tb	Tc	Dsp	Nd	Nosp	Ba	Pa	Na	Ca	Sb	Lsp	Ud	Ua	Total abundance	Number of species
PS65-276-1	4			4	5	1	3		1								18	6
PS65-278-1	4			1													5	2
PS65-279-1							2										2	1
PS65-280-1	2			7	1	1	2		1						1	1	16	8
PS65-281-1				2	1			4									7	3
PS65-292-1					1												1	1
PS65-293-1	2																2	1
PS65-307-1										1							1	1
PS65-308-1					1												1	1
PS65-324-1	1																1	1
PS65-336-1				2													2	1
PS65-339-1				1													1	1
TOTALS	90	5	2	21	12	2	8	5	8	8	6	2	3	3	1	1	177	16

2.4.2 Bioavailability of heavy metals for selected Weddell Sea shelf biota (G.-P. Zauke, E. Vareschi)

Objectives

The polar marine system is one of the most interesting places regarding bioaccumulation of metals in organisms. Deficiencies of some essential elements such as copper and high bioconcentrations of potentially toxic elements like cadmium have been reported frequently. The latter is referred to as 'polar cadmium anomaly'. The bioavailability of metals can be locally affected by processes such as melting of sea-ice, upwelling, high turnover rates of phyto- and zooplankton and probably iceberg scouring. Generally, aquatic sediments show higher metal concentrations than seawater or organisms. Thus, iceberg scouring could increase the metal availability for benthic colonisers compared to undisturbed areas. The present study intended to analyse whether organisms collected from areas disturbed by iceberg scouring have significantly higher metal concentrations than organisms collected from undisturbed areas.

Work at sea

Samples of selected biota were taken from catches of the Agassiz trawl, Bottom trawl, Benthopelagic trawl, Epibenthos sledge and small amphipod traps mounted to larger fish traps and to the Lander. The amphipod traps were baited with frozen fish and supplied with plastic gauze as a shelter and to prevent cannibalism. To avoid contamination only organisms were taken which had had no contact with the working deck of the vessel itself. Subsequently, the animals were washed with seawater from the CTD-R (depths of 100-200 m) and maintained in such seawater for 24-48h at 0°C to allow defecation. Then they were sorted to the lowest taxonomic level possible: amphipods and decapods to species level, other taxa to the level of genus or family. All taxonomic units distinguished were documented by macro photography using a digital camera and a binocular microscope to allow more detailed determinations in the future. Subsequently the organisms were stored frozen at –20° C. Heavy metal analysis of the biota collected will be done upon arrival at the laboratory of the ICBM, Oldenburg.

Preliminary results

During the cruise we collected: Amphipoda (38 species from 28 stations); Decapoda (2 species from 9 stations); Euphausiacea (1 species from 4 stations); Isopoda (6 species from 14 stations); Holothuroidea (1 species from 8 stations); Bivalvia (4 species from 7 stations); Gastropoda (2 species from 4 stations); Polychaeta (about 18 species from 19 stations, partially not yet determined but documented); Pantopoda (about 10 species from 11 stations, not yet determined but documented). In total 327 samples were obtained. However, highly erratic catches in the AGT and Bottom trawls resulted in a poor spatial coverage for many species and frequently only single or few specimens could be recovered from the gear.

Tab. 9 Specimens collected for heavy metal analysis. Stations see Annex table 3.2.

Taxon	Species (Genus)	Station
Amphipoda	*Abyssorchomene plebs, A. pseudoplebs*	14, 240
Amphipoda	*Ampelisca richardsoni*	39, 90, 121, 132, 173, 248, 253, 276, 278, 280
Amphipoda	*Cyllopus lucasi*	299, 310, 312, 322
Amphipoda	*Parschisturella carinata*	167, 173, 195, 240, 288, 290
Amphipoda	*Tryphosella murrayi*	132, 167, 195, 238, 239, 240, 276
Amphipoda	*Waldeckia obesa*	167, 173, 195, 238, 239, 240, 274, 276, 288, 289, 290
Bivalvia	*Limopsis marionensis*	132, 148, 161, 173, 245
Decapoda	*Nematocarcinus lanceopes*	109, 233
Holothuroidea	*Psolus sp.*	173, 232, 233, 245, 259, 274, 276, 284
Isopoda	*Natatolana sp.*	90, 167, 240, 289, 290
Pantopoda	*Pantopoda non det. sp.-1*	132, 166, 173, 174, 175, 253, 259, 276
Polychaeta	*Ampharetidae non det.*	245, 253, 259, 265, 274, 276
Polychaeta	*Harmothoe sp.*	253, 259, 265, 274, 276, 280
Polychaeta	*Pista sp.*	174, 175, 245, 248, 253, 259, 265, 274, 292
Polychaeta	*Polyeunoa laevis*	175, 248, 253, 259, 265, 274, 276, 278, 280, 292

A better coverage and higher abundance was noted for the taxa listed in Table 9. To evaluate whether organisms collected from areas disturbed by iceberg scouring have significantly higher metal concentrations than organisms collected from undisturbed areas, more detailed information on the status of the stations is required which will be available from project 2.1.1 and 2.1.2.

2.5 Biodiversity, evolution and genetics

2.5.1. Genetic variability in Antarctic marine organisms and species richness of Mollusca (K. Linse, T. Cope)

Objectives

The shelf areas of the eastern Weddell Sea are one of the best-investigated areas in the Antarctic and the faunal composition is well known. For selected invertebrate groups, e.g. Bivalvia, Gastropoda, Bryozoa and Amphipoda, comprehensive biogeographic and/or phylogenetic analyses have been carried out. These data provide the basis for our studies on the population genetics of selected benthic invertebrates to investigate the influence of their reproductive mode on the spatial genetic structure, colonization and their roles in the speciation process. We collected marine invertebrates with contrasting modes of larval development (brooding/direct development versus free-spawning) and contrasting adult lifestyles (sessile versus motile). To investigate phylogenetic relationships and population structures we collected DNA sequence data from mitochondrial (16S, COI, CytB) and nuclear (18S, 28S, ITS) regions from a small number of species. These genes will also confirm whether the studied taxa are truly monophyletic or whether they consist of cryptic species, which only show minor morphological differences

and have therefore been synonymised. The more polymorphic regions will allow us to examine the spatial genetic structure of specimens collected from the cruise at different locations and with material from other cruises (EASIZ II, ANDEEP I+II, LAMPOS) and shore-based collections. Furthermore, we collected recently neglected taxa such as pycnogonids for phylogenetic and population genetic studies. The epibenthic sledge was to be used in iceberg scars to investigate the abundance and composition of epibenthic fauna and to identify possible first recolonizers for those disturbed areas.
The collections at Bouvet Island and the Spiess Seamount will enable us to increase our scarce faunal knowledge from this area, to explain the role of these "stepping stone" islands/seamounts in the evolution of the Southern Ocean fauna, and to gain a better understanding of the recent species distributions.
The investigations focus on
- Micromollusc assemblages from Bouvet Island and their links with Magellanic and Antarctic faunas
- Molluscan diversity patterns between Bouvet Island, the Magellan region, the sub-Antarctic islands, and the high Antarctic (Weddell Sea/Ross Sea)
- Tempo and mode of species diversification in the Antarctic: Target taxa are: limopsid, philobryid and limid bivalves, trichotropid gastropods, epimeriid amphipods, and pygnogonids
- Population structure in widely distributed Antarctic invertebrates: cryptic species or ecologically most successful species? Target taxa: *Lissarca notorcadensis*, *Adacnarca nitens*
- Gene flow among free spawning species is higher than in brooders? Target taxa: *Callochiton gaussi*, *Parmaphorella mawsoni*, *Parabuccinum tenuistriatum*, *Margarella biconica*
- Epibenthic species richness in disturbed areas
- Data collection for SOMBASE (Southern Ocean Mollusc Database).

Work at sea
The work at sea was separated into 4 parts: 1. run of the epibenthic sledge (EBS), 2. sorting of trawled material, 3. identification of collected molluscan specimens, and 4. DNA extraction of selected specimens.
- Run of the epibenthic sledge
The epibenthic sledge was deployed six times in depths between 400 and 900 m in the areas of Auståsen and Vestkapp to estimate small macrobenthos species richness in disturbed areas and to collect small species such as molluscs, isopods and amphipods for phylogenetic analyses. Whenever suitable the supranet samples were given to the zooplankton group, the epinet and additional supranet samples were sorted by us. The material collected (~ 1 l) was fixed in pre-cooled 96% ethanol, and stored at 0°C for 48 hours before being sorted under stereomicroscopes. Further material collected in the nets was collected and sorted by eye straight after sampling. Specimens picked from these samples were fixed in ethanol, formaldehyde or frozen according to their scientific use, or transferred to aquaria to keep them alive for further studies.

- Sorting of trawled material

Specimens of all taxa from 18 Agassiz trawl (AGT), 12 bottom trawl (BT) and 26 Rauschert dredge (RD) catches were picked from the substratum as soon as possible and kept in seawater until further sorting. The collected specimens were then sorted to class level and distributed to the taxon responsible scientist; we collected Brachiopoda, Pygnogonida, Bryozoa and Mollusca except Opisthobranchia. The molluscs were either fixed in 96% ethanol or kept in the aquarium to take live photos of them and later passed on to the ecophysiologists for respiration measurements. Shells of large bivalves and gastropods were opened for better fixation by the ethanol to receive better results in DNA extractions. From damaged and freshly dead Octopoda 1cm^2 mantle tissue was cut of and fixed in 96% ethanol. We fixed these specimens and further dead Octopoda (24 specimens) in formaldehyde for taxonomic determination by Louise Allcock (QU, Belfast). The brachiopods were fixed in ethanol and stowed away to be passed on to the working group of Bernie Cohen (NMS, Edinburgh) for their studies on the phylogenetic relationships of the Brachiopoda. Pygnogonids were searched for their parasites, the gastropod *Dickdellia labioflecta* and then fixed in ethanol for phylogenetic studies. In general cheilostomatous Bryozoa were fixed in ethanol, but whole specimens and large broken pieces of *Cellarinella* spp. were washed with freshwater and dried for age determination. Stones with encrusting bryozoans were washed in freshwater and dried.

- Identification of molluscan collected specimens

The collected molluscs were sorted to morphospecies level (Aplacophora) and identified to genus or even species (Polyplacophora, Monoplacophora, Gastropoda, Scaphopoda, Bivalvia). The main identification guides for Bouvet Island and Spiess Seamount were Branch et al. (1991) and Linse (2002) while Dell (1990) and Hain (1990) were used for identification of Weddell Sea molluscs. Biogeographic and depth distributions of rare finds were compared with earlier expeditions to the Weddell Sea and Scotia Arc (see cruise reports EASIZ II, ANDEEP, LAMPOS) and with records within SOMBASE (Griffiths et al. 2003).

- DNA extraction of selected specimens

Based on earlier experience we decided to extract DNA from selected specimens on board to receive higher DNA quality. Specimens fixed in 96% ethanol were dissected and either muscle tissue (foot muscle in gastropods and polyplacophorans, adductor or foot muscle in bivalves) or the whole specimen (in specimens > 3 mm shell size) were used for the DNA extraction. Main target taxa were limopsid, philobryid and limid bivalves, trichotropid gastropods, *Callochiton gaussi* (Polyplacophora), and the gastropods *Parmaphorella mawsoni* and *Probuccinum tenuistriatum*, but specimens of further taxa were also extracted. The Qiagen DNeasy kit was used and the extraction performed following the manufacturer's instructions. In total DNA was extracted from 374 specimens.

Preliminary results

- Bouvet Island/Spiess Seamount

The waters around Bouvet Island belong to the least known sub-Antarctic island areas in the Southern Ocean. Only a few samples have been taken in these stormy waters by scientific expeditions and molluscan records can be found in the reports of Thiele (1912) and from the HMS "Discovery" expeditions. Before ANT XXI-2, 1 polyplacophoran (*Nuttalochiton mirandus*), 1 prosobranch gastropod (*Chlanidota densesculpta*) and 7 bivalves (*Limopsis lilliei*, *Philobrya sublaevis*, *Limatula hodgsoni*, *Cyclocardia astartoides*, *Astarte longirostris*, *Thracia meridionalis*, and *Cuspidaria infelix*) were accounted for in waters around Bouvet. Studying material collected by 4 Agassiz trawls with attached Rauschert dredge at depths between 130 and 550 m, 1 species of Solenogastres (Aplacophora) at station PS 65-029, 3 species of Polyplacophora, 25 species of shelled Gastropoda and 14 species of Bivalvia were identified (Table 10). Our investigation increased the known species by multiple times and we believe that our recent account is by far under representative. The reasons for this are the few hauls taken during this expedition and that species found in earlier studies (*Limatula hodgsoni*, *Astarte longirostris*, *Thracia meridionalis*) were not found in the recent sampling. A preliminary analysis of the diversity off Bouvet Island indicates that the molluscan fauna is diverse and comparable with the species richness found at other sub-Antarctic islands such as South Georgia, Marion Island and Kerguelen Islands. However, further sampling around this island is needed to give better estimates of its diversity and species richness. Regarding the biogeographic position of Bouvet Island the collected fauna comprises elements known from the Magellan region, sub-Antarctic islands, the Weddell Sea and the Ross Sea. Molecular analysis on selected taxa (e.g. *Limopsis marionensis*, *Nuttalochiton mirandus*, *Cyclocardia astartoides*) will confirm whether the Bouvet fauna comprises the sub-Antarctic or the high-Antarctic forms of these taxa.

Tab. 10 Bouvet molluscs per haul/station, excluding Nudibranchia and Cephalopoda. Station numbers according to Annex table 3.2. AGT-Agassiz trawl, EBS-Epibenthic sledge, GSN-bottom trawl, RD-Rauschert dredge, SD-Stonedredge

		019 AGT	020 AGT	028 AGT	029 AGT	344 AGT	347 SD
Polyplacophora							
	Nuttalochiton mirandus	X	X				
	Leptochiton sp.	X	X	X	X		
	Polyplacophora sp 1	X		X			
Gastropoda							
FISSURELLIDAE	*Puncturella conica*	X	X		X		X
TROCHIDAE	*Calliotropis* (*S.*) *antarctica*	X	X				
	Margarella cf. *antarctica*		X	X			
SEGUENZIIDAE	*Seguenzia* cf *antarctica*		X				
RISSOIDAE	*Onoba* cf *gelida*		X	X	X		
EATONIELLIDAE	*Eatoniella* sp 1			X	X		

	Eatoniella sp 2			X	X		
CYCLOSTREMATIDAE	*Liotella* sp 1				X		
EULIMIDAE	*Balcis tumidula*	X	X	X	X		
NATICIDAE	*Kerguelenatica bioperculata*		X	X	X		
	Naticidae sp 1			X			
BUCCINIDAE	*Pareuthria* sp 1	X		X			
	Chlanidota densesculpta		X	X			
	?*Parabuccinum* sp 1				X		
	Prosipho sp 1				X		
CANCELLARIIDAE	*Admete* cf *bullatus*	X			X		
MARGINELLIDAE	*Marginella* cf *hyalina*	X					
TURRIDAE	*Lorabela* sp 1			X			
DIAPHANIDAE	*Diaphana* cf *inflata*		X				
	Toledonia cf *limnaeformis*		X				
	Toledonia sp 1				X		
SCAPHANDRIDAE	*Scaphander* sp 1			X			
PHILINIDAE	*Philine* sp 1		X	X			
PLEUROBRANCHIDAE	*Bathyberthella* sp1	X					
Gastropoda	Gastropoda indet 1		X				
Bivalvia							
SAREPTIDAE	*Yoldiella antarctica*		X		X		
LIMOPSIDAE	*Limopsis lilliei*				X		
PHILOBRYIDAE	*Philobrya sublaevis*			X			
	Philobrya wandelensis			X			
	Adacnarca nitens	X			X		
PROPEAMUSSIIDAE	*Cyclopecten hexagonalis*				X		
	Cyclopecten sp 1		X				
LIMIDAE	*Acesta* sp					X	
CARDITIDAE	*Cyclocardia astartoides*	X	X	X	X		
CYAMIIDAE	*Cyamiocardium denticulatum*			X			
THYASIRIDAE	*Genaxius bongraini*		X		X		
LYONSIIDAE	*Lyonsia arcaeformis*				X		
CUSPIDARIIDAE	*Cuspidaria infelix*		X		X		
	Sum of species	12	19	18	22	1	1

- Eastern Weddell Sea

More than 1500 specimens of 6 molluscan classes (Solenogastres, Polyplacophora, Gastropoda, Bivalvia, Scaphopoda, and Cephalopoda) were collected belonging to more than 150 morphospecies. The most species rich group were gastropods with 90 morphospecies (Table 11) followed by 45 species of bivalves (Table 12). As usual, the other classes occurred in lower species numbers: 4 species of Solenogastres, 2 species of Scaphopoda, and 4 species of Polyplacophora (Table 13). The species numbers of gastropods and bivalves were similar to reports from previous studies on the Antarctic shelf (93 G: 39 B - Weddell Sea, 97 G: 33 B – Enderby Land to Ross Sea, 98 G: 50 B – Davis Sea). Most of the sampling (11 AGTs with attached RD, 12 BTs) was done between 250 and 400m and accounted for 43 species of gastropods and 33 species of bivalves, unfortunately often in low specimen numbers. Quite often a single specimen in the large trawls represented a species. Only the epizoic bivalve *Lissarca notorcadensis* Melvill & Standen, 1907 occurred in higher numbers on cidaroid sea urchins but even here the numbers of bivalves per urchin were lower than observed in previous expeditions. Additionally 15 Rauschert dredge and 6 EBS stations were taken at depths between 84 and 1800m, adding 47 species of gastropods and 12 species of bivalves to the list (the EBS samples alone comprised 39 species of gastropods and 33 species of bivalves). These finds indicate that the wider sampling depth increased the number of collected species by many. The EBS stations were most species rich with 48 species (PS 65-232), 29 species (PS 65-283) and 28 species (EBS PS 65-048) and one combined AGT/RD station (PS 65-276) contained 28 species as well. At the other stations the species numbers varied between 1 and 20 species per station. Highlights of the sampling effort were the collection of 6 specimens of *Bathyarca sinuata* Pelseneer, 1903, only known from the Ross and Bellingshausen seas and not collected outside the Ross Sea since 1911, and the find of the first cardiid bivalve in Antarctic waters.

Tab. 11 Gastropods in the Weddell Sea. Station numbers according to Annex table 3.2. AGT: Agassiz trawl with attached Rauschert dredge, BT: Bottom trawl, EBS: Epibenthic sledge, RD: Rauschert dredge.

Station	039	048	069	090	109	121	132	144	145	148	161	166	173	174	175	205	232	233	245	248	251	253	259	265	274	276	278	279	280	281	283	284	292	293	297	307	308	324	325	326	336	337	339
Gear	AGT	EBS	RD	AGT	AGT	AGT	BT	EBS	EBS	BT	AGT	BT	AGT	BT	BT	BT	EBS	AGT	BT	BT	RD	BT	BT	BT	BT	AGT	AGT	AGT	AGT	RD	EBS	EBS	BT	RD	RD	RD	RD	RD	RD	RD	AGT	RD	RD
SCISSURELLIDAE																																											
Anatoma amoenus																	X																										
Anatoma euglypta									X								X	X													X					X							
ARCHEOGASTROPODA																																											
Limpet sp																																X											
FISSURELLIDAE																																											
Parmaphorella mawsoni				X			X				X	X	X		X				X	X			X	X	X	X																	
LEPETIDAE																																											
Iothia coppingeri																					X									X													
TROCHIDAE																																											
Calliotropis (S.) antarctica																																											
Falsimargarita gemma		X				X				X																X													X				
Margarella cf. antarctica																																											
Margarella biconica						X	X			X						X			X	X		X		X	X																X		
Margarites refulgens				X												X					X			X		X	X	X	X						X								
Margarites crebrilirulata																					X									X													
Antimargarita dulcis						X																				X																	
Solariella sp																																				X							
SEGUENZIIDAE																																											
Seguenzia cf antarctica					X																																						
TURBINIDAE																																											
Leptocollonia innocens																										X		X			X	X							X	X			

Station	Gear	TROCHACLIDAE	Trochaclis antarctica	CYCLOSTREMATIDAE	Brookula sp	RISSOIDAE	Onoba cf gelida	EATONIELLIDAE	Eatoniella sp 1	Eatoniella sp 2	Eatoniella sp 3	Eatoniella sp 4	ZEROLATUNIDAE	Frovina sp	Zerotulanidae sp 1	Zerotulanidae sp 2	TURRITELLIDAE	Turritellopsis gratissima	CERITHIIDAE	Cerithiella erecta	Cerithiella Hain sp 1	Cerithiella Hain sp 2	Cerithiella sp 1	Cerithiella sp 2	EUMETULIDAE
339	RD																								
337	RD																								
336	AGT																								
326	RD																					x			
325	RD																								
324	RD																								
308	RD																					x			
307	RD																								
297	RD										x												x		
293	RD																								
292	BT																								
284	EBS																				x				
283	EBS											x													
281	RD																								
280	AGT																			x					
279	AGT																								
278	AGT										x	x													
276	AGT																								
274	BT		x																						
265	BT																								
259	BT																								
253	BT		x																						
251	RD																								
248	BT		x																						
245	BT		x																						
233	AGT																								
232	EBS		x		x									x	x	x		x							
205	BT																								
175	BT		x																						
174	BT																								
173	AGT																							x	
166	BT																								
161	AGT																								
148	BT		x																						
145	EBS		x								x	x		x											
144	EBS											x		x											
132	BT		x																						
121	AGT																								
109	AGT																			x			x		
090	AGT		x																						
069	RD																								
048	EBS				x				x	x		x		x											
039	AGT																								

Station	039	048	069	090	109	121	132	144	145	148	161	166	173	174	175	205	232	233	245	248	251	253	259	265	274	276	278	279	280	281	283	284	292	293	297	307	308	324	325	326	336	337	339
Gear	AGT	EBS	RD	AGT	AGT	AGT	BT	EBS	EBS	BT	AGT	BT	AGT	BT	BT	BT	EBS	AGT	BT	BT	RD	BT	BT	BT	BT	AGT	AGT	AGT	AGT	RD	EBS	EBS	BT	RD	RD	RD	RD	RD	RD	RD	AGT	RD	RD
Eumetula strebeli strebeli								X																														X					
EULIMIDAE																																											
Balcis solitaria													X																									X					
Balcis tumidula								X	X								X														X			X			X					X	X
TRICHOTROPIDAE																																											
Torellia mirabilis						X																		X		X									X						X		
Torellia planispira						X	X																																				
Torellia smithi						X	X		X														X	X																			
Torellia insignis									X																						X												
CAPULIDAE																																											
Capulus subcompressus		X															X																										
NATICIDAE																																											
Amauropsis rossiana						X	X												X									X															
Kerguelenatica biopercul.																																											
Falsilunatia soluta																																			X								
Sinuber sculptum sculpt.								X																																			
Naticidae sp																		X																									
LAMELLARIIDAE																																											
Marseniopsis sp								X					X													X		X		X					X								
BUCCINIDAE																																											
Pareuthria innocens							X																																				
Pareuthria plicatula																																			X		X					X	
Chlanidota densesculpta																																											
Neobuccinum eatoni						X																				X																	

Station	039	048	069	090	109	121	132	144	145	148	161	166	173	174	175	205	232	233	245	248	251	253	259	265	274	276	278	279	280	281	283	284	292	293	297	307	308	324	325	326	336	337	339
Gear	AGT	EBS	RD	AGT	AGT	AGT	BT	EBS	EBS	BT	AGT	BT	AGT	BT	BT	BT	EBS	AGT	BT	BT	RD	BT	BT	BT	BT	AGT	AGT	AGT	AGT	RD	EBS	EBS	BT	RD	RD	RD	RD	RD	RD	RD	AGT	RD	RD
Antarctodomus thielei																														X													
Probuccinum cf costatum																															X												
Probuccinum tenerum				X																						X									X					X			
P. tenuistriatum				X		X																			X																		
Prosipho elongatus																		X																						X			
Prosipho hunteri																		X											X													X	
Prosipho cf tuberculatus																															X							X					
Prosipho sp WS																													X														
MURICIDAE																																											
Trophon drygalskii																															X				X					X			
VOLUTIDAE																																											
Harpovoluta charcoti												X	X					X																	X						X		
VOLUTOMITRIDAE																																											
Paradmete curta									X										X																								
Paradmete fragillima				X							X																				X												
CANCELLARIIDAE																																											
Admete sp		X			X													X										X															
Nothoadmete tumida																	X																										
MARGINELLIDAE																																											
Marginella ealesae		X		X		X	X				X							X	X			X				X			X		X	X		X	X			X	X	X			
Marginella cf hyalina																																											
TURRIDAE																																											
Aforia magnifica						X											X																								X		

Station	039	048	069	090	109	121	132	144	145	148	161	166	173	174	175	205	232	233	245	248	251	253	259	265	274	276	278	279	280	281	283	284	292	293	297	307	308	324	325	326	336	337	339
Gear	AGT	EBS	RD	AGT	AGT	AGT	BT	EBS	EBS	BT	AGT	BT	AGT	BT	BT	BT	EBS	AGT	BT	BT	RD	BT	BT	BT	BT	AGT	AGT	AGT	AGT	RD	EBS	EBS	BT	RD	RD	RD	RD	RD	RD	RD	AGT	RD	RD
Lorabela pelseneeri										x																x																	
Lorabela plicatula																	x																						x				
Lorabela sp. Bouvet																																											
Belalora striatula																																								x			
Pleurotomella enderbyen.																	x																										
Pleurotomella simillliana				x																						x									x								
Ponthiothauma ergata					x	x																																x					
Turridae sp.				x													x														x												x
Turridae Hain sp. 1																									x																		
DIAPHANIDAE																																											
Toledonia cf hedleyi								x																					x	x													
Toledonia cf limnaeformis								x	x														x					x							x							x	x
Toledonia cf. elata													x																														
SCAPHANDRIDAE																																											
Cylichna cf gelida																																				x							
PHILINIDAE																																											
Philine sp.																									x																		
PLEUROBRANCHIDAE																																											
Bathyberthella																																											
Gastropoda indet 1																																											

Tab. 12 Bivalvia in the Weddell Sea. Station numbers according to Annex table 3.2. AGT: Agassiz trawl with attached Rauschert dredge, BT: Bottom trawl, EBS: Epibenthic sledge, RD: Rauschert dredge.

Station	039	048	069	090	109	121	132	144	145	148	161	166	173	174	175	205	232	233	245	248	251	253	259	265	274	276	278	279	280	281	283	284	292	293	297	307	308	324	325	326	336	337	339
Gear	AGT	EBS	RD	AGT	AGT	AGT	BT	EBS	EBS	BT	AGT	BT	AGT	BT	BT	BT	EBS	AGT	BT	BT	RD	BT	BT	BT	BT	AGT	AGT	AGT	AGT	RD	EBS	EBS	BT	RD	RD	RD	RD	RD	RD	RD	AGT	RD	RD
SAREPTIDAE																																											
Yoldiella antarctica																																											
Yoldiella sabrina					X			X	X																																		
Yoldiella valettii		X							X	X			X				X	X													X	X										X	
SILICULIDAE																																											
Propeleda longicaudata		X					X										X																										
Silicula rouchi		X		X		X		X	X								X																										
ARCIDAE																																											
Bathyarca sinuata																																				X							
LIMOPSIDAE																																											
Limopsis enderbyensis				X						X												X	X			X			X		X									X			
Limopsis lilliei		X									X																X	X															
Limopsis marionensis				X			X				X						X		X							X		X			X			X				X	X	X			
PHILOBRYIDAE																																											
Philobrya barbata																										X			X		X												
Philobrya quadrata				X						X															X	X			X		X								X				
Philobrya sublaevis		X				X	X	X		X		X	X	X	X		X		X	X	X		X	X	X	X	X				X							X			X		X
Philobrya wandelensis		X							X								X										X	X	X		X												
Adacnarca limopsoides				X						X			X													X	X		X		X									X			
Adacnarca nitens	X	X				X		X	X	X	X		X				X	X	X				X	X	X	X	X				X							X	X	X		X	X
Lissarca notorcadensis		X		X			X	X		X	X	X	X		X		X		X			X	X	X	X	X					X		X				X	X	X	X		X	
MYTILIDAE																																											

Station	039	048	069	090	109	121	132	144	145	148	161	166	173	174	175	205	232	233	245	248	251	253	259	265	274	276	278	279	280	281	283	284	292	293	297	307	308	324	325	326	336	337	339
Gear	AGT	EBS	RD	AGT	AGT	AGT	BT	EBS	EBS	BT	AGT	BT	AGT	BT	BT	BT	EBS	AGT	BT	BT	RD	BT	BT	BT	BT	AGT	AGT	AGT	AGT	RD	EBS	EBS	BT	RD	RD	RD	RD	RD	RD	RD	AGT	RD	RD
Dacrydium albidum		X											X				X									X					X	X											
PECTINIDAE																																											
Adamussium colbecki	X																																										
LIMIDAE																																											
Limatula hodgsoni				X		X		X	X								X	X					X		X	X	X					X								X			
Limatula ovalis								X		X							X	X									X	X			X						X	X					
Limatula simillima																	X																										
ASTARTIDAE																																											
Astarte longirostris																															X	X		X			X	X	X	X			
CARDIIDAE																																											
Cardium sp.																															X												
CARDITIDAE																																											
Cyclocardia astartoides		X		X				X	X		X		X				X		X				X	X		X					X	X						X	X	X			X
CYAMIIDAE																																											
Cyamiomactra robusta																												X															
C. denticulatum		X		X																																							
Ptychocardia vanhoeffeni		X				X																																					
Waldo parasiticum																	X																										
THYASIRIDAE																																											
Genaxius bongraini		X						X	X								X	X																									
KELLIIDAE																																											
Kellia simulans																									X				X													X	
Pseudokellya cardifromis																						X																					
Pseudokellya gradata																	X	X														X					X	X					

Station	039	048	069	090	109	121	132	144	145	148	161	166	173	174	175	205	232	233	245	248	251	253	259	265	274	276	278	279	280	281	283	284	292	293	297	307	308	324	325	326	336	337	339
Gear	AGT	EBS	RD	AGT	AGT	AGT	BT	EBS	EBS	BT	AGT	BT	AGT	BT	BT	BT	EBS	AGT	BT	BT	RD	BT	BT	BT	BT	AGT	AGT	AGT	AGT	RD	EBS	EBS	BT	RD	RD	RD	RD	RD	RD	RD	AGT	RD	RD
KELLIELLIDAE																																											
Kelliella sirenkoi		X			X																																						
MONTACUTIDAE																																											
Mysella miniuscula		X						X									X																										
LYONSIIDAE																																											
Lyonsia arcaeformis		X								X							X										X	X			X	X								X			X
THRACIIDAE																																											
Thracia meridionalis		X					X	X	X																	X	X	X	X		X												
POROMYIDAE																																											
Poromya antarctica						X																																					
LATERNULIDAE																																											
Laternula elliptica																												X															
CUSPIDARIIDAE																																											
Cuspidaria infelix		X											X				X															X				X							
Cuspidaria tenella																	X																						X				
Subcuspidaria kerguelen.								X	X																			X															

Tab. 13 Aplacophora, Polyplacohora and Scaphopoda in the Weddell Sea. Station numbers according to Annex table 3.2. AGT: Agassiz trawl with attached Rauschert dredge, BT: Bottom trawl, EBS: Epibenthic sledge, RD: Rauschert dredge.

Station	232	233	245	248	251	253	259	265	274	276	278	279	280	281	283	284	292	293	297	307	308	324	325	326	336	337	339
Gear	EBS	AGT	BT	BT	RD	BT	BT	BT	BT	AGT	AGT	AGT	AGT	RD	EBS	EBS	BT	RD	RD	RD	RD	RD	RD	RD	AGT	RD	RD
Aplacophora																											
Solenogaster sp 1	X																										
Solenogaster sp 2						X																					
Solenogaster sp 3																											
Solenogaster sp 4									X	X								X									
Polyplacophora																											
Nuttalochiton mirandus			X				X			X																	
Lepidochiton sp.																											
Callichiton gaussi	X							X		X			X		X												
Polyplacophora sp	X																										
Scaphopoda																											
DENTALIIDAE																											
Fissidentalium majorinum	X								X	X																	
PULSELLIDAE																											
Pulsellum sp	X																										

2.5.2 Phylogeny, biodiversity and functional ecology of Amphipoda
(C. De Broyer, M. Rauschert, F. Nyssen)

Objectives

Weddell Sea amphipod crustaceans show high diversity, often high abundance and a remarkable ubiquity. These characteristics make them a model group for studying patterns and processes of biodiversity and biogeography. A large dataset on amphipod diversity and distribution obtained from previous "Polarstern" campaigns in the eastern Weddell Sea, the Peninsula and the Scotia Sea regions is presently being synthesized. Additional deep-sea data (ANDEEP) will allow to analyse the evolutionary relationships between the Antarctic shelf and deep-sea fauna.

First attempts to characterize the ecofunctional role of Antarctic amphipods revealed a rather large diversity of trophic types among the investigated species which, however, do not represent the full spectrum of trophic roles within the whole amphipod taxocoenosis. Quantitative estimates of the role of the amphipod community in benthic energy fluxes are missing.

Several complementary objectives are addressed here:

- Biodiversity:

(i) Composition and characteristics of the high Antarctic (Weddell Sea) amphipod fauna as compared to other Antarctic and Subantarctic zoogeographical sub-regions and to the deep slope and abyssal zones (ANDEEP). (ii) Photographic documentation of Antarctic benthos for the AWI Atlas of Antarctic Benthos in preparation by M. Rauschert. (iii) Contribution to the ongoing revision of the whole Antarctic amphipod fauna and to the preparation of new identification tools ("Antarctic Amphipodologist Network").

- Phylogeny and Phylogeography

Phylogeny of selected amphipod taxa (in particular Lysianassoidea) and their biogeographical history by a parallel molecular and ecomorphological study relying on both shelf and deep-sea (ANDEEP) material with emphasis on the polar submergence hypothesis.

- Trophic ecology

(i) Ecological characterization of the amphipod taxocoenosis, in particular the habitat diversity, the ecomorphological types and life styles. (ii) Detailed investigation of amphipod trophodiversity and trophodynamics. This study will involve: digestive tract analyses and feeding behaviour observations in aquaria, stable isotope ratios and fatty acid diet tracers.

- Metabolism

Analysis of trophic adaptive radiation in selected taxa by a morpho-functional approach coupled with a molecular identification of trophic homologies and analogies and molecular polarization of the ecomorphological adaptations.

Work at sea

Amphipods were sampled by Rauschert dredge, Epibenthic sledge, Agassiz trawl, Bottom trawl, and baited traps. Specimens were sorted, photographed and identified to the species on board. Live specimens were maintained in cool container aquaria. Samples for stable isotopes, fatty acids, and bacterial gut content studies were collected. Gut clearance experiments were carried out with 3 amphipod species (*Waldeckia obesa*, *Abyssorchomene plebs*, *Tryphosella murrayi*) and 1 isopod species (*Natatolana* sp.), the experimental animals were fixed in formalin and will be analysed at home. With the collaboration of the T. Brey working group, respiration measurements have been performed with 4 species.

Preliminary results

- Material collected:

56 operations by Rauschert dredge (RD), Epibenthic sledge (EBS), Agassiz trawl (AGT), Bottom trawl (BT), Bentho-pelagic trawl (BPT) and baited traps (T) resulted in more than 11,000 amphipods. Additional material is expected from multibox corer (MG) samples.

- Biodiversity, biogeography and phylogeny:

229 amphipod (morpho)species belonging to 100 genera and 41 families were identified (Table 14). 31 species are probably new to science (but part of them has already been collected by some previous EASIZ or LAMPOS cruises).

Tab. 14 Preliminary list of sorted and identified amphipod species.

Family or Superfamily	Genus	Species	ANT XXI-2	
			Bouvet	EWS
	I. GAMMARIDEA			
Acanthonotozomatidae	*Acanthonotozomoides*	*oatesi*		x
Acanthonotozomatidae	*Acanthonotozomoides*	sp.n. 1		x
Acanthonotozomatidae	*Acanthonotozomoides*	sp.n. 2		x
Acanthonotozomatidae	*Acanthonotozomopsis*	*pushkini*		x
Ampeliscidae	*Ampelisca*	*anversensis*		x
Ampeliscidae	*Ampelisca*	*cf. anversensis*		x
Ampeliscidae	*Ampelisca*	*barnardi*		x
Ampeliscidae	*Ampelisca*	*richardsoni*		x
Ampeliscidae	*Ampelisca*	spp.		x
Ampeliscidae	*Byblis*	sp.		x
Amphilochiidae	*Gitanopsis*	*inaequipes*		x
Amphilochiidae	*Gitanopsis*	*squamosa*	x	
Clarenciidae	*Clarencia*	*chelata*		x
Clarenciidae	*Clarencia*	sp.n.		x
Dexaminidae	*Polycheria*	*antarctica*		x
Dydimocheliidae	*Dydimochelia*	sp.		x
Epimeriidae	*Epimeria*	*annabellae*		x
Epimeriidae	*Epimeria*	*georgiana*		x
Epimeriidae	*Epimeria*	*grandirostris*		x
Epimeriidae	*Epimeria*	*cf heldi* (sp.n.?)		x
Epimeriidae	*Epimeria*	*inermis*		x
Epimeriidae	*Epimeria*	*cf. inermis*		x
Epimeriidae	*Epimeria*	*macrodonta*		x
Epimeriidae	*Epimeria*	*puncticulata*		x
Epimeriidae	*Epimeria*	*robusta*		x
Epimeriidae	*Epimeria*	*cf. robusta*		x
Epimeriidae	*Epimeria*	*rubrieques*		x

Family or Superfamily	Genus	Species	ANT XXI-2 Bouvet	EWS
Epimeriidae	*Epimeria*	*similis*		x
Epimeriidae	*Epimeria*	sp.		x
Epimeriidae	*Epimeria*	sp.		x
Epimeriidae	*Epimeriella*	*cf. truncata*		x
Epimeriidae	*Epimeriella*	*walkeri*		x
Epimeriidae	*Parepimeria*	*crenulata*	x	
Eusiroidea	*Atyloella*	*magellanica*	x	
Eusiroidea	*Atyloella*	sp.n.	x	
Eusiroidea	*Atyloella*	sp.		x
Eusiroidea	*Atylopsis*	*fragilis*	x	x
Eusiroidea	*Atylopsis*	*megalops*	x	x
Eusiroidea	*Atylopsis*	*orthodactylus.*	x	
Eusiroidea	*Atylopsis*	sp.		x
Eusiroidea	*Eusirus*	*antarcticus*		x
Eusiroidea	*Eusirus*	*cf. antarcticus*		x
Eusiroidea	*Eusirus*	*microps*		x
Eusiroidea	*Eusirus*	*perdentatus*		x
Eusiroidea	*Harpinioides*	*drepranocheir*		x
Eusiroidea	*Liouvillea*	*oculata*		x
Eusiroidea	*Liouvillea*	sp.n.		x
Eusiroidea	*Oradarea*	*edentata*		x
Eusiroidea	*Oradarea*	*rossi*	x	
Eusiroidea	*Oradarea*	*tricarinata*		x
Eusiroidea	*Oradarea*	*tridentata*		x
Eusiroidea	*Oradarea*	*walkeri*	x	x
Eusiroidea	*Paramoera*	*fissicauda*		x
Eusiroidea	*Paramoera*	sp.		x
Eusiroidea	*Paramoera*	*hurleyi*		x
Eusiroidea	*Prostebbingia*	*brevicornis*	x	
Eusiroidea	*Prostebbingia*	*gracilis*		x
Eusiroidea	*Rhachotropis*	*antarctica*		x
Eusiroidea	*Rhachotropis*	sp. *(hunteri?)*		x
Eusiroidea	*Schraderia*	*acuticauda*		x
Eusiroidea	*Schraderia*	*gracilis*	x	x
Eusiroidea	*Schraderia*	sp.1		x
Eusiroidea	*Gen. div.*	spp.	x	x
Hadzioidea	*Maera ?*	sp.		x
Hadzioidea	*Paraceradocus*	*gibber*		x
Hadzioidea	*Gen. nov.*	sp.n.		x
Iphimediidae	*Echiniphimedia*	*barnardi*		x
Iphimediidae	*Echiniphimedia*	*echinata*		x
Iphimediidae	*Echiniphimedia*	*imparidentata*		x
Iphimediidae	*Echiniphimedia*	*hodgsoni*	x	x
Iphimediidae	*Echiniphimedia*	sp.		x
Iphimediidae	*Gnathiphimedia*	*barnardi*		x
Iphimediidae	*Gnathiphimedia*	*cf. barnardi*		x
Iphimediidae	*Gnathiphimedia*	*fuchsi*		x
Iphimediidae	*Gnathiphimedia*	*macrops*		
Iphimediidae	*Gnathiphimedia*	*mandibularis*	x	x
Iphimediidae	*Gnathiphimedia*	*cf mandibularis*	x	

Family or Superfamily	Genus	Species	ANT XXI-2 Bouvet	EWS
Iphimediidae	*Gnathiphimedia*	sp. *(cf. mandibularis)*	x	
Iphimediidae	*Gnathiphimedia*	*sexdentata*		x
Iphimediidae	*Gnathiphimedia*	*watlingi*	x	x
Iphimediidae	*Gnathiphimedia*	sp.1	x	
Iphimediidae	*Gnathiphimedia*	sp.2	x	
Iphimediidae	*Iphimediella*	*bransfieldi*		x
Iphimediidae	*Iphimediella*	*cyclogena*		x
Iphimediidae	*Iphimediella*	*microdentata*		x
Iphimediidae	*Iphimediella*	sp.		x
Iphimediidae	*Stegopanoploea*	*joubini*		x
Laphystiopsidae	*Prolaphystius*	*isopodops*		x
Lepechinellidae	*Lepechinella*	*drygalskii*		x
Lepechinellidae	*Lepechinella*	sp.		x
Lepechinellidae?	*Gen. n.*	sp.n.		x
Leucothoidae	*Leucothoe*	*spinicarpa*	x	x
Leucothoidae	*Leucothoe*	*spinicarpa*	x	x
Liljeborgiidae	*Liljeborgia*	*cf dubia*	x	
Liljeborgiidae	*Liljeborgia*	*georgiana*	x	x
Liljeborgiidae	*Liljeborgia*	sp.n.		x
Liljeborgiidae	*Liljeborgia*	sp.	x	
Liljeborgiidae	*Liljeborgia*	spp.		x
Lysianassoidea	*Abyssorchomene*	*charcoti*		x
Lysianassoidea	*Abyssorchomene*	*nodimanus*		x
Lysianassoidea	*Abyssorchomene*	*plebs*	x	x
Lysianassoidea	*Abyssorchomene*	sp.n.	x	
Lysianassoidea	*Abyssorchomene*	*rossi*		x
Lysianassoidea	*Ambasiopsis*	*uncinata*		x
Lysianassoidea	*Aristias*	*antarcticus*		x
Lysianassoidea	*Aristias*	*cf. collinus*		x
Lysianassoidea	*Cheirimedon*	*cf. crenatipalmatus*		x
Lysianassoidea	*Euonyx*	sp.n.		x
Lysianassoidea	*Figurella*	*tanidea*		x
Lysianassoidea	*Gainella*	*chelata*		x
Lysianassoidea	*Gen. nov.*	sp.n. („*Austroschisturella*“)		x
Lysianassoidea	*Gen.*	sp.1	x	x
Lysianassoidea	*Gen.*	sp.2		x
Lysianassoidea	*Gen.*	sp.3		x
Lysianassoidea	*Gen.*	sp.4		x
Lysianassoidea	*Tryphosinae Gen.*	sp.		x
Lysianassoidea	*Hippomedon*	*kergueleni*	x	x
Lysianassoidea	*Hippomedon*	*cf. kergueleni*		x
Lysianassoidea	*Hippomedon*	*major*		x
Lysianassoidea	*Hippomedon*	sp.1		x
Lysianassoidea	*Hippomedon*	sp.2		x
Lysianassoidea	*Hirondellea*	*antarctica*		x
Lysianassoidea	*Hirondellea*	sp.n.1		x
Lysianassoidea	*Hirondellea*	sp.n.2		x
Lysianassoidea	*Kerguelenia*	*cf palpalis*		x
Lysianassoidea	*Kerguelenia*	sp.1		x

Family or Superfamily	Genus	Species	ANT XXI-2 Bouvet	EWS
Lysianassoidea	*Kerguelenia*	sp.2		x
Lysianassoidea	*Orchomenella*	*acanthura*		x
Lysianassoidea	*Orchomenella*	*cf. acanthura*		x
Lysianassoidea	*Orchomenella*	*cavimanus*	x	x
Lysianassoidea	*Orchomenella*	*cf. cavimanus*		x
Lysianassoidea	*Orchomenella*	*cf. kryptopinguides*		x
Lysianassoidea	*Orchomenella*	*pinguides*		x
Lysianassoidea	*Orchomenella*	*ultima*		x
Lysianassoidea	*Orchomenella*	*cf. ultima*		x
Lysianassoidea	*Orchomenella*	sp.	x	
Lysianassoidea	*Orchomenella*	spp.		x
Lysianassoidea	*Pachychelium*	*nichollsi*	x	
Lysianassoidea	*Parschisturella*	*carinata*		x
Lysianassoidea	*Pseudorchomene*	*coatsi*		x
Lysianassoidea	*Pseudorchomene*	sp.n.		x
Lysianassoidea	*Sophrosyne*	*sp.n.*		x
Lysianassoidea	*Stomacontion*	sp.n.	x	x
Lysianassoidea	*Tryphosella*	*cf analogica*		x
Lysianassoidea	*Tryphosella*	*bispinosa*		x
Lysianassoidea	*Tryphosella*	*cf. bispinosa*	x	x
Lysianassoidea	*Tryphosella*	*intermedia*		x
Lysianassoidea	*Tryphosella*	*cf. intermedia*		x
Lysianassoidea	*Tryphosella*	*macropareia*		x
Lysianassoidea	*Tryphosella*	*murrayi*		x
Lysianassoidea	*Tryphosella*	sp.n.		x
Lysianassoidea	*Tryphosella*	sp.1	x	x
Lysianassoidea	*Tryphosella*	sp.2		x
Lysianassoidea	*Tryphosella*	sp.3		x
Lysianassoidea	*Tryphosella*	sp.4		x
Lysianassoidea	*Tryphosella*	spp		x
Lysianassoidea	*Uristes*	*adarei*		x
Lysianassoidea	*Uristes*	*gigas*		x
Lysianassoidea	*Uristes*	*stebbingi*		x
Lysianassoidea	*Uristes*	sp.1		x
Lysianassoidea	*Uristes*	sp.2		x
Lysianassoidea	*Uristes*	sp.n.		x
Lysianassoidea	*Waldeckia*	*obesa*		x
Lysianassoidea	*gen.*	spp.		x
Melphidippidae	*Melphidippa*	*antarctica*	x	x
Melphidippidae	*Melphidippa*	sp.		x
Ochlesiidae	*Odius*	*antarcticus*		x
Oedicerotidae	*Oediceroides*	*calmani*		x
Oedicerotidae	*gen.*	spp.	x	x
Pagetinidae	*Pagetina*	*genarum*	x	
Pardaliscidae	*Halicella*	*parasitica*		x
Pardaliscidae	*Halicella*	*cf. parasitica*		x
Pardaliscidae	*gen.*	sp.	x	
Pardaliscidae	*gen.*	spp.		x
Phoxocephalidae	*gen. div.*	spp.	x	x
Pleustidae	*Parepimeria*	*crenulata*	x	
Pleustidae	*Parepimeria*	*minor*		x

Family or Superfamily	Genus	Species	ANT XXI-2 Bouvet	EWS
Pseudamphilochiidae	*Pseudamphilochus*	sp.n.		x
Sebidae	*Seba*	*cf. antarctica*		x
Stegocephalidae	*Andaniotes*	*linearis*		x
Stegocephalidae	*Andaniotes*	*pseudolinearis*		x
Stegocephalidae	*gen.*	sp.1	x	
Stegocephalidae	*gen.*	sp.2		x
Stegocephalidae	*gen. div.*	spp.		x
Stenothoidae	*Antatelson*	*walkeri*	x	x
Stenothoidae	*Mesometopa*	sp.		x
Stenothoidae	*Metopoides*	sp.n. 1	x	
Stenothoidae	*Metopoides*	sp.n. 2	x	
Stenothoidae	*Metopoides*	sp.n. 3	x	x
Stenothoidae	*Thaumatelson*	*herdmani*		x
Stenothoidae	*Torometopa*	*antarctica*	x	
Stenothoidae	*Torometopa*	*antarctica*	x	
Stenothoidae	*Torometopa*	*cf. antarctica*		x
Stenothoidae	*Torometopa*	sp.n. 1		x
Stenothoidae	*Torometopa*	sp.n. 2		x
Stenothoidae	*Torometopa*	sp.n. 3	x	
Stenothoidae	*Torometopa*	sp. 1		x
Stenothoidae	*Torometopa*	sp. 2		x
Stenothoidae	*gen.*	sp.1	x	
Stenothoidae	*gen.*	sp.2	x	
Stenothoidae	*gen.*	sp. 3		x
Stenothoidae	*gen.div.*	spp.	x	x
Stilipediidae	*Alexandrella*	sp.n.1		x
Stilipediidae	*Alexandrella*	sp.n.2		x
Stilipediidae	*Alexandrella*	sp.n.3		x
Stilipediidae	*Alexandrella*	sp. 4		x
Stilipediidae	*Stilipes*	sp.		x
Stilipediidae	*gen.*	sp.	x	
Stilipediidae	*gen.*	sp.		x
Synopiidae	*Bruzelia*	sp.n. 1		x
Synopiidae	*Bruzelia*	sp.n. 2		x
Synopiidae	*Syrrhoe*	*nodulosa*		x
Synopiidae	*Syrrhoe*	*psychrophila*		x
Synopiidae	*Syrrhoites*	*anaticauda*		x
Synopiidae	*Tiron*	*antarcticus*		x
Synopiidae	*gen.*	sp.1		x
Synopiidae	*gen.*	sp.2		x
Synopiidae	*gen.*	sp.3		x
Synopiidae	*gen.*	sp.n.		x
Urothoidae	*Urothoe*	*cf falcata*		x
Urothoidae	*gen. 1*	sp.		x
Urothoidae	*gen.*	spp.	x	

Family or Superfamily	Genus	Species	ANT XXI-2 Bouvet	EWS
		II. COROPHIIDEA		
Corophiidae	*Gammaropsis*	*serricra*	x	
Corophiidae	*Haplocheira*	*barbimana*	x	
Corophiidae	*Haplocheira*	*cf barbimana*		x
Caprellidae	*Caprellinoides*	*tristanensis*	x	x
Podoceridae	*Neoxenodice*	*cf. hoshiaia*		x
Podoceridae	*Neoxenodice*	*cryophyle*		x
Podoceridae	*Podocerus*	*capillimanus*	x	
Podoceridae	*Podocerus*	*septemcarinatus*		x
Podoceridae	*Pseudodulichia*	*antarctica*	x	
Podoceridae	*Pseudodulichia*	sp.n. 1		x
Ischyroceridae	*Jassa*	*goniamera*	x	x
Ischyroceridae	*Jassa*	*thurstoni*	x	
Ischyroceridae	*Jassa*	sp.	x	x
Ischyroceridae	*Pseudericthonius*	*gaussi*	x	x
Ischyroceridae	*Pseudericthonius*	*hesperidesi*	x	x
Ischyroceridae	*Pseudericthonius*	sp. *(cf.gaussi)*		x
Ischyroceridae	*Ventojassa*	*georgiana*	x	x
Ischyroceridae	*gen.*	sp.	x	
Ischyroceridae	*gen.*	spp.		x
		III. HYPERIIDEA		
Hyperiidae	*Hyperiella*	*dilatata*		x
Hyperiidae	*gen.*	sp.		x
Scinidae	*Scina*	*rattrayi rattrayi*	x	
Vibiliidae	*Cyllopus*	*lucasi*		x

Four trawling and dredging operations as well as one trap deployment were performed on the poorly known bottoms around Bouvet Island. These operations resulted in more than 67 amphipod species (several probably new), compared to only 5 benthic amphipod species known for this site before the cruise. The biogeographical affinities of the Bouvet amphipod fauna as presently known are shown in Figure 44. The biogeographical links with the West Antarctic fauna (Antarctic Peninsula and Scotia Arc, excluding South Georgia) appear to be the strongest (24% of Bouvet species also occur in the West Antarctic), followed by the Weddell Sea (18%) and the other East Antarctic fauna (16%).
Samples for molecular phylogeny studies comprise 52 lysianassoid species (including several new species) belonging to 17 genera and 7 families and 37 species from 18 other amphipod families. Particular attention was paid to the selection of potential cryptic species.

- Photographic documentation of living crustaceans and benthos:
About 750 digital pictures (including 600 amphipod pictures) of live specimens of macrobenthos were taken to complete the photographic documentation of the Weddell Sea fauna for the Atlas of the Antarctic Benthos (M. Rauschert, in prep.). More than 1800 slides were taken from about 350

different invertebrate species of the following taxa: Porifera, Cnidaria, Mollusca, Polychaeta, Chelicerata, Crustacea, Pterobranchia, Echinodermata and Ascidiacea.

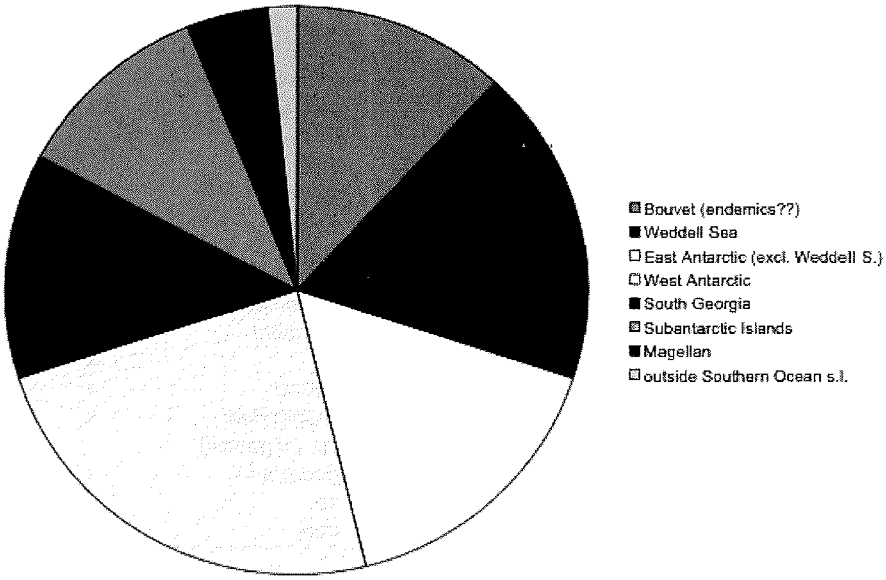

Fig. 44 Biogeographical affinities of the Bouvet amphipod fauna (45 spp.), starting 12 o'clock, clockwise

- (Micro)habitat characterization:

New data on associated amphipods were collected. At station 248, several adult and juvenile specimens of *Aristias collinus* and one stegocephalid were discovered inside the tentacles and pharynx of the actiniid *Hormathia* sp. *A. collinus* and *Ambasiopsis uncinata* were found in the pharynx of another sea anemone *Epiactis cf georgiana* at station 274. Several specimens of the dexaminid *Polycheria antarctica* were recorded in holes at the surface of a demosponge at station 232. *Clarencia* n.sp. was recorded on a hydrozoan species.

- Breeding cycles and reproduction in late spring

Pre-mature, mature and ovigerous females were sampled systematically to establish their reproductive status in late spring at the beginning of the primary production bloom season in the eastern Weddell Sea. Preliminary observations showed that some species (e.g. *Hippomedon* sp.1) had ripe gonads or a marsupium with probably freshly laid eggs at the first stage of development (showing close-packed yolk cells but no trace of embryo). Some species (e.g. *Uristes "pseudoalbinus"*) were bearing eggs at the first segmentation stage. Other species carried fully grown embryos ready to be released (e.g. the predator *Eusirus cf antarcticus*) or late embryos almost completely developed (stage 4) with already pigmented eyes (e.g. *Ampelisca richardsoni*, *Parschisturella carinata*). In one species, *Abyssorchomene*

Tab. 15 Specimens caught with baited traps.

Station & Gear	Depth (m)	Duration (h)	Amphipoda	Isopoda	Mysidacea	Ostracoda	Gastropoda	Pisces
			N spp/ ind	N spp/ ind	N spp/ind	N spp/ ind		Nspp/ ind
14 Trap/A	515	22	3 (>1000)				1 (15)	
103 Trap/F +104 Trap/F	378 372	102	17 (520)	2 (?)		1 (19)		1 (1)
167 LND	392	70	12 (251)	2 (166)		1 (76)		
195 Trap/F +196 Trap/F	305	55	7 (960)					
238 Trap/F +239 Trap/F	245	48	14 (640)	1 (2)				
240 LND	406	48	8 (80)	1 (8)		1(2)		
288 Trap/F	846	84	11 (371)	1 (3)	2 (2)			3 (4)
289 Trap/F	515	86	13 (>5000)	2 (553)				
290 LND	518	85	8 (>1140)	1 (126)				
Total			32 (>9000)	2 (858)	2 (4)	1? (97)	1 (15)	3 (5)

- Trophic ecology

Thirteen baited trap deployments (amphipod traps AT, fish traps FT and NIOZ Lander LN) provided 32 scavenger amphipod species (all Lysianassidae), 2 species of isopods (Natatolana, Cirolanidae), 2 mysids, 1 ostracod, 1 gastropod (Chlanidota densesculpta (Martens, 1885)) and three fish species (Zoarcidae: Pachycara brachycephalum; notothenoids) (Table 15). Part of the collected animals was kept in aquaria for further feeding experiments and metabolism measurements. 32 amphipod species were collected with baited traps: 30 lysianassoid species, one iphimediid and one melphidippid.

During the BENDEX expedition gut contents of some amphipod species already analysed during previous expeditions were re-examined for seasonality in their feeding strategy. Other species were collected for the detailed study of trophic features (Table 16).

Tab. 16 Species collected for gut content (GC), stable isotope (SI) and fatty acid (FA) analysis.

AMPHIPODA					
FAMILY	SPECIES	N	GC	SI	FA
EUSIRIDAE	*Atyloella* sp	1	X	X	
	Eusirus antarcticus	10		X	X
IPHIMEDIIDAE	*Echiniphimedia hodgsoni*	5	X	X	X
	Echiniphimedia barnardi	5	X	X	X
	Echiniphimedia echinata	10		X	X
	Gnathiphimedia mandibularis	4	E	X	X
	Gnathiphimedia watlingi	8	X	X	X
	Gnathiphimedia sexdentata	3	X	X	X
	Gnathiphimedia barnardi	3	X	X	X
	Gnathiphimedia cfr barnardi	10	X	X	X
	Iphimidiella brandsfieldi	2	X	X	X
	Iphimediella microdentata	10	X	X	X
	Iphimediella cyclogena	1	X	X	X
EPIMERIIDAE	*Epimeria walkeri*	2	X	X	X
	Epimeria inermis	4	X	X	X
LILJEBORDIIDAE	*Liljeborgia georgiana*	5	X	X	X
AMPELISCIDAE	*Ampelisca richardsoni*	20	X	X	X
OEDICEROTIDAE	*Oedicerotides calmani*	13	X	X	X
STEGOCEPHALISAE	*Stegocephalidae*	5	X	X	X
PHOXOCEPHALIDAE	*Phoxocephalidae*	15	X	X	X
STILIPEDIDAE	Stilipedidae	4	X	X	X
LYSIANASSIDAE	*Tryphosella murrayi*	4	E	X	X
	Uristes adarei	15	X	X	X
	Uristes gigas	8	X	X	X
	Parschisturella carinata	20	X	X	X
	Aristias antarcticus	3		X	X
	Waldeckia obesa	2	X	X	X
	Orchomenella ultima	20		X	X
ISOPODA					
CHAETILIIDAE	*Glyptonotus antarcticus*	1		X	X
CIROLANIDAE	*Natatolana* sp.	100	X	X	X

Several species of detritivorous and necrophagous amphipods have also been collected for assessing the share of bacteria in their diet. They will be analysed in collaboration with Dr C. DeRidder from Brussels University (ULB).

- Maintenance of live animals for uptake/loss experiments:
Selected amphipod and isopod species were maintained alive for further experiments, in particular for uptake/loss experiments with thorium and polonium radioactive markers planned at the EAAE Marine Environment Laboratory (Radioecology) in Monaco.

- Metabolism
4 amphipod species were chosen for respiration measurements: *Eusirus perdentatus* (macropredator, highly active), *Gnathiphimedia mandibularis* (micropredator, feeding on bryozoans and sponges), *Echiniphimedia hodgsoni* (micropredator, feeding on sponges) and *Waldeckia obesa* (scavenger, motionless). We measured metabolic rates of whole animals in an intermittent-flow respirometer equipped with a state-of-the-art oxygen optode sensor measurement system. The results will be treated in the AWI in collaboration with Dr T. Brey.

2.5.3 Biogeography, speciation and biodiversity of Antarctic Asellota
(M. Raupach)

Objectives

The Isopoda and especially the Asellota are one of the most numerous and important elements of the benthos in all oceans. They are the dominating taxon among crustaceans in the deep sea. Little is known about Antarctic Asellota, and no molecular data are available. Numerous deep-sea Asellota were collected during the ANDEEP expeditions (2002, ANT XIX/3+4) and preserved for molecular studies. Preliminary results of ssu rDNA-gene analyses indicate a multiple colonization of the Antarctic deep sea. This ecosystem has to be considered as a special case. It was colonized not only by Asellota from the neighbouring deep-sea basins but also by shelf forms. The relatives of some blind deep-sea forms, e.g. the Acanthaspidiidae, possess eyes and are endemic to the Antarctic shelf. Hence some deep sea species may have evolved from immigrating shelf forms, a phenomenon called "polar submergence". Interestingly, a great number of typical deep-sea species can also be found on the Antarctic continental shelf ("polar emergence"). Submergence events can be found within other isopod suborders, too: first studies on serolid isopods (Sphaeromatidea) indicate several independent invasions of the deep sea. Since both emergence and submergence can be observed in Antarctica, the evolution of the shelf fauna is closely related to the adjacent deep sea. With additional asellote species from the shelf we will be able to reconstruct the phylogeny of the Asellota and the colonization of the Antarctic deep sea in more detail.

Tab. 17 DNA extractions from Asellota

Suborder	Family	Number of DNA Extractions
Asellota	Acanthaspidiidae	33
	Desmosomatidae	12
	Haploniscidae	1
	Janiridae sensu Wolff	11
	Joeropsididae	4
	Macrostylidae	1
	Munnopsididae	32
	Munnidae	15
	Paramunnidae	9
	Stenetriidae	6
Valvifera	Idoteidae	6
Cymothoidea	Gnathiidae	4

Work at sea

In total, 1563 isopods were collected. 210 specimens were sampled around Bouvet island while 1353 animals were collected in the high Antarctic. At least 69 species were found, 47 of them belonging to the Asellota. In addition, 11 different species of the Asellota were identified.

Owing to their small size (1-10 mm), most Asellota were found in the epibenthic sledge samples. The whole sample was placed in ethanol 96% as quickly as possible after sampling to avoid DNA degradation by enzymatic activity. The DNA of 124 asellote specimens from 10 different families and 10 animals from other isopod suborders (Table 17) was extracted and purified from several separated legs of the specimens, using the QIAmp Tissue Kit (Qiagen GmbH, Hilden), following the extraction protocol. The amputated animals were preserved in ethanol 96% for future morphological and molecular studies. Further processing (PCR, DNA sequencing, phylogenetic analysis) will be carried out in the laboratory of the Ruhr-Universität Bochum. Fast evolving genes like the 16s rRNA gene or cytochrome oxidase III gene are quite useful for population genetics, while slow evolving genes, for example the complete 18s rRNA, will be used to investigate older phylogenetic events within the Asellota.

Preliminary results

- Isopoda of Bouvet Island

The position of Bouvet Island makes this region very interesting for phylogenetic and biogeographic studies, but currently only a small amount of erratic data exists. The Isopoda around Bouvet Island are poorly understood, and no molecular data are available. During this expedition 210 isopods were collected with four Agassiz trawls at different depths ranging from 122 to 553 metres (Table 18). Within the Valvifera only one antarcturid species (49 animals) was found but in all samples. 60 specimens of the only found serolid species were obtained from depths between 247 and 553 metres. Isopoda belonging to the Cymothoidea were found at all depths, *Gnathia sp.* (5) at the two most shallow stations while *Aega sp.* (11) was sampled at the two deeper stations. In addition to these taxa at least 10 different species of the Asellota (85 animals) were collected, mainly from the shallow samples. Many of these species may be unknown.

Tab. 18 Isopoda of Bouvet Island.

Suborder	Family	Genus	Station 28 122 – 134 m	Station 19 247 – 260 m	Station 29 365 – 377 m	Station 20 550 – 553 m
Valvifera	Antarcturidae		x	x	x	x
Sphaeromatidea	Serolidae			x	x	x
Cymothoidea	Aegidae	*Aega sp.*			x	x
	Gnathiidae	*Gnathia sp.*	x	x		
Asellota	Acanthaspidiidae	*Ianthopsis ruseri*		x		
	Janiridae s. Wolff		x			
	Joeropsididae	*Joeropsis sp.* 1		x		
	Munnopsididae	*Echinozone quadrispinosa*	x	x	x	
		Coperonus sp. 1	x	x	x	
	Munnidae	*Munna sp.* 1	x	x		
		Munna sp. 2	x			
		Munna sp. 3			x	
	Paramunnidae		x			

- High Antarctic Isopoda

1353 specimens of five isopod suborders were collected in the high Antarctic. They belong to the suborders Cymothoidea (232 specimens), Valvifera (111), Anthuridea (39), Sphaeromatidea (40) and Asellota (931). The Valvifera animals of the families Antarcturidae and Idoteidae were very abundant (69 = 62%). Specimens of the species *Accalathura gigantissima* (12 = 31%) dominated within the small number of Anthuridea while animals of the family Gnathiidae represented the most abundant taxon within the Cymothoidea (143 = 62%). Besides this one animal of the strange ectoparasitic isopod species *Zonophryxus quinquedens* was collected. *Ceratoserolis trilobitoides* with 28 specimens was the most abundant species of the Sphaeromatidea (70%).

Sphaeromatidea were surprisingly rare, as this taxon is thought to be a characteristic element of the Antarctic benthos. This group may be more abundant below our preferred sampling depth of 250 to 350 m. The most abundant taxon within the Isopoda were the Asellota, mostly collected with the epibenthic sledge (Table 19). They included 10 families with at least 47 species. The Munnopsididae, with 310 animals (23%), were the dominating family within the asellote isopods. Besides this 9 specimens of the Haploniscidae, a typical deep-sea family, were recorded from the Antarctic shelf for the first time.

Tab. 19 Asellota collected with the epibenthic sledge.

Family	Genus	Station 48 457 – 457	Station 144 401 – 407	Station 145 402 – 405	Station 232 890 – 910	Station 283 542 – 554	Station 284 754 – 805 m
Acanthaspidiidae	*Acanthaspidia drygalskii*				x		
	Ianthopsis ruseri	x				x	
	Ianthopsis multispinosa				x	x	
	Ianthopsis nasicornis				x		x
Desmosomatidae	Species 1 (Desmosomatinae)	x	x	x			
	Species 2 (Desmosomatinae)	x					
	Species 3 (Eugerdellatinae)	x		x			
	Species 4 (Desmosomatinae)			x			
	Species 6 (Eugerdellatinae)				x		
Haploniscidae	*Haploniscus sp.*				x	x	
Janiridae sensu Wolff	Species 2		x				x
	Species 3			x			
	Neojaera antarctica				x	x	x
	Species 5				x		
	Species 6				x	x	x
Joeropsididae	*Joeropsis sp.* 2			x	x		
Macrostylidae	*Macrostylis sp.*	x					
Munnidae	*Munna sp.* 6	x				x	
	Echinomunna horrida				x		
	Munna sp. 10					x	
	Munna globicaudata	x	x	x			
	Munna spicata				x		
Munnopsididae	*Coperonus sp.* 2	x	x	x			
	Coperonus sp. 3					x	x
	Species 1 (Eurycopinae)			x	x		
	Species 2 (Eurycopinae)					x	
	Species 3 (Eurycopinae)				x		
	Species 1 (Syneurycopinae)						x
	Echinozone magnifica						x
	Echinozone quadrispinosa		x	x	x		x
	Echinozone spinosa			x	x	x	
	Sursumura robustissima				x		
Paramunnidae	Species 3		x				
	Species 4			x			
	Species 6				x		
	Species 7				x	x	
	Species 8				x		
Stenetriidae	*Stenetrium sp.* 2			x			
	Tenupedunculus acutum				x	x	x

- Isopod species determined so far:
Asellota:
Sursumura robustissima (Monod, 1925); *Echinozone quadrispinosa* (Beddard, 1886); *Echinozone spinosa* Hodgson, 1902; *Echinozone magnifica* Vanhöffen, 1914; *Munna globicauda* Vanhöffen, 1914; *Munna spicata* Teodorczyk & Wägele, 1994; *Ianthopsis multispinosa* Vanhöffen, 1914; *Ianthopsis nasicornis* Vanhöffen, 1914; *Ianthopsis ruseri* Vanhöffen, 1914; *Acanthaspidia drygalskii* Vanhöffen, 1914; *Iathrippa sarsi* (Pfeffer, 1887); *Tenupedunculus acutum* Vanhöffen, 1914; *Echinomunna horrida* Vanhöffen, 1914; *Neojaera antarctica* (Pfeffer, 1887).

Sphaeromatidea:
Ceratoserolis trilobitoides (Eights, 1833).
Valvifera:
Glyptonotus antarcticus Eights, 1853.
Cymothoidea:
Zonophryxus quinquedens Barnard, 1913; *Natatolana albinota* Vanhöffen, 1914; *Natatolana obtusata* (Vanhöffen, 1914); *Gnathia antarctica* (Studer, 1884).
Anthuridea:
Accalathura gigantissima Kussakin, 1967.

2.5.4 Biodiversity and genetics of Cnidaria and Porifera
(J.M. Gili, E. Rodríguez, N. Teixidó, B. Vendrell)

A: Cnidarian biodiversity and reproduction

Objectives
As a continuation of previous studies within the EASIZ programme and to contribute to the current knowledge of the Antarctic cnidarian fauna, our main objective was focused on species composition, density, and demographic features of cnidarian communities in the eastern Weddell Sea. Special attention was placed on the anthozoan fauna. Furthermore, reproductive and output features of various gorgonians and actiniarian species were investigated for temporal comparisons with previous EASIZ cruises carried out in summer and autumn.

Work at sea and preliminary results
Material was collected from 47 stations, mainly using Agassiz and Bottom trawls, but we also obtained some samples from Rauschert's small dredge and the epibenthic sledge. Hydrozoans and gelatinous plankton, mainly jellyfish and siphonophores, were fixed in buffered 10% formalin. For the anthozoan material, the most abundant group among the Cnidaria in this cruise, different methods were used. Octocorals were fixed in buffered 10% formalin, while soft hexacorals (actiniarians and scleractinians) were maintained in the cool room and relaxed using menthol crystals. After relaxing, these specimens were fixed in buffered 10% formalin. Octocoral and scleractinian material will be transferred to 70% ethanol after the fixation period. Small portions of tissues were obtained from fresh specimens and directly fixed in 96% ethanol for further molecular studies. Other material was frozen for alloenzyme and secondary metabolite analyses.

Preliminary results
The hydrozoan material, as the gelatinous plankton collected, will be studied at the CMIMA-CSIC (Barcelona). Hydrozoans were present at all stations of the sampled areas except for those stations corresponding to Atka Bay, west of Kapp Norvegia and the Spiess Seamount. This absence may be due to the different sampling effort in those areas.

- Taxonomy and distribution of anthozoans in the eastern Weddell Sea

Part of the collected anthozoan material was identified to species level on board while others (mainly actiniarians) remain to be identified. The detailed study of the anthozoan material will be carried out at the USE (Seville).

During this cruise we collected 61 species of Anthozoa. 27 species belong to the subclass Octocorallia, and 32 to the subclass Hexacorallia. Within the octocoral species there were 27 Alcyonacea (4 stolonate octocorals, 5 soft corals, 18 gorgonians) and 2 Pennatulacea. Within the hexacoral species the order Actiniaria was the most abundant with 28 species, followed by 3 Scleractinia, and one Zoantharia. A preliminary list of the number of anthozoan species per station, grouped by areas is shown in Table 20.

Compared to preliminary results obtained from the previous EASIZ II and III cruises, in which 63 and 93 anthozoan species were collected respectively, we observed a slight decrease in the number of species collected during the present cruise (61 anthozoan species). However, if we include only the eastern Weddell Sea area (Auståsen, Drescher Inlet, and Kapp Norvegia), the number of collected anthozoan species is quite similar for the three cruises (both EASIZ cruises included stations in the Antarctic Peninsula region).

The Auståsen area yielded the highest number of species, followed by northern Kapp Norvegia and Drescher Inlet (40, 37, and 21 anthozoan species, respectively). In the EASIZ II cruise the northern Kapp Norvegia area presented the highest number of species. The higher species richness at Auståsen is probably due to the high number of stations sampled. The lower number of species found for Drescher Inlet may be related to the fact that the deepest stations (more than 500 m depth) were located in this area. We suggest that the highest anthozoan species number is found at stations between 200 and 400 m depth.

- Taxonomy and distribution of anthozoans at Bouvet and Spiess Seamount

Most of the anthozoan species collected off Bouvet and Spiess Mountain still remain unidentified. The expected identification will clarify biogeographic and phylogenetic traits of anthozoan fauna from these areas in relation with the high Antarctic fauna. However, the new collected material will extend the distribution records for many species. Regarding the actiniarian material, eight species were collected from Bouvet Island (where four of them are currently cited) and two species from the Spiess Seamount (where none has been cited before) (Carlgren 1927, 1928; Fautin 2004).

- Reproduction of anthozoans

Colonies of six selected gorgonian species, *Ainigmaptilon antarcticus*, *Dasystenella acanthina*, *Fannyella rossii*, *F. spinosa*, and *Thouarella* sp. 2 were collected to compare the reproductive state during spring, summer, and autumn conditions. A detailed study of the quantitative reproductive features (size ranges of oocytes, presence of larvae...) will be done at the CMIMA-CSIC (Barcelona) and at the USE (Seville).

Colonies of the gorgonians *Dasystenella acanthina, Thouarella* sp. 2, *Tokoprimno* sp., and of the pennatulacean *Umbellula* sp. seemed to exhibit development of reproductive tissues. Within the actiniarian material three different reproductive strategies have been observed: larval spawning, internal brooding (within the family Actinostolidae) and external brooding (*Epiactis* cf.

georgiana). Although the detailed histological study remains to be done, differences among juvenile sizes of the external brooder species *Epiactis* cf *georgiana* were observed between material collected in autumn and material collected in spring, during the present cruise (juvenile size ranges seem to be higher in autumn than in late spring).

Tab. 20 Anthozoan species collected during the ANT XXI/2 cruise. Abbreviations: A: Atka Bay; AUS: Auståsen; BI: Bouvet Island; DI: Drescher Inlet; N/KN: Northern Kapp Norvegia; S: Spiess Seamount; St: Station; W/KN: Western Kapp Norvegia.

Species	BI				A	AUS																				N/ KN										W/ KN		DI									S
St.	019	020	028	029	048	090	121	132	140	144	146	148	161	163	166	173	174	175	245	237	259	265	274	336	339	039	109	248	251	253	276	278	279	280	281	232	233	282	283	292	293	297	308	324	325	326	344
Actiniaria sp. 1							+	+		+		+																+		+	+			+													
Actiniaria sp. 2	+		+																															+													
Actiniaria sp. 3	+																																														
Actiniaria sp. 4							+	+								+			+			+						+		+	+																
Actiniaria sp. 5							+																																								
Actiniaria sp. 6						+	+	+													+		+					+		+	+																
Actiniaria sp. 7																																	+									+					
Actiniaria sp. 8																						+																				+					
Actiniaria sp. 9	+																									+																					
Actiniaria sp.10	+																																														
Actiniaria sp.11																																															+
Actiniaria sp.12																																															+
Actinernus sp.										+																		+																			
Actinostola sp. 1	+																																														
Actinostola sp. 2																							+								+			+													
Ainigmaptilon antarcticum	+	+		+			+	+				+			+		+	+	+	+	+	+	+		+			+		+				+													
Alcyonium sp. 1			+				+										+					+		+				+	+	+	+					+				+		+					
Alcyonium sp. 2																																					+										
Alcyonium sp. 3																																			+						+						
Arntzia gracialis							+																		+															+							
Bolocera sp.																											+																				
Capnea cf. georgiana	+																						+																								
Caryophyllia sp.						+										+																															
Clavularia cf. frankliniana																			+										+																		
Clavularia sp.																														+																+	
Dasystenella acanthina							+								+		+	+	+		+	+	+					+		+	+									+				+			
Epiactis cf. georgiana							+	+							+		+		+			+						+		+	+			+						+							
Fannyella mawsoni				+																																									+		
Fannyella nodosa																	+	+			+																+										
Fannyella rossii				+											+			+			+																	+									
Fannyella sp.	+																																														
Fannyella spinosa															+		+	+				+	+					+								+	+			+							
Flabellum spp.	+			+				+					+			+															+			+					+	+		+				+	
Glyphoperidium cf. bursa			+					+				+							+																		+										
Hormathia armata							+															+		+		+		+			+			+													

Species	BI				A	AUS																				N/ KN										W/ KN		DI									S
St.	019	020	028	029	048	090	121	132	140	144	146	148	161	163	166	173	174	175	245	237	259	265	274	336	339	039	109	248	251	253	276	278	279	280	281	232	233	282	283	292	293	297	308	324	325	326	344
Hormathia cf. lacunifera					+		+	+														+				+							+														
Hormathia sp. 1							+																	+		+		+			+			+													
Hormathia sp. 2																			+		+	+	+					+			+	+		+													
Hormosoma cf scotti																			+							+																					
Inflatocalyx sp.			+	+																																				+		+	+			+	
Isosicyonis sp.						+									+	+			+					+																							
Javania sp.																																												+			
Notisis sp.						+		+									+	+				+		+	+		+					+															
Parazoanthus antarcticus																																								+			+			+	
Plumarella sp.																					+							+		+										+		+					
Primnoella spp.				+																+		+	+		+			+			+									+							
Primnoisis antarctica	+					+	+	+				+			+			+	+			+		+	+	+		+			+			+			+										
Primnoisis cf. formosa																		+				+						+		+																	
Sphaeralcyon n. sp																														+																	
Stephanauge sp.	+	+																	+								+																				
Stolonifera gen. sp.																						+																									
Stomphia cf. sellaginella			+	+				+																		+																					
Thouarella sp. 1							+	+				+	+		+		+	+		+	+	+	+					+		+	+			+													
Thouarella sp. 2				+			+	+				+			+		+	+			+	+	+			+		+		+	+			+						+							
Thouarella sp. 3								+							+		+		+				+	+				+		+				+						+							
Thouarella sp. 4																												+												+						+	
Tokoprimno sp.							+								+		+	+	+	+		+	+					+		+	+									+							
Umbellula magniflora																			+																												
Umbellula sp.	+			+				+				+			+		+	+	+		+	+	+					+		+	+									+							
Urticinopsis sp.																																		+													
Xenia cf. antarctica				+																																											

B: Genetic studies in sponges

Objectives
Sponges exhibit different modes of reproduction and dispersal abilities. For example, asexually reproducing species are often locally dispersed, whereas species with sexual reproduction may disperse over greater distances. Hexactinellid sponges play an important role in the benthic communities of the Weddell Sea shelf. From video images, we observed high abundance of the hexactinellid *Rossella nuda* / *Scolymastra joubini* with spectacular outgrowths (buds) on their surface at a shallow station (st.059, 117 m depth) during the cruise ANT XVII/3. This phenomenon has also been recorded at deeper stations on the Weddell Sea shelf. The major aim of this study was to investigate the population genetics of some hexactinellid species displaying different reproduction strategies (balance between sexual/asexual) to understand their dispersal capacities and genetic variability within and among different populations. This information will provide new insights into their dispersal potential, the degree of connection among populations, and their recovery after iceberg disturbance.

Work at sea
10 samples of each, hexactinellids (7 species: *Rossella antarctica*, *R. levis*, *R. nuda*, *R. racovitzae*, *R. vanhoeffeni*, *R. villosa*, *Scolymastra joubini*) and demosponges (1 species, *Cinachyra barbata*) were taken using trawl catches (AGT and BT) from 14 stations in Auståsen and 1 station in Drescher Inlet, whenever sponges occurred. Samples of each species were collected for identification validation. Total length and width, osculum size, and presence of visible reproductive elements (e.g. eggs, propagules) were recorded. The samples were fixed with absolute ethanol (97 %) and stored in cool chambers. The genetic analyses will be done at the home laboratory. Genetic microsatellite markers on the DNA and ribosomal internal transcribed spacer (ITS) will be identified. These genetic markers are powerful tools for studying population structure and for identifying individuals or clones (Estoup & Angers 1998). This genetic approach will provide relevant information on the maintenance and/or extinction of local populations, the recovery after disturbance, and the colonization of new areas.

2.5.5 Biogeographic and phylogenetic relationships between sub- and high Antarctic fauna: sampling at Bouvet Island

(W. Arntz, S. Thatje, with the assistance of all participants)

Objectives
Marine biological work near Bouvet Island (Bouvetøya) in the maritime Antarctic was carried out during RV „Polarstern" cruise ANT XXI/2 on 3 days in November 2003 and January 2004. Sampling the marine fauna of this „white spot" in the Atlantic sector of the Southern Ocean, our intention was to contribute to identifying the role of Bouvet in the faunal exchange between the Sub- and high Antarctic. While this goal demands extensive molecular

analysis of the material sampled, which will require some more time, a check of the samples and data at hand widens the faunal and environmental inventory substantially and allows first preliminary conclusions on the relations of this remote, isolated island with the Magellan region, the Antarctic Peninsula, and the high Antarctic Weddell Sea, which were sampled on various occasions before. There seem to be different connections for individual higher taxa rather than a generally valid consistent picture.

Work at sea

Sampling near Bouvet Island (54°26'S, 3°24'E) was done on the way to the Antarctic continent on November 24 and 25, 2003, and at nearby Spiess Seamount (54°44'S, 0°07'E) on January 11, 2004, on the return to Cape Town. The gear used was a small (1.5 m width) Agassiz trawl with the small, narrow-meshed Rauschert dredge tied to it, baited traps and a photosled near Bouvet, and a normal Agassiz trawl (3 m width) + Rauschert dredge, a stone dredge and the photosled at Spiess Seamount (for exact positions cf. Annex chapter 3.2). Mesh size in the codends of the AGTs was 10 mm, that of the Rauschert dredge 1 mm. Box corer deployment proved to be unsuccessful due to the lack of soft sediment. CTD casts were performed with a SeaBird 911plus series from the surface to an approximate distance of 5-1 m above the seabed.

Preliminary results

Ice conditions around Bouvet in November did not cause any problem as we encountered open water, with a number of icebergs and growlers stranded close to the island and occasional large bergs drifting by. However, the pack ice margin was only < 200 km further south.

Temperature of surface waters around the island was about –0.6 to –0.7°C, and surface salinity was between 34.1 and 34.2 PSU, with a mixed layer extension to 160-200 m on 24 November but only to about 70 m at the northernmost station on 25 November. Below the pycnocline warmer and saltier water extended at least to 600 m.

The seafloor around Bouvet (4 AGT stations, 100-550 m) turned out to be less rugged than we expected. Bottom topography was smooth, obviously volcanic, with a thin layer of coarse sand or (AGT 3) lava pebbles on top. All four AGT were retrieved without damage and with interesting benthic catches. Conversely, bottom topography at the Spiess Seamount was extremely varied, with steep peaks and crevices, and despite the use of hydrosweep sonar the net of the second AGT was completely torn and a Rauschert dredge lost while the first AGT returned full of stones. For this reason, a stone dredge was deployed. The photosled yielded excellent picture transects at both sites.

AGT catches at Bouvet are summarised according to a 4-point check on deck, in which several experienced zoologists participated, in chapter 2.5.6. Echinoderms, in particular ophiuroids, were strongly dominant except echinoids, which were almost absent. Compared with the E Weddell Sea (high Antarctic), three-dimensionality of the benthic communities was low, however red macroalgae and hydroids were dominant at 130 m, erect, flexible bryozoans (mainly *Austroflustra*) at 250 m, and some large sponges and

gorgonians added complexity to the assemblage at 370 m. Other dominant elements at 130 m were serpulid polychaetes, small amphipods incl. caprellids, small pycnogonids, and small nototheniod fish (mostly *Lepidonotothen larseni*, some L. *kempi*). Material from the small Rauschert dredge, including small taxa such as cumaceans, still remains to be analysed.
No zoarcid fish and no lithodid decapods were caught at Bouvet, however, they might occur in deeper water. No other reptant decapods were detected and only two caridean (hippolytid) shrimp species. Several typical high Antarctic faunal elements were missing, including the large epimerid and eusirid amphipods, large serolid isopods, the genus *Glyptonotus*, large pycnogonids, the mollusc families Trochidae and Limopsidae, and (with one exception) large polynoid and aphroditid polychaetes. Isopods were rare and most of them (excl. *Antarcturus*), as well as most amphipods, were very small. The baited amphipod traps yielded thousands of lysianassids as happens elsewhere.
In some taxa the number of species known for Bouvet Island was increased substantially. Preliminary figures based on a first check on board are the benthic amphipods (from 5 to 67 spp., at least 7 new to science; cf. chapter 2.5.2) and the molluscs (from 16 to 48 spp; cf. chapter 2.5.1); other taxa may present a similar relation indicating that further research would be rewarding.

In contrast to Bouvet, AGT sampling at the Spiess Seamount (570 m) yielded very little material including, however, 3 specimens of lithodid decapods (*Paralomis* n.sp.) for which we had been looking in vain at Bouvet Island, and five deep-sea carideans (*Nematocarcinus lanceopes*), which we had never found that shallow. A fourth specimen of the new *Paralomis* species was caught with the stone dredge.

The deeper shelf fauna around Bouvet was compared with high Antarctic, Peninsular and Magellan samples taken during former cruises (both nearshore shallow water and deep sea are not considered as we have no samples from these areas). The general aspect of the Bouvet fauna resembles the Magellan region rather than the high Antarctic. In fact the motile peracarids and the molluscs seem to be related principally to the Antarctic Peninsula and the Scotia Arc, a distribution that could well be explained by the transport of adults, larvae and drift stages via the West Wind Drift/Circumpolar Current, but quite a few are also related to the high Antarctic. On the other hand, the sessile cnidarians (actinians, hydrozoans, gorgonians) show closer affinities to the high Antarctic Weddell Sea. An interesting find, at 270 m, was the gastropod *Calliotropis (Solaricida) antarctica* Dell, 1990, which had been described from 2700 m at the Antarctic Peninsula and found during the ANDEEP cruise at 775 m, thus showing considerable eurybathy. The decapods reveal both Scotia Arc relations (lithodid, hippolytids) and Weddell Sea affinities (*N. lanceopes*); except for the hippolytids, colonisation may be assumed via the deep sea. The two *Lepidonotothen* species are characteristic species of the Scotia Arc, but *L. kempi* juveniles also occur in the E Weddell Sea. We do not know whether the different populations are maintaining an active exchange. With respect to other taxa, the material has been sent out to specialists, who will hopefully determine the respective affiliations. Some of these biogeographic (and possibly, phylogenetic) relationships will be further elucidated after the analysis of the large material to be subjected to molecular genetic techniques at the home laboratories.

2.5.6 Visual inspection of Agassiz and bottom trawl catches

(W. Arntz, with the assistance of all participants)

Objectives

During most "Polarstern" expeditions to the Antarctic, benthic trawl samples were subjected to a semiquantitative visual check on deck in order to obtain a comprehensive biogeographic comparison comprising the Magellan region, the Antarctic Peninsula, the Scotia Arc, Bouvet Island and the high Antarctic Weddell Sea. Some of the questions to be answered from this study are:
(i) Can regional characteristics in the Antarctic and Subantarctic be distinguished from demersal trawl catches using major invertebrate taxa? (ii) Do assemblages from areas mostly covered by pack ice separate from ice-free areas? (iii) Does a consistent latitudinal gradient show up in the data? (iv) Is the Scotia Arc region recognisable as a transitional area? (v) Do clear depth gradients become visible? (vi) Are the pictures emerging from the two types of gear used different? And finally, (vii) Is this method of any use other than avoiding the tedious task of determining the fauna in each catch to species level?
Presently, the entire data set comprises >300 trawl hauls taken between 45° and 75°30'S latitude on 11 cruises, BENDEX being the last one to be included.

Work at sea and preliminary results

During the BENDEX cruise, 18 Agassiz trawl hauls (4 at Bouvet Island, 14 in the high Antarctic Weddell Sea) and 9 bottom trawl hauls (all in the Weddell Sea) were taken between 120 and 1550 m depth. Several experienced marine zoologists participated in the semiquantitative visual check. 35 major benthic taxa were distinguished and evaluated for their relative abundance using a 4-point classification system (0=absent, 1=rare; 2=common, 3=dominant; see Annex chapter 3.3).

2.5.7 ROV operations in shelf biodiversity studies, a feasibility approach

(J. Gutt, W. Dimmler, H. Schulz, M. Potthoff, N. Teixido, A. Rose, S. Thatje)

Objectives

The ROV operations had three objectives: (1) to check, whether the "Cherokee" system is suited for advanced benthological work in the high latitude Antarctic shelf areas; (2) to support the disturbance experiment, providing immediate visual information; (3) to continue ecological work that started in 1989 at the hilltop situated at the northern margin of the Norsel Bank off the 4-Seasons Inlet (Weddell Sea).

Work at sea

The "Cherokee" is a modern inspection ROV for operation in water depths up to 1000m in its present configuration. It is owned by the Marum research unit at the University of Bremen (Prof Dr G Wefer) and was leased by the AWI for the period of the expedition ANT XXI/2. The main components of the entire system are the vehicle, a tether cable, a depressor connected to a ship's single conductor cable and the control and navigation units on board. The vehicle is equipped with 3 video cameras, 2 of which support the operation. A high resolution Tritech Typhoon camera is used for scientific observations to be recorded. In addition, the ROV has a manipulator, a still camera, lights and strobe, compass, 2 lasers, a Posidonia transponder and an obstacle avoidance sonar. The size of the vehicle is 160 x 90 x 90cm.

In the present configuration without TMS (tether management system) the deployment has to start with paying out the full cable length, lay it in loops on deck and connect the glass fibres at the tether's spool winch. After a final technical check the vehicle is deployed into the water, actively driven perpendicular to the ship's axis and floatings are fixed to the tether. At a cable length of approx. 50m, the tether is tightened to the depressor by several cable ties and both components are lowered towards the sea floor, the vehicle by the thruster's propulsion and the depressor by the ship's winch. At 5m intervals the tether has to be tied to the single conductor cable. In good weather conditions the instruments supporting the navigation of the ROV, especially the Posidonia system, allow an operation mode to follow the ship's course if the ship's speed is slow. Together with the lasers which act as a scale in the images they also allow a reproducible scientific analysis since the transect can be plotted in a GIS system. Consequently, the area observed can be easily calculated. An operation as a predominantly drifting system, especially in areas with bottom near currents, is also possible, however, the connection of the tether at the rear of the vehicle is unsuitable for such conditions. The recovery of the system corresponds to that of the deployment. Most important is to reach the surface of the sea at a safe distance perpendicular to the ship's axis in order not to interfere with the ship's propellers. During this phase the Posidonia transponder system is of high relevance although it has to be switched off at a water depth of approx. 40m.

The minimum personal needed is 4 persons to handle the tether on deck, one person to operate the ship's winch, one pilot and one additional technician for the ROV's operation itself, one scientist, and one person on the ship's bridge in addition to one on deck for whale watching when the Posidonia system is in use. The time for the deployment of the ROV until it reaches the sea floor depends on the water depth and consequently on the length of the cable to be paid out beforehand and to be tightened to the single conductor cable. Deployment and recovery at intermediate water depths can last up to 2 hours each. A reasonable time for benthological observations close to the sea floor is 1 to 3 hours but can be extended if scientifically justified.

Preliminary results

After a first test station, the ROV was deployed 3 times for observations related to the disturbance experiment. For preliminary impressions see chapter 2.1.1 (Presurvey, Postsurvey with imaging methods). A first attempt to cross the hilltop at the northern margin of the Norsel Bank close to the 4-Seasons Inlet was successful only for the first hundreds of metres transect length. The benthic community was dominated in biomass by the demosponge *Cinachyra barbata*. Due to the strong current of approx. 1nm/h, the design of the system (see above), and an expected more difficult current regime between grounded icebergs and the top of the hilltop the operation was stopped before the hilltop was reached. In a second attempt the hilltop was successfully crossed because the current and wind situation was much more suitable. In contrast to earlier expeditions with the "sprint" ROV it was the first time that both slopes, the smoother in the northeast and the steeper in the southwest were continuously observed during one cast. A coarse classification of the hilltop fauna shows patches dominated by single taxa: cnidarians, hydrozoans, holothurians, sea urchins and stalked sponges. Approximately 20% of the north-eastern slope was devastated by grounding icebergs. Here the sediments consisted of large boulders, gravel or blocks of finer sediment looking like an irregularly ploughed field. On the Norsel Bank the *Cinachyra* concentrations were locally associated with high abundances of sea anemones. Total observation time amounted to 11.5 hours corresponding to almost 6-9 km transect length.

2.6 Other Topics

2.6.1 Bioacoustic research on Weddell seals at Drescher Inlet
(M. Mirhaj, J. Plötz)

Objectives
These investigations on Weddell seals are part of the new project "Oceanic Acoustics" that integrates zoological, biophysical and oceanographic approaches towards underwater behaviour of free-ranging marine mammals, thus aiming at the development of automated acoustic census techniques, too. The Weddell seal is one of the most vocal pinnipeds. Underwater vocalizations are most extensive during the breeding season and geographically distant breeding populations differ in their vocal repertoires. The present study, which was conducted at the Drescher Inlet in December 2003, is the first to examine the acoustic characteristics of Weddell seals from the Weddell Sea region. Study targets are the identification of different types of calls, the diurnal variation in these calls and the localisation and movement of seals vocalizing under the fast ice. It will contribute to determine whether Weddell seals in our study area have peculiarities in their sound patterns distinct from those recorded at other breeding sites around the Antarctic continent.

Work at sea
Weddell seal vocalizations were recorded in December when males defend their underwater territories and females teach their pups to forage under the ice. Our acoustic station, a cabin sledge, was placed on solid sea ice at about 8 km distance from the open sea. The study site was close to a large ice crack where a number of adult Weddell seals and recently weaned pups hauled out during the day. No other seal species was present. The recordings were made by lowering three bipolar hydrophones through small ice holes drilled at equal distances of 100 m through 2.7 m thick sea ice. The hydrophones were connected to an analogue/digital converter to collect and measure electric signals from the hydrophones and transfer them to a laptop. The equipment had the capacity to detect frequencies in the range of 0.5 Hz - 24 kHz. The data records were stored in 2-minute files, processed by Ishmael software. The hydrophone system was powered by a 1kw Honda generator.

Preliminary results
The listening conditions in the 20 km long and 450 m deep inlet were good because firm sea ice and the underwater ice cliffs of the floating ice shelf mass acted as an insulator from wind and wave noise. Of the total of 210 hours of acoustic data obtained, 168 hours were recorded continuously. As our studies were conducted towards the end of the lactation and mating period, we presume that in addition to mother-pup vocalizations many of the calls were from adult males and were most likely related to courtship and territorial behaviour. So far 15 different call types (range: 0.1 - 18 kHz) were identified from the large sample size of acoustic recordings obtained. Many of the sounds were distinctive long trills characterized by decreasing frequency

(Fig. 45). These sounds are thought to function in territorial advertisement during the mating season.

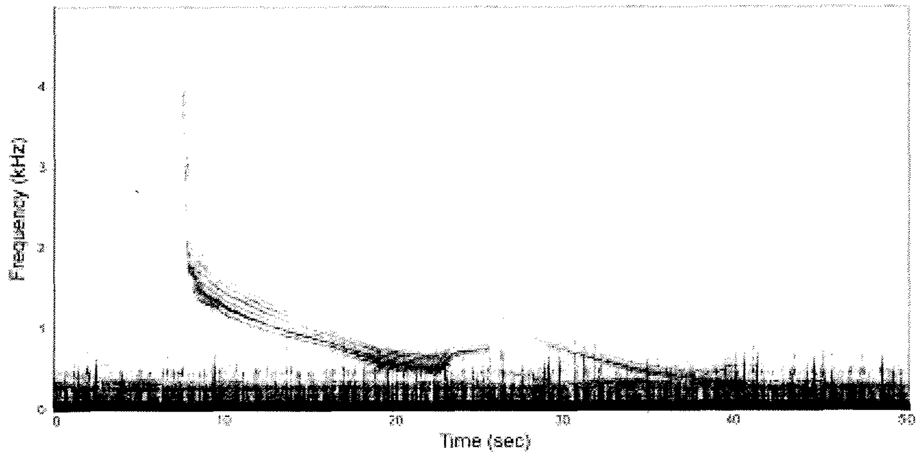

Fig. 45 Sonogram of a 35s-long downward trill made by a Weddell seal.

2.6.2 Seabird observations (M. Fröb)

Objectives

Seabirds were monitored during the entire cruise in order to get an impression of occurrence and distribution of birds in southern spring.

Work at sea

Since bird watchers were occupied with other work on board, no systematic observation was possible and effort varied considerably over the cruise. However, the attempt was made to make recordings at least on a daily basis. For this reason the presented results do not necessarily reflect absolute species richness and distribution aspects in the area under investigation. Identification and nomenclature was done on the basis of available literature (Tuck & Heinzel, 1984).

Preliminary results

All bird sightings are summarised in Table 21. Wilson´s Storm-Petrel *Oceanites oceanicus* behaved quite interestingly between Atka Bay und Drescher Inlet, as groups of up to 12 birds played around the ship during sunny afternoons and evenings showing courting behaviour. Unexpectedly, several individuals of the Southern Black-backed Gull *Larus dominicanus* were present around Drescher Inlet. Remarkable is the large number of species and individuals sighted around Bouvet Island and on the return voyage in the iceberg girdle around 58°S.

Tab. 21 Seabird sightings during ANT XXI/2 (English names at bottom of table). Reference: Gerald Tuck/Hermann Heinzel, Die Meeresvögel der Welt, Verlag Paul Parey, Hamburg und Berlin.

Date	Position	Aptenodytes forsteri	Pygoscelis adeliae	Pygoscelis antarctica	Eudyptes chrysolophus	Diomedea exulans	Diomedea melanophris	Diomedea chrysostoma	Phoebetria fusca	Phoebetria palpebrata	Macronectes giganteus	Fulmarus glacialoides	Daption capensis	Pagodroma nivea	Thalassoica antarctica	Halobaena caerulea	Pachyptila spp.	Procellaria aequinoctialis	Ardenna gravis	Pterodroma lessoni	Pterodroma macroptera	Pterodroma brevirostris	Pterodroma mollis	Oceanites oceanicus	Fregetta tropica	Catharacta skua	Larus dominicanus	Sterna paradisea
18.11.	36°29.724S, 16°47.435E					X															X		X					
19.11.	40°32.212S, 14°58.201E					X											X	X		X	X		X	X	X	X		
20.11.	44°5.158S, 13°53.599E					X	X									X	X	X										
21.11.	48°0.593S, 11°55.304E					X	X	X		X	X		X			X	X	X						X	X			
22.11.	50°37.643S, 10°36.868E					X	X	X		X	X		X			X	X	X						X	X			
23.11.	53°38.875S, 82°8.067E				X		X			X		X	X			X	X											
24.11.	54°37.291S, 3°8.194E			X	X		X			X	X	X	X	X		X	X							X	X		X	
25.11.	54°37.558S, 3°7.677E			X	X		X			X	X	X	X	X		X	X							X	X			
26.11.	56°13.311S, 1°21.944E			X							X	X	X	X	X		X											
27.11.	59°22.229S, 0°1.048W	X		X										X	X													
28.11.	62°48.892S, 1°10.895W		X											X	X													X
29.11.	66°7.225S, 2°54.521W													X	X													X
30.11.	70°2.140S, 7°8.298W	X	X											X	X									X				X
01.12.	70°31.457S, 8°9.760W	X	X											X	X									X				
02.12.	70°31.435S, 8°9.725W	X	X								X			X	X													
03.12.	70°51.021S, 10°37.896W	X									X			X	X													
04.12.	72°48.806S, 19°28.730W	X									X			X	X											X		
05.12.	71°7.637S, 13°32.505W	X												X	X													X
06.12.	70°33.515S, 8°56.595W	X	X								X			X	X									X				X
07.12.	70°34.468S, 9°1.798W	X	X											X	X									X				X
08.12.	70°26.310S, 9°16.347W	X	X											X	X									X				
09.12.	70°55.817S, 10°30.113W	X												X	X									X				

Species	10.12. 70°50.948S, 10°38.520W	11.12. 70°56.507S, 10°31.756W	12.12. 70°55.798S, 10°31.238W	13.12. 70°56.753S, 10°32.33W	14.12. 70°49.122S, 10°39.568W	15.12. 70°58.142S, 10°36.596W	16.12. 70°55.399S, 10°28.845W	17.12. 70°56.362S, 10°30.644W	18.12. 70°56.521S, 10°31.713W	19.12. 70°29.351S, 9°9.905W	20.12. 70°52.2813S, 10°29.543W	21.12. 71°24.966S, 13°50.644W	22.12. 70°48.987S, 10°39.935W	23.12. 71°7.814S, 11°29.573W	24.12. 70°50.688S, 10°34.943W	25.12. 70°56.183S, 10°28.775W	26.12. 70°56.154S, 10°28.638W	27.12. 70°48.876S, 10°50.734W	28.12. 70°52.087S, 10°41.423W	29.12. 71°7.606S, 11°31.682W	30.12. 71°47.566S, 17°19.220W	31.12. 72°52.236S, 19°39.840W	01.01. 72°49.786S, 19°30.577W	02.01. 72°52.900S, 19°39.695W	03.01. 72°54.597S, 19°43.599W
Sterna paradisea	X		X																		X				
Larus dominicanus						X																X			X
Catharacta skua															X					X					X
Fregetta tropica																									
Oceanites oceanicus	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X				X	X	X	X	X	X	X
Pterodroma mollis																									
Pterodroma brevirostris																									
Pterodroma macroptera																									
Pterodroma lessoni																									
Ardenna gravis																									
Procellaria aequinoctialis																									
Pachyptila spp.																									
Halobaena caerulea																									
Thalassoica antarctica	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X
Pagodroma nivea	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X
Daption capensis						X	X																		
Fulmarus glacialoides														X					X						X
Macronectes giganteus			X				X	X									X	X	X	X	X	X	X	X	X
Phoebetria palpebrata																									
Phoebetria fusca																									
Diomedea chrysostoma																									
Diomedea melanophris																									
Diomedea exulans																									
Eudyptes chrysolophus																									
Pygoscelis antarctica																									
Pygoscelis adeliae					X	X	X	X	X	X	X	X	X	X	X		X		X	X	X	X	X	X	X
Aptenodytes forsteri	X		X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X

Date	04.01.	05.01.	06.01.	07.01.	08.01.	09.01.	10.01.	11.01.	12.01.	13.01.	14.01.	15.01.	16.01.	
Position	71°34.943S, 16°46.125W	70°50.673S, 10°27.942W	70°22.285S, 9°19.165W	70°19.244S, 9°26.496W	67°15.586S, 6°49.899W	62°57.807S, 2°31.039W	58°16.152S, 0°43.439W	54°44.196S, 0°8.822E	51°45.983S, 3°9.175E	48°9.995S, 6°36.245E	44°39.636S, 9°44.292E	41°18.052S, 12°34.132E	38°17.207S, 14°59.150E	
Sterna paradisea	x			x	x									Arctic Tern
Larus dominicanus							x							South. Black-backed Gull
Catharacta skua					x		x							Great Skua
Fregetta tropica							x	x	x			x	x	Black-bellied Storm Petrel
Oceanites oceanicus	x	x	x											Wilson's Storm Petrel
Pterodroma mollis								x	x	x	x	x	x	Soft-plumaged Petrel
Pterodroma brevirostris							x	x						Kerguelen Petrel
Pterodroma macroptera													x	Great-winged Petrel
Pterodroma lessoni														White-headed Petrel
Ardenna gravis											x	x	x	Great Shearwater
Procellaria aequinoctialis												x	x	White-chinned Petrel
Pachyptila spp.							x	x	x	x	x			Prion
Halobaena caerulea							x	x	x	x				Blue Petrel
Thalassoica antarctica	x	x	x	x	x	x	x							Antarctic Petrel
Pagodroma nivea	x	x	x	x	x	x	x							Snow Petrel
Daption capensis							x							Cape Pigeon
Fulmarus glacialoides							x							Southern Antarctic Fulmar
Macronectes giganteus		x					x	x	x	x		x		Southern Giant Petrel
Phoebetria palpebrata							x					x		Light-maled Albatross
Phoebetria fusca												x		Sooty Albatross
Diomedea chrysostoma												x		Grey-headed Albatross
Diomedea melanophris							x	x	x	x		x		Black-browed Albatross
Diomedea exulans										x	x	x	x	Wandering Albatross
Eudyptes chrysolophus														Macaroni Penguin
Pygoscelis antarctica					x		x	x						Chin-strap Penguin
Pygoscelis adeliae	x	x	x	x	x									Adelie Penguin
Aptenodytes forsteri	x	x	x	x										Emperor Penguin

2.6.3 Measurement of atmospheric trace gases (D. Wevill)

Objectives

To use an automated GC-MS (University Of York, UK) for the continuous measurement of Volatile Halogenated Organic Compounds (VHOCs), both in the atmosphere and in surface water depth profiles with the aim of understanding their roles in tropospheric chemistry. MAX-DOAS measurements (University of Heidelberg) were also taken looking for species such as IO, BrO, OH, O_3, SO_2 which are involved in both tropospheric and stratospheric chemistry.

Work at sea

Measurements by MAX-DOAS were taken continuously during the cruise. The GC-MS air measurements were also taken continuously with the exception of calibrations and water profile measurements. Six water profiles were obtained at different stations during the cruise, concentrating on the first 100m in depth.

Preliminary results

The data obtained from the MAX-DOAS instrument will be analysed in Heidelberg, so no results can be presented yet. The air measurements from the GC-MS show some interesting events possibly linked to large plankton blooms. The data need referencing to air trajectories to fully understand the air masses sampled. This will be done along with more detailed analyses back in York. The water profiles represent the most exciting data collected and give some idea, combined with the air measurements, of the role of the Antarctic region as source/sink for VHOCs. Some of the shortest lived species such as CH_2I_2 were not observed in the air but have been found in fairly high concentrations at depths from 20 – 80m, suggesting production in that region. The brominated compounds CH_2Br_2 and $CHBr_3$ have been detected in the air during the entire cruise and their concentrations in the water column have been found to be fairly constant from the surface down to 100m.

3. ANNEXES

3.1 Abbreviations of gear

Gear

Abbreviation	Gear
AGT/s	Agassiz trawl small (1.5 m)
AGT/l	Agassiz trawl large (3m)
BIOROSI	Bio Rosette
BO_h	Bongo net - horizontal haul
BO_v	Bongo net - vertical haul
BPN	Benthopelagic trawl
CC_h	Calcofi plankton net - horizontal haul
CC_v	Calcofi plankton net - vertical haul
CTD	Conductivity-Temp-Depth data logger
DRG	Stone Dredge
EBS	Epibenthic sledge
FTS	Photo sled
GEOD	Geological dredge
GKG	Giant box corer
GSN	Bottom trawl
GWS	Giant Water Sampler (Lavaleye)
HS	Hydrosweep
HS & PS	Hydrosweep & Parasound
ISP	In Situ Pump (Challenger)
LND	Lander
LND_rec	Lander recovery
LD	Lovrich dredge
LHHN	Large horizontal hauling net
MG	Multigrab
MN_h	Multinet - horizontal haul
MN_v	Multinet - vertical haul
MOR	Mooring - deployment
MOR_rec	Mooring - recovery
MUC	Multicorer
NAV	Navigation Echo Sounder
PSN	Pelagic fish trawl
RD	Rauschert's small dredge
RG	Revolver grab
ROV	Remotely operated vehicle
SHHN	Small horizontal hauling net
Trap/A	Amphipod trap - deployment
Trap/A_rec	Amphipod trap - recovery
Trap/F	Fish trap - deployment
Trap/F_rec	Fish trap - recovery
Trap/L	Lobster trap - deployment
Trap/L_rec	Lobster trap - recovery
TVG	TV grab

3.2 Station list

Date	Time ship	Stat. PS65/	Lat. (°S)	Long.	Depth (m)	Gear	Operation
23.11.03	04:52	012-1	53°22.42'	10°02.01'E	2466	MOR	surface
23.11.03	05:19	012-1	53°22.22'	10°03.05'E	2497	MOR	on deck
24.11.03	06:09	013-1	54°25.74'	03°29.38'E	243	Test	surface
24.11.03	06:13	013-1	54°25.71'	03°29.35'E	232	Test	at depth
24.11.03	06:23	013-1	54°25.71'	03°29.41'E	233	Test	on deck
24.11.03	06:27	013-1	54°25.68'	03°29.40'E	226	Test	surface
24.11.03	06:33	013-1	54°25.62'	03°29.38'E	218	Test	at depth
24.11.03	06:42	013-1	54°25.59'	03°29.40'E	213	Test	on deck
24.11.03	06:45	013-1	54°25.60'	03°29.43'E	214	Test	surface
24.11.03	06:52	013-1	54°25.60'	03°29.53'E	222	Test	at depth
24.11.03	07:03	013-1	54°25.54'	03°29.56'E	221	Test	on deck
24.11.03	07:46	014-1	54°24.90'	03°30.36'E	205	HS	start track
24.11.03	12:30	014-1	54°36.98'	03°11.91'E	541	HS	profile end
24.11.03	13:09	014-1	54°37.94'	03°06.80'E	515	Trap/A	surface
24.11.03	13:40	015-1	54°37.94'	03°07.31'E	517	Trap/L	surface
24.11.03	13:56	015-1	54°37.86'	03°07.08'E	515	Trap/L	surface
24.11.03	13:57	015-1	54°37.87'	03°07.08'E	515	Trap/L	surface
24.11.03	14:12	015-1	54°37.80'	03°06.92'E	511	Trap/L	surface
24.11.03	15:16	016-1	54°29.92'	03°12.04'E	281	Trap/F	surface
24.11.03	15:35	017-1	54°29.06'	03°10.98'E	306	Trap/F	surface
24.11.03	15:50	018-1	54°29.13'	03°10.83'E	297	CTD	surface
24.11.03	16:10	018-1	54°29.27'	03°10.59'E	302	CTD	on deck
24.11.03	16:43	019-1	54°30.22'	03°14.37'E	254	AGT	surface
24.11.03	16:51	019-1	54°30.09'	03°14.13'E	247	AGT	on ground
24.11.03	17:09	019-1	54°30.01'	03°13.97'E	260	AGT	off ground
24.11.03	17:19	019-1	54°30.15'	03°13.95'E	263	AGT	on deck
24.11.03	18:29	020-1	54°37.41'	03°13.37'E	611	AGT	surface
24.11.03	18:50	020-1	54°36.95'	03°12.42'E	553	AGT	on ground
24.11.03	19:10	020-1	54°37.02'	03°12.18'E	550	AGT	off ground
24.11.03	19:32	020-1	54°37.30'	03°12.60'E	572	AGT	on deck
24.11.03	19:42	021-1	54°37.38'	03°12.66'E	576	CTD	surface
24.11.03	19:54	021-1	54°37.41'	03°12.84'E	582	CTD	at depth
24.11.03	20:14	021-1	54°37.49'	03°12.99'E	596	CTD	on deck
24.11.03	20:39	022-1	54°36.34'	03°12.24'E	534	FTS	surface
24.11.03	20:55	022-1	54°36.33'	03°12.58'E	538	FTS	at ground
24.11.03	21:28	022-1	54°36.29'	03°12.75'E	540	FTS	off ground
24.11.03	21:40	022-1	54°36.28'	03°12.80'E	539	FTS	on deck
24.11.03	21:48	023-1	54°36.29'	03°12.82'E	539	ISP	into water
24.11.03	22:04	023-1	54°36.28'	03°12.89'E	539	ISP	pump at depth
24.11.03	23:31	023-1	54°36.24'	03°12.89'E	540	ISP	on deck
25.11.03	00:26	024-1	54°29.66'	03°14.08'E	244	FTS	surface
25.11.03	00:34	024-1	54°29.68'	03°14.04'E	246	FTS	at ground
25.11.03	01:16	024-1	54°29.66'	03°13.92'E	245	FTS	off ground
25.11.03	01:21	024-1	54°29.66'	03°13.92'E	244	FTS	on deck
25.11.03	01:28	025-1	54°29.68'	03°13.90'E	245	ISP	into water
25.11.03	01:38	025-1	54°29.72'	03°13.89'E	251	ISP	pump at depth
25.11.03	02:53	025-1	54°29.81'	03°13.76'E	256	ISP	Information
25.11.03	03:00	025-1	54°29.85'	03°13.73'E	264	ISP	on deck
25.11.03	04:00	026-1	54°21.75'	03°15.23'E	193	HS	start track
25.11.03	04:45	026-1	54°22.09'	03°21.06'E	264	HS	profile break
25.11.03	05:00	026-1	54°21.83'	03°23.16'E	175	HS	alter course
25.11.03	05:55	026-1	54°24.21'	03°13.69'E	199	HS	alter course
25.11.03	07:03	026-1	54°21.52'	03°23.25'E	192	HS	profile end
25.11.03	07:30	027-1	54°22.29'	03°19.02'E	119	CTD	surface
25.11.03	07:38	027-1	54°22.32'	03°19.09'E	114	CTD	at depth
25.11.03	07:45	027-1	54°22.36'	03°19.07'E	112	CTD	on deck
25.11.03	08:05	028-1	54°22.33'	03°18.20'E	139	AGT	surface

Date	Time ship	Stat. PS65/	Lat. (°S)	Long.	Depth (m)	Gear	Operation
25.11.03	08:13	028-1	54°22.49'	03°17.58'E	134	AGT	on ground
25.11.03	08:29	028-1	54°22.54'	03°17.21'E	122	AGT	off ground
25.11.03	08:37	028-1	54°22.52'	03°17.20'E	122	AGT	on deck
25.11.03	11:13	014-1	54°37.86'	03°06.86'E	515	Trap/A_rec	released
25.11.03	11:36	014-1	54°37.77'	03°06.78'E	510	Trap/A_rec	on deck
25.11.03	13:07	015-1	54°37.84'	03°07.72'E	517	Trap/L_rec	on deck
25.11.03	14:42	016-1	54°29.92'	03°12.38'E	276	Trap/F_rec	released
25.11.03	15:14	016-1	54°29.79'	03°11.83'E	275	Trap/F_rec	on deck
25.11.03	15:33	017-1	54°28.99'	03°11.38'E	308	Trap/F_rec	released
25.11.03	15:56	017-1	54°29.14'	03°10.78'E	301	Trap/F_rec	on deck
25.11.03	16:45	029-1	54°31.45'	03°13.99'E	370	AGT	surface
25.11.03	16:59	029-1	54°31.59'	03°13.05'E	377	AGT	on ground
25.11.03	17:19	029-1	54°31.51'	03°12.84'E	365	AGT	off ground
25.11.03	17:32	029-1	54°31.56'	03°12.92'E	369	AGT	on deck
25.11.03	17:50	030-1	54°31.99'	03°12.04'E	420	GWS	surface
25.11.03	18:09	030-1	54°32.06'	03°12.10'E	431	GWS	on deck
25.11.03	19:30	031-1	54°23.15'	03°15.92'E	118	FTS	surface
25.11.03	20:25	031-1	54°23.06'	03°16.25'E	114	FTS	off ground
25.11.03	20:29	031-1	54°23.06'	03°16.25'E	114	FTS	on deck
25.11.03	20:54	032-1	54°22.56'	03°17.40'E	119	FTS	surface
25.11.03	21:48	032-1	54°22.65'	03°17.67'E	111	FTS	on deck
25.11.03	23:34	033-1	54°33.33'	03°09.56'E	424	ISP	into water
26.11.03	00:05	033-1	54°33.22'	03°09.39'E	418	ISP	pump at depth
26.11.03	01:18	033-1	54°33.11'	03°09.67'E	408	ISP	Information
26.11.03	01:29	033-1	54°33.13'	03°09.68'E	409	ISP	on deck
02.12.03	23:59	034-1	70°34.24'	07°33.61'W	194	FTS	surface
03.12.03	00:07	034-1	70°34.24'	07°33.55'W	195	FTS	at ground
03.12.03	00:57	034-1	70°34.21'	07°33.56'W	194	FTS	off ground
03.12.03	01:05	034-1	70°34.20'	07°33.51'W	194	FTS	on deck
03.12.03	06:19	035-1	70°32.69'	08°53.23'W	410	MOR	surface
03.12.03	06:19	035-1	70°32.69'	08°53.23'W	410	MOR	action
03.12.03	06:27	035-1	70°32.70'	08°53.06'W	407	MOR	surface
03.12.03	06:43	035-1	70°32.74'	08°52.93'W	405	MOR	surface
03.12.03	06:51	035-1	70°32.74'	08°52.97'W	405	MOR	surface
03.12.03	07:04	035-1	70°32.75'	08°52.99'W	405	MOR	surface
03.12.03	07:15	035-1	70°32.74'	08°53.09'W	407	MOR	surface
03.12.03	07:21	035-1	70°32.73'	08°53.11'W	407	MOR	at depth
03.12.03	07:22	035-1	70°32.73'	08°53.10'W	407	MOR	surface
03.12.03	07:25	035-1	70°32.72'	08°53.08'W	406	MOR	on deck
03.12.03	07:37	036-1	70°32.64'	08°53.79'W	421	CTD	surface
03.12.03	07:48	036-1	70°32.61'	08°53.98'W	422	CTD	at depth
03.12.03	07:56	036-1	70°32.60'	08°53.93'W	422	CTD	on deck
04.12.03	08:55	037-1	72°48.78'	19°31.56'W	568	GWS	surface
04.12.03	09:18	037-1	72°48.78'	19°31.50'W	566	GWS	on deck
04.12.03	09:30	038-1	72°48.78'	19°31.67'W	571	CTD	surface
04.12.03	09:45	038-1	72°48.79'	19°31.78'W	574	CTD	at depth
04.12.03	10:02	038-1	72°48.80'	19°32.07'W	582	CTD	on deck
05.12.03	17:32	039-1	71°06.63'	11°32.72'W	166	AGT	surface
05.12.03	17:33	039-1	71°06.61'	11°32.63'W	164	AGT	surface
05.12.03	17:39	039-1	71°06.47'	11°32.29'W	166	AGT	on ground
05.12.03	17:54	039-1	71°06.30'	11°32.04'W	175	AGT	off ground
05.12.03	18:01	039-1	71°06.29'	11°31.97'W	183	AGT	on deck
05.12.03	18:30	040-1	71°06.40'	11°31.98'W	0	CTD	surface
05.12.03	18:37	040-1	71°06.44'	11°32.12'W	164	CTD	at depth
05.12.03	18:42	040-1	71°06.48'	11°32.27'W	165	CTD	on deck
05.12.03	21:35	041-1	70°54.35'	10°56.82'W	307	EF	start
05.12.03	21:50	041-1	70°54.54'	10°57.21'W	305	EF	end
06.12.03	06:40	042-1	70°29.69'	08°58.98'W	853	FTS	surface
06.12.03	06:50	042-1	70°29.66'	08°58.73'W	428	FTS	at ground
06.12.03	07:00	042-1	70°29.65'	08°58.55'W	429	FTS	off ground
06.12.03	07:09	042-1	70°29.64'	08°58.41'W	429	FTS	on deck

Date	Time ship	Stat. PS65/	Lat. (°S)	Long.	Depth (m)	Gear	Operation
06.12.03	07:39	043-1	70°30.55'	08°58.70'W	444	FTS	surface
06.12.03	07:51	043-1	70°30.51'	08°58.53'W	444	FTS	at ground
06.12.03	08:01	043-1	70°30.48'	08°58.39'W	444	FTS	off ground
06.12.03	08:15	043-1	70°30.42'	08°58.23'W	440	FTS	on deck
06.12.03	08:48	044-1	70°31.83'	08°58.57'W	448	FTS	surface
06.12.03	09:02	044-1	70°31.78'	08°58.63'W	448	FTS	at ground
06.12.03	09:15	044-1	70°31.75'	08°58.62'W	448	FTS	off ground
06.12.03	09:27	044-1	70°31.76'	08°58.64'W	448	FTS	on deck
06.12.03	09:44	045-1	70°31.84'	09°01.14'W	438	Trap/F	surface
06.12.03	09:51	046-1	70°31.73'	09°01.47'W	440	Trap/F	surface
06.12.03	10:05	047-1	70°31.76'	09°02.21'W	438	Trap/A	surface
06.12.03	11:48	048-1	70°33.54'	08°56.08'W	452	EBS	surface
06.12.03	12:07	048-1	70°33.48'	08°57.10'W	457	EBS	on ground
06.12.03	12:11	048-1	70°33.46'	08°57.36'W	457	EBS	start trawling
06.12.03	12:21	048-1	70°33.44'	08°57.93'W	457	EBS	end trawling
06.12.03	12:26	048-1	70°33.44'	08°58.00'W	457	EBS	off ground
06.12.03	12:44	048-1	70°33.46'	08°58.03'W	457	EBS	on deck
06.12.03	13:03	049-1	70°33.46'	08°57.71'W	457	CTD	surface
06.12.03	13:14	049-1	70°33.42'	08°57.82'W	456	CTD	at depth
06.12.03	13:32	049-1	70°33.46'	08°58.06'W	457	CTD	on deck
06.12.03	13:49	050-1	70°33.49'	08°58.16'W	456	MN_v	surface
06.12.03	14:00	050-1	70°33.50'	08°58.27'W	457	MN_v	at depth
06.12.03	14:23	050-1	70°33.52'	08°58.62'W	456	MN_v	on deck
06.12.03	14:45	051-1	70°33.70'	08°58.70'W	459	BO	surface
06.12.03	15:03	051-1	70°33.79'	08°59.00'W	457	BO	at depth
06.12.03	15:29	051-1	70°33.93'	08°59.41'W	460	BO	on deck
06.12.03	15:49	052-1	70°33.89'	08°59.09'W	460	GWS	surface
06.12.03	16:08	052-1	70°33.98'	08°59.28'W	461	GWS	on deck
06.12.03	17:41	053-1	70°25.79'	09°14.92'W	326	FTS	surface
06.12.03	17:48	053-1	70°25.88'	09°15.10'W	317	FTS	at ground
06.12.03	18:02	053-1	70°25.90'	09°15.28'W	322	FTS	off ground
06.12.03	18:09	053-1	70°26.02'	09°15.51'W	318	FTS	on deck
06.12.03	18:29	054-1	70°25.33'	09°16.21'W	362	FTS	surface
06.12.03	18:37	054-1	70°25.35'	09°16.34'W	362	FTS	at ground
06.12.03	18:50	054-1	70°25.45'	09°16.63'W	359	FTS	off ground
06.12.03	18:55	054-1	70°25.46'	09°16.70'W	360	FTS	on deck
06.12.03	19:14	055-1	70°24.90'	09°18.73'W	400	FTS	surface
06.12.03	19:25	055-1	70°24.92'	09°18.92'W	402	FTS	at ground
06.12.03	19:45	055-1	70°25.18'	09°19.53'W	382	FTS	off ground
06.12.03	19:52	055-1	70°25.26'	09°19.72'W	384	FTS	on deck
06.12.03	20:47	056-1	70°21.29'	09°19.68'W	0	CTD	surface
06.12.03	21:06	056-1	70°21.42'	09°20.22'W	0	CTD	at depth
06.12.03	21:26	056-1	70°21.55'	09°20.55'W	788	CTD	on deck
06.12.03	22:35	057-1	70°22.48'	09°19.89'W	495	CTD	surface
06.12.03	22:46	057-1	70°22.50'	09°19.85'W	494	CTD	at depth
06.12.03	22:59	057-1	70°22.54'	09°19.95'W	492	CTD	on deck
06.12.03	23:29	058-1	70°22.73'	09°21.25'W	486	CTD	surface
06.12.03	23:43	058-1	70°22.84'	09°22.05'W	507	CTD	at depth
06.12.03	23:59	058-1	70°23.06'	09°23.35'W	597	CTD	on deck
07.12.03	00:47	059-1	70°22.87'	09°19.52'W	474	ISP	into water
07.12.03	00:55	059-1	70°22.92'	09°20.00'W	472	ISP	pump at depth
07.12.03	02:04	059-1	70°24.06'	09°23.58'W	443	ISP	Information
07.12.03	02:11	059-1	70°24.20'	09°23.93'W	440	ISP	on deck
07.12.03	02:46	060-1	70°25.70'	09°15.45'W	332	CTD	surface
07.12.03	02:57	060-1	70°25.75'	09°15.98'W	332	CTD	at depth
07.12.03	03:05	060-1	70°25.78'	09°16.13'W	330	CTD	on deck
07.12.03	03:36	061-1	70°28.31'	09°11.73'W	349	CTD	surface
07.12.03	03:46	061-1	70°28.28'	09°12.07'W	344	CTD	at depth
07.12.03	03:55	061-1	70°28.29'	09°12.25'W	347	CTD	on deck
07.12.03	04:30	062-1	70°28.39'	09°12.19'W	351	CTD	surface
07.12.03	04:40	062-1	70°28.53'	09°12.55'W	357	CTD	at depth

Date	Time ship	Stat. PS65/	Lat. (°S)	Long.	Depth (m)	Gear	Operation
07.12.03	04:52	062-1	70°28.68'	09°12.90'W	363	CTD	on deck
07.12.03	05:01	063-1	70°28.64'	09°12.04'W	364	ISP	into water
07.12.03	05:10	063-1	70°28.57'	09°11.36'W	361	ISP	Information
07.12.03	05:14	063-1	70°28.55'	09°11.05'W	374	ISP	pump at depth
07.12.03	06:24	063-1	70°28.45'	09°11.19'W	369	ISP	Information
07.12.03	06:26	063-1	70°28.44'	09°11.27'W	360	ISP	Information
07.12.03	06:30	063-1	70°28.45'	09°11.44'W	356	ISP	on deck
07.12.03	07:01	064-1	70°31.55'	09°07.58'W	417	CTD	surface
07.12.03	07:12	064-1	70°31.62'	09°07.75'W	418	CTD	at depth
07.12.03	07:22	064-1	70°31.61'	09°07.70'W	417	CTD	on deck
07.12.03	08:11	065-1	70°34.43'	09°01.72'W	469	CTD	surface
07.12.03	08:18	065-1	70°34.48'	09°02.00'W	472	CTD	at depth
07.12.03	08:33	065-1	70°34.46'	09°01.81'W	470	CTD	on deck
07.12.03	09:09	066-1	70°34.52'	09°02.16'W	474	CTD	surface
07.12.03	09:20	066-1	70°34.48'	09°01.97'W	472	CTD	at depth
07.12.03	09:32	066-1	70°34.45'	09°01.94'W	470	CTD	on deck
07.12.03	10:15	067-1	70°34.52'	09°01.85'W	472	CTD	surface
07.12.03	10:23	067-1	70°34.50'	09°01.90'W	472	CTD	at depth
07.12.03	10:29	067-1	70°34.48'	09°01.98'W	471	CTD	on deck
07.12.03	10:50	068-1	70°34.51'	09°01.87'W	472	ISP	into water
07.12.03	12:05	068-1	70°34.48'	09°01.86'W	470	ISP	Information
07.12.03	12:11	068-1	70°34.49'	09°02.00'W	471	ISP	on deck
07.12.03	17:47	069-1	70°25.87'	08°37.41'W	414	RD	surface
07.12.03	17:59	069-1	70°25.87'	08°37.43'W	414	RD	start dredging
07.12.03	18:50	069-1	70°25.94'	08°37.23'W	408	RD	on deck
07.12.03	21:05	070-1	70°23.60'	09°26.72'W	795	MN_v	surface
07.12.03	21:31	070-1	70°23.78'	09°27.42'W	879	MN_v	at depth
07.12.03	21:33	070-1	70°23.79'	09°27.43'W	877	MN_v	hoisting
07.12.03	22:02	070-1	70°24.10'	09°28.21'W	872	MN_v	on deck
07.12.03	22:32	071-1	70°24.59'	09°28.63'W	798	MN_v	surface
07.12.03	22:59	071-1	70°24.81'	09°29.15'W	804	MN_v	at depth
07.12.03	23:02	071-1	70°24.84'	09°29.21'W	803	MN_v	hoisting
07.12.03	23:41	071-1	70°25.32'	09°30.17'W	778	MN_v	on deck
08.12.03	00:38	072-1	70°26.34'	09°32.82'W	850	MN_v	surface
08.12.03	01:08	072-1	70°26.57'	09°33.66'W	874	MN_v	at depth
08.12.03	01:56	072-1	70°27.09'	09°35.29'W	925	MN_v	on deck
08.12.03	02:44	073-1	70°28.36'	09°38.33'W	834	MN_v	surface
08.12.03	03:13	073-1	70°28.62'	09°39.06'W	830	MN_v	at depth
08.12.03	03:58	073-1	70°28.86'	09°40.14'W	835	MN_v	on deck
08.12.03	06:25	074-1	70°22.75'	09°20.93'W	486	MG	surface
08.12.03	06:51	074-1	70°22.97'	09°21.60'W	479	MG	at ground
08.12.03	06:53	074-1	70°22.99'	09°21.65'W	477	MG	at ground
08.12.03	06:54	074-1	70°23.00'	09°21.68'W	476	MG	at ground
08.12.03	07:04	074-1	70°23.09'	09°21.95'W	476	MG	at ground
08.12.03	07:16	074-1	70°23.19'	09°22.26'W	470	MG	on deck
08.12.03	08:02	075-1	70°22.44'	09°20.71'W	499	MG	surface
08.12.03	08:20	075-1	70°22.58'	09°21.13'W	494	MG	at ground
08.12.03	08:34	075-1	70°22.68'	09°21.50'W	495	MG	on deck
08.12.03	08:58	076-1	70°22.86'	09°22.02'W	495	MG	surface
08.12.03	09:13	076-1	70°22.97'	09°22.31'W	489	MG	at ground
08.12.03	09:25	076-1	70°23.06'	09°22.61'W	489	MG	on deck
08.12.03	11:00	077-1	70°26.02'	09°15.05'W	317	MG	surface
08.12.03	11:19	077-1	70°26.08'	09°15.30'W	311	MG	at ground
08.12.03	11:30	077-1	70°26.11'	09°15.49'W	311	MG	on deck
08.12.03	11:58	078-1	70°26.30'	09°16.32'W	309	GWS	surface
08.12.03	12:16	078-1	70°26.36'	09°16.57'W	311	GWS	on deck
08.12.03	12:19	079-1	70°26.37'	09°16.62'W	307	GWS	surface
08.12.03	12:36	079-1	70°26.46'	09°17.01'W	313	GWS	on deck
08.12.03	13:12	080-1	70°28.33'	09°11.67'W	348	MG	surface
08.12.03	13:23	080-1	70°28.27'	09°11.71'W	343	MG	at ground
08.12.03	13:46	080-1	70°28.20'	09°12.34'W	341	MG	on deck

Date	Time ship	Stat. PS65/	Lat. (°S)	Long.	Depth (m)	Gear	Operation
08.12.03	13:57	081-1	70°28.22'	09°12.63'W	341	GWS	surface
08.12.03	14:14	081-1	70°28.24'	09°12.72'W	342	GWS	on deck
08.12.03	15:15	082-1	70°31.43'	09°05.95'W	418	MG	surface
08.12.03	15:36	082-1	70°31.52'	09°06.28'W	422	MG	at ground
08.12.03	15:48	082-1	70°31.57'	09°06.52'W	420	MG	on deck
08.12.03	15:59	083-1	70°31.63'	09°06.65'W	421	GWS	surface
08.12.03	16:22	083-1	70°31.75'	o9°07.05'W	422	GWS	on deck
08.12.03	17:41	084-1	70°35.20'	09°03.75'W	482	MG	surface
08.12.03	18:04	084-1	70°35.27'	09°03.47'W	484	MG	at ground
08.12.03	18:16	084-1	70°35.29'	09°03.33'W	484	MG	on deck
08.12.03	18:35	085-1	70°35.34'	09°03.35'W	486	GWS	surface
08.12.03	19:04	085-1	70°35.35'	09°03.12'W	488	GWS	on deck
09.12.03	06:04	086-1	70°52.80'	10°53.12'W	280	FTS	surface
09.12.03	06:12	086-1	70°52.80'	10°53.22'W	283	FTS	at ground
09.12.03	06:25	086-1	70°52.94'	10°53.07'W	276	FTS	off ground
09.12.03	06:32	086-1	70°52.95'	10°53.09'W	280	FTS	on deck
09.12.03	07:01	087-1	70°53.69'	10°44.97'W	306	FTS	surface
09.12.03	07:09	087-1	70°53.67'	10°44.90'W	304	FTS	at ground
09.12.03	07:21	087-1	70°53.60'	10°44.86'W	302	FTS	off ground
09.12.03	07:28	087-1	70°53.64'	10°44.74'W	303	FTS	on deck
09.12.03	07:49	088-1	70°54.35'	10°38.55'W	312	FTS	surface
09.12.03	07:57	088-1	70°54.39'	10°38.44'W	309	FTS	at ground
09.12.03	08:10	088-1	70°54.43'	10°38.32'W	308	FTS	off ground
09.12.03	08:16	088-1	70°54.45'	10°38.25'W	326	FTS	on deck
09.12.03	08:49	089-1	70°56.45'	10°30.96'W	260	FTS	surface
09.12.03	08:56	089-1	70°56.49'	10°30.92'W	260	FTS	at ground
09.12.03	09:07	089-1	70°56.47'	10°30.75'W	255	FTS	off ground
09.12.03	09:14	089-1	70°56.51'	10°30.81'W	258	FTS	on deck
09.12.03	09:25	090-1	70°56.43'	10°31.04'W	264	AGT	surface
09.12.03	09:36	090-1	70°56.14'	10°31.70'W	274	AGT	on ground
09.12.03	09:56	090-1	70°55.92'	10°32.37'W	288	AGT	off ground
09.12.03	10:06	090-1	70°55.90'	10°32.44'W	288	AGT	on deck
09.12.03	11:28	091-1	70°55.80'	10°30.24'W	233	ROV	surface
09.12.03	11:40	091-1	70°55.82'	10°30.14'W	231	ROV	depressor to water
09.12.03	12:21	091-1	70°55.78'	10°30.08'W	228	ROV	at depth
09.12.03	13:44	091-1	70°55.68'	10°30.22'W	232	ROV	back to surface
09.12.03	14:04	091-1	70°55.60'	10°30.41'W	234	ROV	depressor on deck
09.12.03	14:09	091-1	70°55.61'	10°30.38'W	233	ROV	on deck
09.12.03	15:00	092-1	70°49.98'	10°40.23'W	315	MUC	surface
09.12.03	15:09	092-1	70°50.01'	10°40.22'W	314	MUC	at ground
09.12.03	15:18	092-1	70°50.01'	10°40.13'W	314	MUC	on deck
09.12.03	16:29	093-1	70°48.31'	10°45.93'W	486	MOR	surface
09.12.03	16:32	093-1	70°48.32'	10°46.02'W	490	MOR	surface
09.12.03	16:37	093-1	70°48.33'	10°46.08'W	490	MOR	surface
09.12.03	16:42	093-1	70°48.34'	10°46.08'W	491	MOR	surface
09.12.03	16:55	093-1	70°48.35'	10°45.99'W	489	MOR	surface
09.12.03	17:01	093-1	70°48.36'	10°46.04'W	490	MOR	surface
09.12.03	17:11	093-1	70°48.36'	10°45.83'W	481	MOR	surface
09.12.03	17:13	093-1	70°48.37'	10°45.83'W	481	MOR	action
09.12.03	17:18	093-1	70°48.37'	10°45.78'W	480	MOR	on deck
09.12.03	18:21	094-1	70°53.58'	10°45.03'W	302	GKG	surface
09.12.03	18:27	094-1	70°53.60'	10°45.07'W	304	GKG	at ground
09.12.03	18:35	094-1	70°53.57'	10°45.01'W	300	GKG	on deck
09.12.03	18:54	095-1	70°53.50'	10°44.92'W	298	RD	surface
09.12.03	19:10	095-1	70°53.60'	10°45.26'W	303	RD	start dredging
09.12.03	19:20	095-1	70°53.68'	10°45.59'W	308	RD	stop dredging
09.12.03	19:40	095-1	70°53.65'	10°45.65'W	306	RD	on deck
09.12.03	20:29	096-1	70°48.48'	10°44.03'W	468	CTD	surface
09.12.03	20:40	096-1	70°48.55'	10°44.25'W	457	CTD	at depth
09.12.03	20:54	096-1	70°48.56'	10°44.39'W	454	CTD	on deck
09.12.03	21:07	097-1	70°48.47'	10°44.53'W	472	MN_v	surface

Date	Time ship	Stat. PS65/	Lat. (°S)	Long.	Depth (m)	Gear	Operation
09.12.03	21:35	097-1	70°48.43'	10°44.77'W	466	MN_v	at depth
09.12.03	21:36	097-1	70°48.43'	10°44.78'W	467	MN_v	hoisting
09.12.03	21:55	097-1	70°48.49'	10°44.85'W	469	MN_v	on deck
09.12.03	22:22	098-1	70°48.76'	10°44.85'W	447	BO_v	surface
09.12.03	22:30	098-1	70°48.77'	10°44.85'W	446	BO_v	at depth
09.12.03	22:39	098-1	70°48.78'	10°44.86'W	444	BO_v	on deck
09.12.03	22:49	099-1	70°48.76'	10°44.87'W	447	BO_v	surface
09.12.03	23:06	099-1	70°48.82'	10°44.85'W	440	BO_v	at depth
09.12.03	23:26	099-1	70°48.90'	10°44.81'W	437	BO_v	on deck
09.12.03	23:39	100-1	70°48.98'	10°44.78'W	436	BO_v	surface
09.12.03	23:55	100-1	70°49.03'	10°44.78'W	433	BO_v	at depth
10.12.03	00:17	100-1	70°49.02'	10°44.75'W	432	BO_v	on deck
10.12.03	01:54	101-1	70°44.50'	11°05.17'W	1260	CTD	surface
10.12.03	02:18	101-1	70°44.59'	11°05.03'W	1250	CTD	at depth
10.12.03	02:45	101-1	70°44.69'	11°04.86'W	1240	CTD	on deck
10.12.03	07:10	102-1	70°56.39'	10°31.52'W	273	ROV	surface
10.12.03	07:16	102-1	70°56.40'	10°31.46'W	270	ROV	depressor to water
10.12.03	07:58	102-1	70°56.41'	10°31.45'W	268	ROV	at depth
10.12.03	09:52	102-1	70°56.74'	10°32.47'W	306	ROV	back to surface
10.12.03	09:59	102-1	70°56.75'	10°32.46'W	306	ROV	Information
10.12.03	10:28	102-1	70°56.77'	10°32.43'W	306	ROV	depressor on deck
10.12.03	10:33	102-1	70°56.77'	10°32.40'W	306	ROV	on deck
10.12.03	11:29	103-1	70°49.05'	10°39.79'W	378	Trap/F	surface
10.12.03	11:37	104-1	70°49.19'	10°40.21'W	373	Trap/F	surface
10.12.03	13:08	105-1	70°56.52'	10°31.90'W	295	MG	surface
10.12.03	13:28	105-1	70°56.50'	10°32.01'W	300	MG	at ground
10.12.03	13:39	105-1	70°56.48'	10°32.00'W	300	MG	on deck
10.12.03	14:39	106-1	70°56.63'	10°32.07'W	304	MG	surface
10.12.03	15:08	106-1	70°56.64'	10°32.03'W	302	MG	at ground
10.12.03	15:18	106-1	70°56.64'	10°32.03'W	302	MG	on deck
10.12.03	15:33	107-1	70°56.63'	10°32.02'W	303	GKG	surface
10.12.03	15:39	107-1	70°56.63'	10°32.01'W	304	GKG	at ground
10.12.03	15:46	107-1	70°56.63'	10°32.06'W	305	GKG	on deck
10.12.03	17:14	108-1	70°48.96'	10°39.22'W	393	LND	surface
10.12.03	18:50	109-1	70°47.89'	11°15.52'W	1342	AGT	surface
10.12.03	19:42	109-1	70°47.88'	11°21.56'W	1488	AGT	on ground
10.12.03	19:58	109-1	70°47.86'	11°23.72'W	1516	AGT	start hoisting
10.12.03	20:10	109-1	70°47.88'	11°24.13'W	1525	AGT	off ground
10.12.03	21:24	109-1	70°47.97'	11°25.83'W	1546	AGT	on deck
10.12.03	23:07	110-1	70°48.52'	10°43.73'W	472	CTD	surface
10.12.03	23:21	110-1	70°48.55'	10°43.80'W	469	CTD	at depth
10.12.03	23:35	110-1	70°48.48'	10°43.92'W	476	CTD	on deck
10.12.03	23:48	111-1	70°48.44'	10°43.90'W	480	MN_v	surface
11.12.03	00:05	111-1	70°48.42'	10°43.84'W	484	MN_v	at depth
11.12.03	00:23	111-1	70°48.52'	10°43.69'W	476	MN_v	on deck
11.12.03	00:43	112-1	70°48.47'	10°43.93'W	481	BO_v	surface
11.12.03	00:55	112-1	70°48.52'	10°43.97'W	472	BO_v	at depth
11.12.03	01:14	112-1	70°48.54'	10°44.07'W	471	BO_v	on deck
11.12.03	01:22	113-1	70°48.58'	10°44.04'W	464	BO_v	surface
11.12.03	01:36	113-1	70°48.58'	10°44.09'W	466	BO_v	at depth
11.12.03	01:54	113-1	70°48.61'	10°44.07'W	459	BO_v	on deck
11.12.03	02:02	114-1	70°48.62'	10°44.12'W	462	BO_v	surface
11.12.03	02:13	114-1	70°48.64'	10°44.14'W	459	BO_v	at depth
11.12.03	02:31	114-1	70°48.69'	10°44.02'W	459	BO_v	on deck
11.12.03	02:46	115-1	70°48.69'	10°44.07'W	456	ISP	into water
11.12.03	02:54	115-1	70°48.68'	10°44.02'W	458	ISP	pump at depth
11.12.03	04:04	115-1	70°48.39'	10°43.54'W	487	ISP	Information
11.12.03	04:11	115-1	70°48.37'	10°43.64'W	489	ISP	on deck
11.12.03	06:19	116-1	70°56.81'	10°32.56'W	320	MG	surface
11.12.03	06:41	116-1	70°56.81'	10°32.87'W	326	MG	at ground
11.12.03	06:45	116-1	70°56.81'	10°32.84'W	326	MG	at ground

Date	Time ship	Stat. PS65/	Lat. (°S)	Long.	Depth (m)	Gear	Operation
11.12.03	07:00	116-1	70°56.83'	10°32.72'W	325	MG	on deck
11.12.03	07:50	117-1	70°56.60'	10°31.75'W	289	MG	surface
11.12.03	08:14	117-1	70°56.62'	10°32.22'W	310	MG	at ground
11.12.03	08:26	117-1	70°56.66'	10°32.28'W	312	MG	on deck
11.12.03	08:53	118-1	70°56.61'	10°31.97'W	300	FTS	surface
11.12.03	09:04	118-1	70°56.61'	10°31.99'W	301	FTS	at ground
11.12.03	10:01	118-1	70°56.67'	10°32.19'W	311	FTS	off ground
11.12.03	10:10	118-1	70°56.68'	10°32.30'W	313	FTS	on deck
11.12.03	10:29	119-1	70°56.61'	10°31.89'W	298	GKG	surface
11.12.03	10:39	119-1	70°56.59'	10°31.91'W	300	GKG	at ground
11.12.03	10:50	119-1	70°56.58'	10°31.92'W	299	GKG	on deck
11.12.03	11:00	120-1	70°56.75'	10°32.44'W	316	FTS	surface
11.12.03	11:14	120-1	70°56.76'	10°32.38'W	315	FTS	at ground
11.12.03	11:39	120-1	70°56.72'	10°32.36'W	315	FTS	off ground
11.12.03	11:46	120-1	70°56.72'	10°32.38'W	332	FTS	on deck
11.12.03	14:36	121-1	70°50.07'	10°36.73'W	268	AGT	surface
11.12.03	14:45	121-1	70°50.08'	10°35.75'W	269	AGT	on ground
11.12.03	14:47	121-1	70°50.08'	10°35.54'W	268	AGT	start trawl
11.12.03	15:00	121-1	70°50.08'	10°34.76'W	274	AGT	stop Trawl
11.12.03	15:04	121-1	70°50.07'	10°34.74'W	274	AGT	off ground
11.12.03	15:16	121-1	70°50.05'	10°34.50'W	278	AGT	on deck
11.12.03	16:21	122-1	70°56.59'	10°32.03'W	303	GKG	surface
11.12.03	16:27	122-1	70°56.61'	10°32.00'W	302	GKG	at ground
11.12.03	16:33	122-1	70°56.61'	10°31.97'W	302	GKG	surface
11.12.03	16:39	122-1	70°56.59'	10°31.86'W	296	GKG	at ground
11.12.03	16:47	122-1	70°56.60'	10°31.92'W	299	GKG	on deck
11.12.03	18:03	123-1	70°56.39'	10°31.61'W	284	GKG	surface
11.12.03	18:10	123-1	70°56.41'	10°31.58'W	283	GKG	at ground
11.12.03	18:17	123-1	70°56.43'	10°31.57'W	283	GKG	on deck
11.12.03	19:34	124-1	70°56.37'	10°31.78'W	297	MG	surface
11.12.03	19:45	124-1	70°56.40'	10°31.74'W	289	MG	at ground
11.12.03	19:54	124-1	70°56.41'	10°31.78'W	290	MG	on deck
11.12.03	20:18	125-1	70°56.41'	10°31.50'W	280	MG	surface
11.12.03	20:27	125-1	70°56.40'	10°31.56'W	284	MG	at ground
11.12.03	20:37	125-1	70°56.39'	10°31.66'W	286	MG	on deck
11.12.03	21:39	126-1	70°48.61'	10°44.74'W	460	CTD	surface
11.12.03	21:49	126-1	70°48.62'	10°44.88'W	464	CTD	at depth
11.12.03	22:05	126-1	70°48.65'	10°44.84'W	462	CTD	on deck
11.12.03	22:16	127-1	70°48.65'	10°44.87'W	461	MN_v	surface
11.12.03	22:35	127-1	70°48.67'	10°45.00'W	466	MN_v	at depth
11.12.03	22:53	127-1	70°48.70'	10°45.00'W	460	MN_v	on deck
11.12.03	23:13	128-1	70°48.68'	10°45.37'W	468	BO_v	surface
11.12.03	23:25	128-1	70°48.71'	10°45.51'W	472	BO_v	at depth
11.12.03	23:43	128-1	70°48.76'	10°45.51'W	468	BO_v	on deck
11.12.03	23:53	129-1	70°48.79'	10°45.39'W	464	BO_v	surface
12.12.03	00:05	129-1	70°48.81'	10°45.37'W	466	BO_v	at depth
12.12.03	00:20	129-1	70°48.82'	10°45.41'W	464	BO_v	on deck
12.12.03	00:29	130-1	70°48.83'	10°45.23'W	456	BO_v	surface
12.12.03	00:41	130-1	70°48.83'	10°45.18'W	454	BO_v	at depth
12.12.03	00:57	130-1	70°48.85'	10°45.08'W	452	BO_v	on deck
12.12.03	01:17	131-1	70°48.87'	10°45.04'W	449	ISP	into water
12.12.03	01:25	131-1	70°48.87'	10°45.10'W	450	ISP	pump at depth
12.12.03	02:26	131-1	70°48.88'	10°44.38'W	446	ISP	Information
12.12.03	02:32	131-1	70°48.87'	10°44.37'W	446	ISP	on deck
12.12.03	06:53	132-1	70°58.29'	10°36.58'W	438	GSN	cod end surface
12.12.03	07:08	132-1	70°57.60'	10°34.64'W	362	GSN	boards to surface
12.12.03	07:28	132-1	70°56.42'	10°31.61'W	284	GSN	on ground
12.12.03	07:28	132-1	70°56.42'	10°31.61'W	284	GSN	start trawling
12.12.03	07:51	132-1	70°55.86'	10°30.15'W	244	GSN	stop trawling
12.12.03	07:57	132-1	70°55.78'	10°29.96'W	238	GSN	hook
12.12.03	09:08	132-1	70°55.59'	10°28.78'W	0	GSN	boards on deck

Date	Time ship	Stat. PS65/	Lat. (°S)	Long.	Depth (m)	Gear	Operation
12.12.03	12:31	132-1	70°55.74'	10°31.60'W	551	GSN	cod end on deck
12.12.03	14:39	133-1	70°51.12'	10°40.13'W	295	RD	surface
12.12.03	15:01	133-1	70°51.25'	10°40.37'W	290	RD	start dredging
12.12.03	15:11	133-1	70°51.33'	10°40.54'W	292	RD	stop dredging
12.12.03	15:35	133-1	70°51.41'	10°40.61'W	284	RD	on deck
12.12.03	16:06	134-1	70°48.86'	10°44.69'W	445	CTD	surface
12.12.03	16:18	134-1	70°48.85'	10°44.73'W	446	CTD	at depth
12.12.03	16:30	134-1	70°48.84'	10°44.76'W	446	CTD	on deck
12.12.03	16:50	135-1	70°48.59'	10°43.50'W	469	CTD	surface
12.12.03	17:01	135-1	70°48.58'	10°43.42'W	470	CTD	at depth
12.12.03	17:17	135-1	70°48.65'	10°43.48'W	460	CTD	on deck
12.12.03	17:58	136-1	70°48.74'	10°43.63'W	452	MN_v	surface
12.12.03	18:16	136-1	70°48.73'	10°43.67'W	454	MN_v	at depth
12.12.03	18:34	136-1	70°48.68'	10°43.64'W	460	MN_v	on deck
12.12.03	18:48	137-1	70°48.65'	10°43.61'W	461	BO_v	surface
12.12.03	19:01	137-1	70°48.62'	10°43.60'W	462	BO_v	at depth
12.12.03	19:21	137-1	70°48.62'	10°43.74'W	462	BO_v	on deck
12.12.03	19:28	138-1	70°48.62'	10°43.79'W	464	BO_v	surface
12.12.03	19:41	138-1	70°48.63'	10°43.93'W	464	BO_v	at depth
12.12.03	19:57	138-1	70°48.65'	10°44.06'W	458	BO_v	on deck
12.12.03	20:12	139-1	70°48.58'	10°44.20'W	460	ISP	into water
12.12.03	20:17	139-1	70°48.53'	10°44.25'W	466	ISP	pump at depth
12.12.03	21:31	139-1	70°48.39'	10°44.15'W	486	ISP	on deck
12.12.03	21:42	140-1	70°48.37'	10°44.14'W	487	RD	surface
12.12.03	21:59	140-1	70°48.35'	10°44.19'W	487	RD	start dredging
12.12.03	22:09	140-1	70°48.34'	10°43.94'W	492	RD	stop dredging
12.12.03	22:10	140-1	70°48.34'	10°43.93'W	492	RD	hoisting
12.12.03	22:39	140-1	70°48.30'	10°43.77'W	488	RD	on deck
12.12.03	22:56	141-1	70°48.27'	10°44.11'W	494	MN_v	surface
12.12.03	23:12	141-1	70°48.28'	10°44.16'W	490	MN_v	at depth
12.12.03	23:29	141-1	70°48.28'	10°44.20'W	488	MN_v	on deck
12.12.03	23:43	142-1	70°48.33'	10°44.10'W	487	BO_v	surface
12.12.03	23:55	142-1	70°48.35'	10°44.31'W	485	BO_v	at depth
13.12.03	00:16	142-1	70°48.27'	10°44.49'W	489	BO_v	on deck
13.12.03	00:26	143-1	70°48.22'	10°44.62'W	491	BO_v	surface
13.12.03	00:42	143-1	70°48.18'	10°44.72'W	497	BO_v	at depth
13.12.03	01:01	143-1	70°48.18'	10°44.78'W	505	BO_v	on deck
13.12.03	06:11	144-1	70°57.07'	10°49.56'W	398	EBS	surface
13.12.03	06:25	144-1	70°57.02'	10°48.70'W	402	EBS	on ground
13.12.03	06:31	144-1	70°57.02'	10°48.43'W	401	EBS	start trawling
13.12.03	06:41	144-1	70°56.98'	10°48.04'W	407	EBS	end trawling
13.12.03	06:48	144-1	70°56.97'	10°48.06'W	406	EBS	off ground
13.12.03	07:00	144-1	70°56.95'	10°48.04'W	405	EBS	on deck
13.12.03	07:23	145-1	70°57.02'	10°49.04'W	397	EBS	surface
13.12.03	07:40	145-1	70°57.01'	10°48.64'W	406	EBS	on ground
13.12.03	07:46	145-1	70°56.99'	10°48.26'W	402	EBS	start trawling
13.12.03	07:56	145-1	70°56.97'	10°47.71'W	405	EBS	end trawling
13.12.03	08:04	145-1	70°56.98'	10°47.72'W	405	EBS	off ground
13.12.03	08:20	145-1	70°57.00'	10°47.91'W	404	EBS	on deck
13.12.03	08:43	146-1	70°56.94'	10°47.96'W	401	RD	surface
13.12.03	09:08	146-1	70°56.96'	10°47.74'W	404	RD	start dredging
13.12.03	09:18	146-1	70°56.94'	10°47.62'W	403	RD	stop dredging
13.12.03	09:19	146-1	70°56.94'	10°47.62'W	403	RD	hoisting
13.12.03	09:44	146-1	70°56.90'	10°47.75'W	418	RD	on deck
13.12.03	10:30	147-1	70°56.79'	10°32.36'W	317	FTS	surface
13.12.03	10:38	147-1	70°56.81'	10°32.44'W	0	FTS	at ground
13.12.03	11:17	147-1	70°56.71'	10°32.12'W	304	FTS	off ground
13.12.03	11:26	147-1	70°56.71'	10°32.07'W	303	FTS	on deck
13.12.03	14:06	148-1	70°58.49'	10°37.00'W	452	GSN	cod end surface
13.12.03	14:18	148-1	70°58.03'	10°35.51'W	398	GSN	boards to surface
13.12.03	14:41	148-1	70°56.67'	10°32.05'W	302	GSN	on ground

Date	Time ship	Stat. PS65/	Lat. (°S)	Long.	Depth (m)	Gear	Operation
13.12.03	14:43	148-1	70°56.56'	10°31.75'W	290	GSN	start trawling
13.12.03	15:00	148-1	70°56.12'	10°30.61'W	256	GSN	stop trawling
13.12.03	15:00	148-1	70°56.12'	10°30.61'W	256	GSN	off ground
13.12.03	15:14	148-1	70°55.86'	10°29.93'W	233	GSN	boards on deck
13.12.03	17:15	148-1	70°54.69'	10°30.84'W	238	GSN	cod end on deck
13.12.03	20:05	149-1	70°48.48'	10°44.33'W	478	CTD	surface
13.12.03	20:18	149-1	70°48.50'	10°44.35'W	476	CTD	at depth
13.12.03	20:32	149-1	70°48.50'	10°44.39'W	476	CTD	on deck
13.12.03	20:49	150-1	70°48.49'	10°44.49'W	483	ISP	into water
13.12.03	21:03	150-1	70°48.48'	10°44.60'W	480	ISP	pump at depth
13.12.03	22:08	150-1	70°48.30'	10°45.07'W	496	ISP	on deck
13.12.03	22:24	151-1	70°48.33'	10°46.97'W	503	MN_v	surface
13.12.03	22:41	151-1	70°48.34'	10°47.20'W	486	MN_v	at depth
13.12.03	23:00	151-1	70°48.37'	10°47.44'W	488	MN_v	on deck
13.12.03	23:15	152-1	70°48.64'	10°48.23'W	481	BO_v	surface
13.12.03	23:25	152-1	70°48.65'	10°48.31'W	481	BO_v	at depth
13.12.03	23:46	152-1	70°48.69'	10°48.60'W	479	BO_v	on deck
13.12.03	23:52	153-1	70°48.73'	10°48.79'W	474	BO_v	surface
14.12.03	00:03	153-1	70°48.74'	10°48.85'W	474	BO_v	at depth
14.12.03	00:24	153-1	70°48.76'	10°48.94'W	479	BO_v	on deck
14.12.03	07:29	108-1	70°49.05'	10°39.41'W	394	LND_rec	Information
14.12.03	07:48	108-1	70°49.05'	10°39.91'W	394	LND_rec	Information
14.12.03	07:56	108-1	70°48.98'	10°39.76'W	395	LND_rec	Information
14.12.03	07:58	108-1	70°48.99'	10°39.76'W	395	LND_rec	released
14.12.03	08:03	108-1	70°49.00'	10°39.84'W	395	LND_rec	Information
14.12.03	08:17	108-1	70°49.09'	10°40.25'W	0	LND_rec	Information
14.12.03	08:51	108-1	70°49.29'	10°39.76'W	0	LND_rec	on Deck
14.12.03	09:08	103-1	70°49.17'	10°39.93'W	387	Trap/F_rec	hyphone to water
14.12.03	09:09	103-1	70°49.17'	10°39.96'W	387	Trap/F_rec	released
14.12.03	09:12	103-1	70°49.17'	10°40.00'W	387	Trap/F_rec	hyphone on deck
14.12.03	09:25	103-1	70°49.35'	10°40.15'W	376	Trap/F_rec	Information
14.12.03	09:35	103-1	70°49.26'	10°39.84'W	378	Trap/F_rec	on deck
14.12.03	11:25	154-1	70°48.96'	10°39.16'W	392	GWS	surface
14.12.03	11:44	154-1	70°49.05'	10°39.33'W	387	GWS	on deck
14.12.03	13:40	155-1	70°56.66'	10°31.51'W	280	FTS	surface
14.12.03	13:48	155-1	70°56.67'	10°31.49'W	278	FTS	at ground
14.12.03	14:25	155-1	70°56.63'	10°31.67'W	284	FTS	off ground
14.12.03	14:32	155-1	70°56.63'	10°31.73'W	287	FTS	on deck
14.12.03	18:27	104-1	70°48.86'	10°40.77'W	418	Trap/F_rec	hyphone to water
14.12.03	18:29	104-1	70°48.86'	10°40.81'W	420	Trap/F_rec	released
14.12.03	18:34	104-1	70°48.84'	10°40.85'W	422	Trap/F_rec	releaser on Deck
14.12.03	18:37	104-1	70°48.82'	10°40.79'W	424	Trap/F_rec	Information
14.12.03	18:55	104-1	70°49.10'	10°40.16'W	389	Trap/F_rec	on deck
14.12.03	19:42	156-1	70°48.77'	10°45.20'W	462	CTD	surface
14.12.03	19:56	156-1	70°48.72'	10°45.30'W	468	CTD	at depth
14.12.03	20:11	156-1	70°48.75'	10°45.41'W	465	CTD	on deck
14.12.03	20:30	157-1	70°48.69'	10°45.55'W	472	ISP	into water
14.12.03	20:34	157-1	70°48.66'	10°45.59'W	479	ISP	pump at depth
14.12.03	21:43	157-1	70°48.74'	10°45.74'W	471	ISP	Information
14.12.03	21:48	157-1	70°48.74'	10°45.79'W	472	ISP	on deck
14.12.03	22:13	158-1	70°49.01'	10°45.11'W	445	MN_v	surface
14.12.03	22:28	158-1	70°49.02'	10°45.12'W	446	MN_v	at depth
14.12.03	22:29	158-1	70°49.02'	10°45.14'W	444	MN_v	hoisting
14.12.03	22:46	158-1	70°49.02'	10°45.31'W	442	MN_v	on deck
14.12.03	23:06	159-1	70°49.01'	10°45.66'W	447	BO_v	surface
14.12.03	23:18	159-1	70°48.98'	10°45.75'W	460	BO_v	at depth
14.12.03	23:38	159-1	70°48.97'	10°45.73'W	452	BO_v	on deck
14.12.03	23:52	160-1	70°48.91'	10°45.64'W	458	BO_v	surface
15.12.03	00:04	160-1	70°48.89'	10°45.80'W	458	BO_v	at depth
15.12.03	00:21	160-1	70°48.94'	10°46.09'W	453	BO_v	on deck
15.12.03	06:26	161-1	70°56.69'	10°32.33'W	314	AGT	surface

Date	Time ship	Stat. PS65/	Lat. (°S)	Long.	Depth (m)	Gear	Operation
15.12.03	06:40	161-1	70°56.43'	10°31.47'W	280	AGT	on ground
15.12.03	06:51	161-1	70°56.34'	10°31.09'W	270	AGT	start hoisting
15.12.03	06:59	161-1	70°56.33'	10°31.03'W	266	AGT	off ground
15.12.03	07:11	161-1	70°56.24'	10°31.22'W	270	AGT	on deck
15.12.03	08:16	162-1	70°56.52'	10°29.58'W	232	EF	start
15.12.03	08:38	162-1	70°56.51'	10°29.58'W	232	EF	end
15.12.03	09:09	163-1	70°55.98'	10°31.50'W	276	RD	surface
15.12.03	09:32	163-1	70°56.15'	10°31.44'W	278	RD	start dredging
15.12.03	09:42	163-1	70°56.14'	10°31.25'W	270	RD	stop dredging
15.12.03	09:58	163-1	70°56.17'	10°31.20'W	268	RD	on deck
15.12.03	11:51	164-1	70°58.46'	10°37.63'W	445	GSN	cod end surface
15.12.03	12:05	164-1	70°57.98'	10°36.01'W	409	GSN	boards to surface
15.12.03	12:28	164-1	70°56.65'	10°32.12'W	308	GSN	on ground
15.12.03	12:28	164-1	70°56.65'	10°32.12'W	308	GSN	start trawling
15.12.03	12:48	164-1	70°56.07'	10°30.80'W	256	GSN	stop trawling
15.12.03	12:48	164-1	70°56.07'	10°30.80'W	256	GSN	off ground
15.12.03	12:57	164-1	70°55.91'	10°30.49'W	253	GSN	boards on deck
15.12.03	13:44	164-1	70°55.17'	10°30.14'W	231	GSN	cod end on deck
15.12.03	15:20	165-1	70°56.52'	10°31.19'W	276	FTS	surface
15.12.03	15:27	165-1	70°56.53'	10°31.09'W	275	FTS	at ground
15.12.03	15:54	165-1	70°56.45'	10°30.97'W	270	FTS	off ground
15.12.03	16:02	165-1	70°56.40'	10°30.94'W	268	FTS	on deck
15.12.03	16:35	166-1	70°58.46'	10°36.61'W	444	GSN	cod end surface
15.12.03	16:43	166-1	70°58.04'	10°35.64'W	401	GSN	boards to surface
15.12.03	17:00	166-1	70°56.90'	10°32.78'W	328	GSN	on ground
15.12.03	17:01	166-1	70°56.83'	10°32.61'W	338	GSN	start trawling
15.12.03	17:23	166-1	70°56.00'	10°30.53'W	253	GSN	off ground
15.12.03	17:23	166-1	70°56.00'	10°30.53'W	253	GSN	stop trawling
15.12.03	17:33	166-1	70°55.69'	10°29.76'W	234	GSN	boards on deck
15.12.03	17:48	166-1	70°55.01'	10°29.38'W	230	GSN	cod end on deck
15.12.03	18:47	167-1	70°48.97'	10°39.17'W	393	LND	surface
15.12.03	19:36	168-1	70°48.47'	10°44.03'W	478	CTD	surface
15.12.03	19:46	168-1	70°48.49'	10°44.10'W	480	CTD	at depth
15.12.03	20:00	168-1	70°48.51'	10°43.94'W	474	CTD	on deck
15.12.03	20:16	169-1	70°48.54'	10°44.10'W	471	ISP	into water
15.12.03	20:23	169-1	70°48.54'	10°44.07'W	472	ISP	pump at depth
15.12.03	21:37	169-1	70°48.42'	10°43.70'W	487	ISP	on deck
15.12.03	22:00	170-1	70°48.35'	10°43.11'W	480	MN_v	surface
15.12.03	22:17	170-1	70°48.25'	10°42.91'W	486	MN_v	at depth
15.12.03	22:38	170-1	70°48.20'	10°42.84'W	490	MN_v	on deck
15.12.03	23:00	171-1	70°48.02'	10°42.45'W	21	BO_v	surface
15.12.03	23:12	171-1	70°47.97'	10°42.53'W	0	BO_v	at depth
15.12.03	23:31	171-1	70°47.88'	10°42.59'W	20	BO_v	on deck
15.12.03	23:40	172-1	70°47.82'	10°42.63'W	20	BO_v	surface
15.12.03	23:54	172-1	70°47.75'	10°42.74'W	0	BO_v	at depth
16.12.03	00:10	172-1	70°47.66'	10°42.93'W	20	BO_v	on deck
16.12.03	06:28	173-1	70°56.88'	10°32.74'W	327	AGT	surface
16.12.03	06:38	173-1	70°56.82'	10°31.76'W	296	AGT	on ground
16.12.03	06:48	173-1	70°56.77'	10°31.16'W	279	AGT	start hoisting
16.12.03	06:54	173-1	70°56.77'	10°31.17'W	279	AGT	off ground
16.12.03	07:01	173-1	70°56.75'	10°31.16'W	279	AGT	on deck
16.12.03	09:15	174-1	70°58.14'	10°35.91'W	413	GSN	cod end surface
16.12.03	09:28	174-1	70°57.55'	10°34.34'W	359	GSN	boards to surface
16.12.03	09:44	174-1	70°56.57'	10°31.86'W	296	GSN	on ground
16.12.03	10:03	174-1	70°55.94'	10°30.54'W	253	GSN	off ground
16.12.03	10:12	174-1	70°55.78'	10°30.05'W	240	GSN	boards on deck
16.12.03	10:27	174-1	70°55.65'	10°30.51'W	248	GSN	boards to surface
16.12.03	10:45	174-1	70°56.82'	10°32.57'W	321	GSN	on ground
16.12.03	10:59	174-1	70°57.33'	10°33.86'W	352	GSN	off ground
16.12.03	11:09	174-1	70°57.51'	10°34.44'W	359	GSN	boards on deck
16.12.03	11:15	174-1	70°57.68'	10°34.89'W	365	GSN	cod end on deck

Date	Time ship	Stat. PS65/	Lat. (°S)	Long.	Depth (m)	Gear	Operation
16.12.03	13:09	175-1	70°55.33'	10°28.89'W	216	GSN	cod end surface
16.12.03	13:17	175-1	70°55.72'	10°29.81'W	234	GSN	boards to surface
16.12.03	13:31	175-1	70°56.52'	10°31.78'W	289	GSN	on ground
16.12.03	13:31	175-1	70°56.52'	10°31.78'W	289	GSN	start trawling
16.12.03	13:49	175-1	70°57.11'	10°33.40'W	337	GSN	off ground
16.12.03	13:49	175-1	70°57.11'	10°33.40'W	337	GSN	stop trawling
16.12.03	13:55	175-1	70°57.21'	10°33.75'W	344	GSN	boards on deck
16.12.03	14:15	175-1	70°58.03'	10°35.54'W	400	GSN	boards to surface
16.12.03	14:30	175-1	70°57.11'	10°33.32'W	337	GSN	start trawling
16.12.03	14:30	175-1	70°57.11'	10°33.32'W	337	GSN	on ground
16.12.03	14:56	175-1	70°56.12'	10°30.88'W	261	GSN	stop trawling
16.12.03	15:02	175-1	70°55.99'	10°30.59'W	254	GSN	boards on deck
16.12.03	15:19	175-1	70°55.39'	10°29.35'W	227	GSN	boards to surface
16.12.03	15:33	175-1	70°56.36'	10°31.31'W	276	GSN	on ground
16.12.03	15:33	175-1	70°56.36'	10°31.31'W	276	GSN	start trawling
16.12.03	15:52	175-1	70°57.06'	10°33.12'W	332	GSN	off ground
16.12.03	15:52	175-1	70°57.06'	10°33.12'W	332	GSN	stop trawling
16.12.03	15:58	175-1	70°57.16'	10°33.39'W	338	GSN	boards on deck
16.12.03	16:16	175-1	70°57.75'	10°34.36'W	365	GSN	boards to surface
16.12.03	16:29	175-1	70°56.85'	10°32.43'W	319	GSN	on ground
16.12.03	16:47	175-1	70°56.12'	10°31.01'W	261	GSN	off ground
16.12.03	16:54	175-1	70°55.94'	10°30.75'W	255	GSN	boards on deck
16.12.03	17:08	175-1	70°55.81'	10°29.33'W	226	GSN	boards to surface
16.12.03	17:15	175-1	70°56.22'	10°30.73'W	262	GSN	on ground
16.12.03	17:35	175-1	70°56.93'	10°33.24'W	334	GSN	off ground
16.12.03	17:43	175-1	70°57.01'	10°33.68'W	336	GSN	boards on deck
16.12.03	17:55	175-1	70°57.26'	10°34.62'W	354	GSN	cod end on deck
16.12.03	19:12	176-1	70°48.48'	10°43.64'W	477	ISP	into water
16.12.03	19:30	176-1	70°48.48'	10°43.72'W	480	ISP	pump at depth
16.12.03	20:43	176-1	70°48.47'	10°43.38'W	478	ISP	on deck
16.12.03	20:52	177-1	70°48.45'	10°43.33'W	481	CTD	surface
16.12.03	21:05	177-1	70°48.46'	10°43.34'W	481	CTD	at depth
16.12.03	21:21	177-1	70°48.45'	10°43.37'W	479	CTD	on deck
16.12.03	21:50	178-1	70°48.48'	10°43.30'W	477	CTD	surface
16.12.03	22:02	178-1	70°48.50'	10°43.29'W	473	CTD	at depth
16.12.03	22:13	178-1	70°48.51'	10°43.25'W	480	CTD	on deck
16.12.03	22:31	179-1	70°48.53'	10°43.36'W	473	MN_v	surface
16.12.03	22:48	179-1	70°48.55'	10°43.42'W	476	MN_v	at depth
16.12.03	23:05	179-1	70°48.51'	10°43.37'W	474	MN_v	on deck
16.12.03	23:27	180-1	70°48.61'	10°43.38'W	467	BO_v	surface
16.12.03	23:41	180-1	70°48.61'	10°43.35'W	468	BO_v	at depth
17.12.03	00:01	180-1	70°48.61'	10°43.31'W	465	BO_v	on deck
17.12.03	00:13	181-1	70°48.65'	10°43.45'W	461	BO_v	surface
17.12.03	00:24	181-1	70°48.67'	10°43.40'W	461	BO_v	at depth
17.12.03	00:46	181-1	70°48.69'	10°43.26'W	461	BO_v	on deck
17.12.03	00:53	182-1	70°48.72'	10°43.03'W	459	ISP	into water
17.12.03	01:14	182-1	70°48.74'	10°42.92'W	461	ISP	pump at depth
17.12.03	02:22	182-1	70°48.73'	10°42.53'W	448	ISP	Information
17.12.03	02:32	182-1	70°48.74'	10°42.24'W	450	ISP	on deck
17.12.03	02:34	182-1	70°48.73'	10°42.15'W	449	ISP	Information
17.12.03	06:45	183-1	70°56.52'	10°32.09'W	302	MG	surface
17.12.03	07:03	183-1	70°56.54'	10°31.81'W	290	MG	at ground
17.12.03	07:14	183-1	70°56.53'	10°31.71'W	288	MG	on deck
17.12.03	08:55	184-1	70°56.52'	10°32.12'W	303	ROV	surface
17.12.03	09:01	184-1	70°56.52'	10°32.07'W	301	ROV	depressor to water
17.12.03	09:59	184-1	70°56.53'	10°32.08'W	302	ROV	at depth
17.12.03	13:07	184-1	70°56.00'	10°29.44'W	228	ROV	back to surface
17.12.03	13:37	184-1	70°56.03'	10°29.32'W	235	ROV	depressor on deck
17.12.03	13:44	184-1	70°56.05'	10°29.31'W	228	ROV	on deck
17.12.03	14:27	185-1	70°56.61'	10°31.84'W	293	MG	surface
17.12.03	14:53	185-1	70°56.61'	10°31.65'W	293	MG	at ground

Date	Time ship	Stat. PS65/	Lat. (°S)	Long.	Depth (m)	Gear	Operation
17.12.03	15:02	185-1	70°56.60'	10°31.67'W	284	MG	on deck
17.12.03	15:30	186-1	70°56.50'	10°31.94'W	297	FTS	surface
17.12.03	15:37	186-1	70°56.51'	10°31.89'W	293	FTS	at ground
17.12.03	16:13	186-1	70°56.54'	10°31.62'W	282	FTS	on deck
17.12.03	17:01	187-1	70°56.62'	10°32.17'W	308	MG	surface
17.12.03	17:31	187-1	70°56.60'	10°32.02'W	301	MG	at ground
17.12.03	17:39	187-1	70°56.61'	10°32.13'W	307	MG	on deck
17.12.03	17:50	188-1	70°56.62'	10°32.18'W	308	FTS	surface
17.12.03	18:00	188-1	70°56.61'	10°32.09'W	306	FTS	at ground
17.12.03	18:23	188-1	70°56.60'	10°31.78'W	290	FTS	off ground
17.12.03	18:30	188-1	70°56.60'	10°31.76'W	289	FTS	on deck
17.12.03	18:43	189-1	70°56.28'	10°30.55'W	254	FTS	surface
17.12.03	19:15	189-1	70°56.28'	10°30.20'W	248	FTS	off ground
17.12.03	19:20	189-1	70°56.28'	10°30.14'W	247	FTS	on deck
17.12.03	20:34	190-1	70°48.58'	10°43.30'W	467	CTD	surface
17.12.03	20:49	190-1	70°48.59'	10°43.30'W	466	CTD	at depth
17.12.03	21:03	190-1	70°48.58'	10°43.20'W	464	CTD	on deck
17.12.03	21:25	191-1	70°48.61'	10°43.24'W	464	ISP	into water
17.12.03	21:30	191-1	70°48.61'	10°43.25'W	464	ISP	pump at depth
17.12.03	22:43	191-1	70°48.42'	10°42.40'W	467	ISP	on deck
17.12.03	22:54	192-1	70°48.51'	10°43.04'W	472	MN_v	surface
17.12.03	23:11	192-1	70°48.47'	10°43.01'W	472	MN_v	at depth
17.12.03	23:29	192-1	70°48.43'	10°43.04'W	473	MN_v	on deck
17.12.03	23:53	193-1	70°48.42'	10°43.00'W	473	BO_v	surface
18.12.03	00:05	193-1	70°48.40'	10°42.93'W	474	BO_v	at depth
18.12.03	00:25	193-1	70°48.36'	10°42.84'W	479	BO_v	on deck
18.12.03	00:54	194-1	70°48.36'	10°42.70'W	478	ISP	into water
18.12.03	01:02	194-1	70°48.35'	10°42.60'W	476	ISP	pump at depth
18.12.03	02:11	194-1	70°48.32'	10°42.59'W	482	ISP	Information
18.12.03	02:16	194-1	70°48.31'	10°42.61'W	483	ISP	on deck
18.12.03	06:03	195-1	70°56.60'	10°32.09'W	306	Trap/F	surface
18.12.03	06:11	196-1	70°56.58'	10°31.90'W	295	Trap/F	surface
18.12.03	06:26	197-1	70°56.32'	10°30.50'W	254	MG	surface
18.12.03	06:43	197-1	70°56.29'	10°30.32'W	250	MG	at ground
18.12.03	06:52	197-1	70°56.30'	10°30.31'W	250	MG	on deck
18.12.03	08:07	198-1	70°56.79'	10°32.58'W	319	FTS	surface
18.12.03	08:16	198-1	70°56.80'	10°32.64'W	320	FTS	at ground
18.12.03	08:43	198-1	70°56.76'	10°32.33'W	313	FTS	off ground
18.12.03	08:49	198-1	70°56.77'	10°32.37'W	316	FTS	on deck
18.12.03	08:59	199-1	70°56.74'	10°32.28'W	311	MG	surface
18.12.03	09:15	199-1	70°56.74'	10°32.25'W	311	MG	at ground
18.12.03	09:25	199-1	70°56.73'	10°32.21'W	318	MG	on deck
18.12.03	09:50	200-1	70°56.28'	10°33.21'W	315	FTS	surface
18.12.03	09:58	200-1	70°56.27'	10°33.21'W	315	FTS	at ground
18.12.03	10:26	200-1	70°56.25'	10°32.95'W	312	FTS	off ground
18.12.03	10:34	200-1	70°56.24'	10°32.94'W	312	FTS	on deck
18.12.03	10:43	201-1	70°56.26'	10°33.06'W	314	MG	surface
18.12.03	11:06	201-1	70°56.26'	10°33.00'W	313	MG	at ground
18.12.03	11:14	201-1	70°56.25'	10°33.01'W	321	MG	on deck
18.12.03	12:13	202-1	70°56.53'	10°31.70'W	287	MG	surface
18.12.03	12:35	202-1	70°56.54'	10°31.84'W	292	MG	at ground
18.12.03	12:43	202-1	70°56.54'	10°31.90'W	295	MG	on deck
18.12.03	13:03	203-1	70°56.43'	10°31.60'W	284	GKG	surface
18.12.03	13:10	203-1	70°56.44'	10°31.60'W	284	GKG	at ground
18.12.03	13:18	203-1	70°56.43'	10°31.49'W	279	GKG	on deck
18.12.03	14:40	204-1	70°48.41'	10°43.00'W	478	CTD	surface
18.12.03	14:51	204-1	70°48.41'	10°43.09'W	481	CTD	at depth
18.12.03	15:10	204-1	70°48.46'	10°43.16'W	474	CTD	on deck
18.12.03	15:38	205-1	70°48.81'	10°37.74'W	372	GWS	surface
18.12.03	15:52	205-1	70°48.77'	10°37.70'W	371	GWS	on deck
18.12.03	16:15	167-1	70°48.95'	10°39.52'W	394	LND_rec	Information

Date	Time ship	Stat. PS65/	Lat. (°S)	Long.	Depth (m)	Gear	Operation
18.12.03	16:17	167-1	70°48.95'	10°39.53'W	394	LND_rec	released
18.12.03	16:26	167-1	70°48.93'	10°39.55'W	395	LND_rec	Information
18.12.03	16:39	167-1	70°48.81'	10°39.56'W	408	LND_rec	Information
18.12.03	16:57	167-1	70°49.01'	10°39.27'W	390	LND_rec	on deck
18.12.03	17:44	206-1	70°48.45'	10°43.40'W	480	ISP	into water
18.12.03	17:52	206-1	70°48.47'	10°43.47'W	478	ISP	Information
18.12.03	17:56	206-1	70°48.49'	10°43.50'W	482	ISP	into water
18.12.03	19:15	206-1	70°48.56'	10°43.48'W	476	ISP	Information
18.12.03	19:20	206-1	70°48.58'	10°43.55'W	473	ISP	on deck
18.12.03	19:31	207-1	70°48.59'	10°43.52'W	472	MN_v	surface
18.12.03	19:47	207-1	70°48.65'	10°43.56'W	461	MN_v	at depth
18.12.03	20:04	207-1	70°48.63'	10°43.30'W	466	MN_v	on deck
18.12.03	20:29	208-1	70°48.65'	10°43.31'W	461	BO_v	surface
18.12.03	20:41	208-1	70°48.68'	10°43.31'W	461	BO_v	at depth
18.12.03	21:04	208-1	70°48.69'	10°43.14'W	460	BO_v	on deck
18.12.03	21:12	209-1	70°48.72'	10°43.23'W	458	BO_v	surface
18.12.03	21:24	209-1	70°48.73'	10°43.15'W	459	BO_v	at depth
18.12.03	21:43	209-1	70°48.73'	10°43.09'W	458	BO_v	on deck
18.12.03	21:51	210-1	70°48.74'	10°43.15'W	457	BO_v	surface
18.12.03	22:03	210-1	70°48.77'	10°43.20'W	454	BO_v	at depth
18.12.03	22:22	210-1	70°48.75'	10°43.20'W	454	BO_v	on deck
18.12.03	22:32	211-1	70°48.75'	10°43.20'W	454	BO_v	surface
18.12.03	22:43	211-1	70°48.74'	10°43.19'W	455	BO_v	at depth
18.12.03	23:03	211-1	70°48.75'	10°43.13'W	458	BO_v	on deck
19.12.03	08:18	212-1	70°22.66'	09°19.76'W	492	GWS	surface
19.12.03	08:46	212-1	70°22.64'	09°19.78'W	492	GWS	on deck
19.12.03	09:33	213-1	70°25.28'	09°16.09'W	371	GWS	surface
19.12.03	09:52	213-1	70°25.29'	09°16.08'W	731	GWS	on deck
19.12.03	11:15	214-1	70°28.46'	09°11.36'W	373	GWS	surface
19.12.03	11:35	214-1	70°28.51'	09°11.31'W	370	GWS	on deck
19.12.03	12:44	215-1	70°31.68'	09°08.37'W	426	GWS	surface
19.12.03	13:06	215-1	70°31.70'	09°08.50'W	425	GWS	on deck
19.12.03	13:42	216-1	70°34.31'	09°02.63'W	480	GWS	surface
19.12.03	14:03	216-1	70°34.30'	09°02.66'W	480	GWS	on deck
19.12.03	14:25	217-1	70°34.19'	09°02.46'W	478	CTD	surface
19.12.03	14:36	217-1	70°34.20'	09°02.38'W	478	CTD	at depth
19.12.03	14:49	217-1	70°34.23'	09°02.33'W	480	CTD	on deck
19.12.03	15:23	218-1	70°34.38'	09°02.18'W	481	CTD	surface
19.12.03	15:35	218-1	70°34.38'	09°02.18'W	482	CTD	at depth
19.12.03	15:49	218-1	70°34.44'	09°02.27'W	486	CTD	on deck
19.12.03	16:05	219-1	70°34.46'	09°02.27'W	484	ISP	into water
19.12.03	16:07	219-1	70°34.45'	09°02.26'W	484	ISP	Information
19.12.03	16:11	219-1	70°34.46'	09°02.26'W	484	ISP	pump at depth
19.12.03	17:18	219-1	70°34.58'	09°02.78'W	485	ISP	Information
19.12.03	17:23	219-1	70°34.58'	09°02.80'W	486	ISP	on deck
19.12.03	19:09	220-1	70°32.11'	09°10.24'W	430	CTD	surface
19.12.03	19:20	220-1	70°32.11'	09°10.19'W	428	CTD	at depth
19.12.03	19:31	220-1	70°32.13'	09°10.18'W	428	CTD	on deck
19.12.03	20:47	221-1	70°28.86'	09°11.81'W	376	CTD	surface
19.12.03	20:57	221-1	70°28.88'	09°11.81'W	376	CTD	at depth
19.12.03	21:07	221-1	70°28.89'	09°11.82'W	374	CTD	on deck
19.12.03	21:35	222-1	70°28.94'	09°11.83'W	376	CTD	surface
19.12.03	21:45	222-1	70°28.94'	09°11.85'W	377	CTD	at depth
19.12.03	21:57	222-1	70°28.93'	09°11.81'W	375	CTD	on deck
19.12.03	22:09	223-1	70°28.93'	09°11.77'W	375	ISP	into water
19.12.03	22:13	223-1	70°28.92'	09°11.76'W	375	ISP	pump at depth
19.12.03	23:28	223-1	70°28.97'	09°11.37'W	376	ISP	on deck
20.12.03	01:01	224-1	70°25.55'	09°14.62'W	349	CTD	surface
20.12.03	01:10	224-1	70°25.58'	09°14.65'W	345	CTD	at depth
20.12.03	01:20	224-1	70°25.58'	09°14.68'W	346	CTD	on deck
20.12.03	02:02	225-1	70°22.57'	09°19.73'W	502	CTD	surface

Date	Time ship	Stat. PS65/	Lat. (°S)	Long.	Depth (m)	Gear	Operation
20.12.03	02:15	225-1	70°22.59'	09°19.81'W	500	CTD	at depth
20.12.03	02:27	225-1	70°22.59'	09°19.95'W	496	CTD	on deck
20.12.03	03:02	226-1	70°22.67'	09°19.96'W	492	CTD	surface
20.12.03	03:12	226-1	70°22.68'	09°20.07'W	492	CTD	at depth
20.12.03	03:24	226-1	70°22.72'	09°20.12'W	492	CTD	on deck
20.12.03	03:50	227-1	70°22.80'	09°20.47'W	492	CTD	surface
20.12.03	04:02	227-1	70°22.85'	09°20.60'W	491	CTD	at depth
20.12.03	04:12	227-1	70°22.87'	09°20.74'W	491	CTD	on deck
20.12.03	04:17	228-1	70°22.87'	09°20.82'W	492	ISP	into water
20.12.03	04:22	228-1	70°22.86'	09°20.89'W	492	ISP	into water
20.12.03	04:26	228-1	70°22.86'	09°20.94'W	492	ISP	pump at depth
20.12.03	05:36	228-1	70°23.18'	09°21.35'W	478	ISP	Information
20.12.03	05:41	228-1	70°23.19'	09°21.39'W	477	ISP	on deck
20.12.03	12:57	195-1	70°56.36'	10°32.36'W	304	Trap/F_rec	released
20.12.03	13:18	195-1	70°56.56'	10°32.09'W	304	Trap/F_rec	on deck
20.12.03	13:25	196-1	70°56.42'	10°32.16'W	301	Trap/F_rec	released
20.12.03	13:43	196-1	70°56.56'	10°31.87'W	293	Trap/F_rec	on deck
20.12.03	15:11	229-1	70°48.54'	10°42.57'W	465	MN_v	surface
20.12.03	15:27	229-1	70°48.48'	10°42.57'W	468	MN_v	at depth
20.12.03	15:45	229-1	70°48.44'	10°42.67'W	468	MN_v	on deck
20.12.03	16:06	230-1	70°48.40'	10°42.70'W	476	CTD	surface
20.12.03	16:18	230-1	70°48.36'	10°42.76'W	480	CTD	at depth
20.12.03	16:36	230-1	70°48.30'	10°42.92'W	484	CTD	on deck
20.12.03	18:42	231-1	70°47.95'	11°21.15'W	1480	MG	surface
20.12.03	19:12	231-1	70°48.08'	11°21.40'W	1475	MG	at ground
20.12.03	19:50	231-1	70°48.13'	11°21.85'W	1476	MG	on deck
21.12.03	14:28	232-1	71°17.98'	13°53.41'W	899	EBS	surface
21.12.03	15:03	232-1	71°18.44'	13°55.31'W	899	EBS	on ground
21.12.03	15:18	232-1	71°18.61'	13°56.12'W	910	EBS	start trawling
21.12.03	15:28	232-1	71°18.73'	13°56.57'W	900	EBS	end trawling
21.12.03	15:45	232-1	71°18.80'	13°56.65'W	883	EBS	off ground
21.12.03	16:20	232-1	71°18.96'	13°56.84'W	863	EBS	on deck
21.12.03	16:53	233-1	71°18.12'	13°53.58'W	878	AGT	surface
21.12.03	17:24	233-1	71°18.99'	13°56.56'W	848	AGT	on ground
21.12.03	17:50	233-1	71°19.19'	13°57.45'W	844	AGT	off ground
21.12.03	18:15	233-1	71°19.24'	13°57.46'W	832	AGT	on deck
21.12.03	19:01	234-1	71°19.51'	13°57.62'W	780	CTD	surface
21.12.03	19:18	234-1	71°19.56'	13°57.65'W	777	CTD	at depth
21.12.03	19:32	234-1	71°19.59'	13°57.66'W	774	CTD	on deck
21.12.03	19:46	235-1	71°19.48'	13°57.81'W	798	MN_v	surface
21.12.03	20:08	235-1	71°19.52'	13°57.87'W	798	MN_v	at depth
21.12.03	20:54	235-1	71°19.46'	13°58.14'W	820	MN_v	on deck
21.12.03	21:13	236-1	71°19.41'	13°58.30'W	836	BO_v	surface
21.12.03	21:17	236-1	71°19.41'	13°58.33'W	839	BO_v	at depth
21.12.03	21:24	236-1	71°19.40'	13°58.38'W	844	BO_v	on deck
22.12.03	08:09	237-1	70°48.97'	10°33.57'W	278	GSN	turn
22.12.03	08:16	237-1	70°49.00'	10°33.78'W	548	GSN	cod end surface
22.12.03	08:27	237-1	70°49.64'	10°34.50'W	563	GSN	boards to surface
22.12.03	08:38	237-1	70°50.50'	10°35.54'W	264	GSN	start trawling
22.12.03	08:47	237-1	70°51.02'	10°36.18'W	243	GSN	hook
22.12.03	09:02	237-1	70°50.78'	10°35.72'W	254	GSN	stop trawling
22.12.03	09:09	237-1	70°50.93'	10°35.84'W	238	GSN	boards on deck
22.12.03	09:22	237-1	70°51.37'	10°36.25'W	238	GSN	cod end on deck
22.12.03	11:09	238-1	70°50.73'	10°35.29'W	0	Trap/F	surface
22.12.03	11:14	239-1	70°50.69'	10°35.52'W	246	Trap/F	surface
22.12.03	12:07	240-1	70°48.97'	10°39.92'W	0	LND	surface
22.12.03	12:47	241-1	70°48.62'	10°43.41'W	462	CTD	surface
22.12.03	13:00	241-1	70°48.62'	10°43.44'W	460	CTD	at depth
22.12.03	13:14	241-1	70°48.63'	10°43.51'W	460	CTD	on deck
22.12.03	13:28	242-1	70°48.66'	10°43.54'W	461	MN_v	surface
22.12.03	13:45	242-1	70°48.69'	10°43.53'W	458	MN_v	at depth

Date	Time ship	Stat. PS65/	Lat. (°S)	Long.	Depth (m)	Gear	Operation
22.12.03	13:45	242-1	70°48.69'	10°43.53'W	458	MN_v	hoisting
22.12.03	14:01	242-1	70°48.71'	10°43.48'W	455	MN_v	on deck
22.12.03	14:24	243-1	70°48.74'	10°43.40'W	454	BO_v	surface
22.12.03	14:36	243-1	70°48.75'	10°43.35'W	453	BO_v	at depth
22.12.03	14:54	243-1	70°48.79'	10°43.30'W	454	BO_v	on deck
22.12.03	15:21	244-1	70°48.86'	10°43.42'W	442	BO_v	surface
22.12.03	15:32	244-1	70°48.90'	10°43.41'W	442	BO_v	at depth
22.12.03	15:49	244-1	70°48.95'	10°43.39'W	439	BO_v	on deck
22.12.03	17:05	245-1	70°55.14'	10°29.30'W	238	GSN	cod end surface
22.12.03	17:26	245-1	70°56.18'	10°30.42'W	250	GSN	boards to surface
22.12.03	17:37	245-1	70°56.74'	10°32.60'W	318	GSN	on ground
22.12.03	17:37	245-1	70°56.74'	10°32.60'W	318	GSN	start trawling
22.12.03	17:48	245-1	70°57.11'	10°33.52'W	337	GSN	stop trawling
22.12.03	17:48	245-1	70°57.11'	10°33.52'W	337	GSN	off ground
22.12.03	17:57	245-1	70°57.31'	10°34.11'W	355	GSN	boards on deck
22.12.03	18:12	245-1	70°57.60'	10°34.95'W	366	GSN	cod end on deck
22.12.03	21:40	246-1	71°07.32'	11°28.33'W	66	FTS	surface
22.12.03	21:44	246-1	71°07.33'	11°28.28'W	67	FTS	at ground
22.12.03	22:03	246-1	71°07.27'	11°28.38'W	70	FTS	off ground
22.12.03	22:14	246-1	71°07.37'	11°28.75'W	116	FTS	on deck
22.12.03	22:26	246-2	71°07.33'	11°28.36'W	68	FTS	surface
22.12.03	22:33	246-2	71°07.31'	11°28.33'W	0	FTS	at ground
23.12.03	00:14	246-2	71°06.66'	11°27.19'W	271	FTS	off ground
23.12.03	00:21	246-2	71°06.62'	11°27.16'W	283	FTS	on deck
23.12.03	00:43	247-1	71°07.29'	11°28.34'W	68	FTS	surface
23.12.03	00:46	247-1	71°07.28'	11°28.37'W	70	FTS	at ground
23.12.03	01:18	247-1	71°07.37'	11°28.80'W	114	FTS	off ground
23.12.03	01:22	247-1	71°07.38'	11°28.87'W	117	FTS	on deck
23.12.03	06:33	248-1	71°06.62'	11°27.11'W	283	GSN	turn
23.12.03	06:41	248-1	71°06.32'	11°28.04'W	280	GSN	boards to surface
23.12.03	06:56	248-1	71°05.51'	11°30.46'W	286	GSN	on ground
23.12.03	07:08	248-1	71°04.96'	11°31.90'W	287	GSN	off ground
23.12.03	07:18	248-1	71°04.62'	11°32.76'W	311	GSN	boards on deck
23.12.03	07:29	248-1	71°04.32'	11°33.42'W	320	GSN	cod end on deck
23.12.03	10:17	249-1	71°06.79'	11°27.37'W	196	ROV	surface
23.12.03	10:30	249-1	71°06.79'	11°27.34'W	207	ROV	on deck
23.12.03	11:29	250-1	71°08.28'	11°30.29'W	225	ROV	surface
23.12.03	11:39	250-1	71°08.17'	11°30.01'W	227	ROV	depressor to water
23.12.03	11:46	250-1	71°08.07'	11°29.80'W	226	ROV	at depth
23.12.03	12:16	250-1	71°07.50'	11°29.22'W	221	ROV	back to surface
23.12.03	12:36	250-1	71°07.01'	11°29.62'W	252	ROV	depressor on deck
23.12.03	12:40	250-1	71°06.92'	11°29.60'W	250	ROV	on deck
23.12.03	13:25	251-1	71°07.33'	11°27.73'W	168	RD	surface
23.12.03	13:33	251-1	71°07.34'	11°27.80'W	146	RD	start dredging
23.12.03	13:46	251-1	71°07.36'	11°27.91'W	125	RD	stop dredging
23.12.03	14:00	251-1	71°07.39'	11°27.82'W	128	RD	on deck
23.12.03	14:25	252-1	71°07.32'	11°28.03'W	122	BO_v	surface
23.12.03	14:29	252-1	71°07.31'	11°28.03'W	121	BO_v	at depth
23.12.03	14:33	252-1	71°07.30'	11°28.03'W	122	BO_v	on deck
23.12.03	15:25	253-1	71°06.44'	11°27.89'W	260	GSN	cod end surface
23.12.03	15:35	253-1	71°05.84'	11°29.39'W	286	GSN	boards to surface
23.12.03	15:50	253-1	71°04.89'	11°32.21'W	295	GSN	start trawling
23.12.03	15:50	253-1	71°04.89'	11°32.21'W	295	GSN	on ground
23.12.03	16:05	253-1	71°04.30'	11°33.92'W	309	GSN	off ground
23.12.03	16:05	253-1	71°04.30'	11°33.92'W	309	GSN	stop trawling
23.12.03	16:16	253-1	71°03.97'	11°34.73'W	324	GSN	boards on deck
23.12.03	16:26	253-1	71°03.62'	11°34.72'W	344	GSN	cod end on deck
23.12.03	19:44	254-1	70°48.48'	10°43.95'W	479	CTD	surface
23.12.03	19:57	254-1	70°48.46'	10°44.09'W	482	CTD	at depth
23.12.03	20:14	254-1	70°48.52'	10°44.59'W	475	CTD	on deck
23.12.03	20:33	255-1	70°48.53'	10°44.76'W	470	ISP	into water

Date	Time ship	Stat. PS65/	Lat. (°S)	Long.	Depth (m)	Gear	Operation
23.12.03	20:37	255-1	70°48.52'	10°44.74'W	472	ISP	pump at depth
23.12.03	21:50	255-1	70°48.55'	10°44.31'W	466	ISP	on deck
23.12.03	22:04	256-1	70°48.60'	10°44.35'W	464	MN_v	surface
23.12.03	22:25	256-1	70°48.64'	10°44.36'W	463	MN_v	at depth
23.12.03	22:38	256-1	70°48.68'	10°44.42'W	461	MN_v	on deck
23.12.03	22:55	257-1	70°48.57'	10°44.02'W	464	BO_v	surface
23.12.03	23:26	257-1	70°48.64'	10°44.52'W	468	BO_v	on deck
23.12.03	23:35	258-1	70°48.62'	10°44.47'W	473	BO_v	surface
23.12.03	23:48	258-1	70°48.66'	10°44.77'W	461	BO_v	at depth
24.12.03	00:08	258-1	70°48.71'	10°45.05'W	464	BO_v	on deck
24.12.03	08:35	259-1	70°55.20'	10°28.43'W	217	GSN	cod end surface
24.12.03	08:43	259-1	70°55.45'	10°29.05'W	215	GSN	boards to surface
24.12.03	09:03	259-1	70°56.57'	10°31.98'W	300	GSN	on ground
24.12.03	09:13	259-1	70°57.00'	10°33.02'W	333	GSN	off ground
24.12.03	09:26	259-1	70°57.29'	10°33.59'W	344	GSN	boards on deck
24.12.03	09:39	259-1	70°57.58'	10°34.11'W	357	GSN	cod end on deck
24.12.03	11:14	238-1	70°50.53'	10°35.64'W	261	Trap/F_rec	hyphone to water
24.12.03	11:16	238-1	70°50.52'	10°35.60'W	262	Trap/F_rec	released
24.12.03	11:18	238-1	70°50.52'	10°35.52'W	263	Trap/F_rec	hyphone on deck
24.12.03	11:35	238-1	70°50.73'	10°34.55'W	231	Trap/F_rec	on deck
24.12.03	11:43	239-1	70°50.56'	10°35.21'W	256	Trap/F_rec	hyphone to water
24.12.03	11:44	239-1	70°50.57'	10°35.14'W	252	Trap/F_rec	released
24.12.03	11:46	239-1	70°50.57'	10°35.06'W	249	Trap/F_rec	hyphone on deck
24.12.03	12:03	239-1	70°50.70'	10°34.90'W	231	Trap/F_rec	on deck
24.12.03	12:36	240-1	70°49.05'	10°40.25'W	406	LND_rec	released
24.12.03	13:00	240-1	70°48.98'	10°39.32'W	394	LND_rec	on Deck
27.12.03	06:06	260-1	70°48.89'	10°42.72'W	444	CTD	surface
27.12.03	06:20	260-1	70°48.90'	10°42.96'W	438	CTD	at depth
27.12.03	06:38	260-1	70°48.85'	10°43.83'W	451	CTD	on deck
27.12.03	06:59	261-1	70°49.18'	10°42.83'W	416	GWS	surface
27.12.03	07:10	261-1	70°49.24'	10°42.70'W	415	GWS	surface
27.12.03	07:18	261-1	70°49.27'	10°42.80'W	411	GWS	on deck
27.12.03	07:42	262-1	70°48.91'	10°42.97'W	437	ISP	into water
27.12.03	07:46	262-1	70°48.95'	10°43.09'W	439	ISP	pump at depth
27.12.03	09:01	262-1	70°49.03'	10°44.13'W	440	ISP	on deck
27.12.03	09:14	263-1	70°49.07'	10°44.24'W	432	MN_v	surface
27.12.03	09:29	263-1	70°49.16'	10°44.44'W	432	MN_v	at depth
27.12.03	09:44	263-1	70°49.21'	10°44.70'W	426	MN_v	on deck
27.12.03	10:08	264-1	70°49.43'	10°44.69'W	408	MN_v	surface
27.12.03	10:57	264-1	70°49.45'	10°45.64'W	412	MN_v	on deck
27.12.03	12:39	265-1	70°52.55'	10°57.19'W	328	GSN	cod end surface
27.12.03	12:47	265-1	70°52.64'	10°55.75'W	300	GSN	boards to surface
27.12.03	13:00	265-1	70°52.74'	10°52.72'W	286	GSN	on ground
27.12.03	13:12	265-1	70°52.75'	10°51.24'W	295	GSN	off ground
27.12.03	13:26	265-1	70°52.78'	10°49.79'W	287	GSN	boards on deck
27.12.03	13:34	265-1	70°52.87'	10°49.27'W	289	GSN	cod end on deck
27.12.03	16:50	266-1	70°47.92'	11°21.11'W	1476	MG	surface
27.12.03	18:05	266-1	70°47.90'	11°21.36'W	1482	MG	at ground
27.12.03	18:25	266-1	70°48.04'	11°22.00'W	1481	MG	on deck
27.12.03	20:30	267-1	70°54.25'	11°4.29'W	287	FTS	surface
27.12.03	20:39	267-1	70°54.24'	11°4.26'W	289	FTS	at ground
27.12.03	21:07	267-1	70°54.19'	11°4.44'W	286	FTS	off ground
27.12.03	21:18	267-1	70°54.20'	11°4.51'W	287	FTS	on deck
27.12.03	22:52	268-1	70°54.65'	10°24.73'W	230	FTS	surface
27.12.03	23:00	268-1	70°54.65'	10°24.77'W	230	FTS	at ground
27.12.03	23:25	268-1	70°54.57'	10°24.96'W	446	FTS	off ground
27.12.03	23:33	268-1	70°54.58'	10°24.85'W	449	FTS	on deck
28.12.03	06:28	269-1	70°48.61'	10°43.50'W	468	CTD	surface
28.12.03	06:40	269-1	70°48.62'	10°43.61'W	464	CTD	at depth
28.12.03	06:58	269-1	70°48.58'	10°43.53'W	474	CTD	on deck
28.12.03	07:14	270-1	70°48.55'	10°43.76'W	470	MN_v	surface

Date	Time ship	Stat. PS65/	Lat. (°S)	Long.	Depth (m)	Gear	Operation
28.12.03	07:31	270-1	70°48.51'	10°43.90'W	472	MN_v	at depth
28.12.03	07:48	270-1	70°48.46'	10°43.91'W	480	MN_v	on deck
28.12.03	08:16	271-1	70°48.53'	10°44.91'W	475	MN_v	surface
28.12.03	08:27	271-1	70°48.56'	10°45.13'W	468	MN_v	at depth
28.12.03	09:01	271-1	70°48.69'	10°45.45'W	477	MN_v	on deck
28.12.03	09:07	272-1	70°48.72'	10°45.55'W	472	GWS	surface
28.12.03	09:30	272-1	70°48.76'	10°45.44'W	468	GWS	on deck
28.12.03	09:49	273-1	70°48.79'	10°45.33'W	464	ISP	into water
28.12.03	09:56	273-1	70°48.81'	10°45.36'W	465	ISP	pump at depth
28.12.03	11:12	273-1	70°48.90'	10°43.81'W	445	ISP	on deck
28.12.03	12:22	274-1	70°52.20'	10°48.95'W	298	GSN	cod end surface
28.12.03	12:30	274-1	70°52.19'	10°47.35'W	297	GSN	boards to surface
28.12.03	12:46	274-1	70°52.16'	10°43.69'W	291	GSN	on ground
28.12.03	12:57	274-1	70°52.15'	10°42.16'W	288	GSN	off ground
28.12.03	13:06	274-1	70°52.14'	10°41.28'W	293	GSN	boards on deck
28.12.03	13:15	274-1	70°52.17'	10°40.37'W	277	GSN	cod end on deck
28.12.03	15:45	275-1	71°7.29'	11°27.88'W	164	FTS	surface
28.12.03	15:53	275-1	71°7.30'	11°27.85'W	86	FTS	at ground
28.12.03	16:43	275-1	71°7.11'	11°28.78'W	77	FTS	off ground
28.12.03	16:46	275-1	71°7.11'	11°28.85'W	78	FTS	on deck
28.12.03	18:01	276-1	71°6.18'	11°28.77'W	268	AGT	surface
28.12.03	18:14	276-1	71°6.44'	11°27.76'W	277	AGT	on ground
28.12.03	18:27	276-1	71°6.64'	11°27.28'W	268	AGT	off ground
28.12.03	18:35	276-1	71°6.67'	11°27.29'W	261	AGT	on deck
29.12.03	06:52	277-1	71°7.26'	11°26.79'W	188	ROV	surface
29.12.03	06:58	277-1	71°7.26'	11°26.74'W	190	ROV	depressor to water
29.12.03	07:30	277-1	71°7.26'	11°26.81'W	196	ROV	Information
29.12.03	11:13	277-1	71°7.61'	11°31.70'W	133	ROV	back to surface
29.12.03	11:30	277-1	71°7.59'	11°31.72'W	134	ROV	depressor on deck
29.12.03	11:35	277-1	71°7.59'	11°31.75'W	135	ROV	on deck
29.12.03	12:13	278-1	71°7.56'	11°30.97'W	128	AGT	surface
29.12.03	12:23	278-1	71°7.51'	11°29.94'W	120	AGT	on ground
29.12.03	12:31	278-1	71°7.50'	11°29.59'W	119	AGT	off ground
29.12.03	12:38	278-1	71°7.50'	11°29.56'W	119	AGT	on deck
29.12.03	12:52	279-1	71°7.60'	11°30.66'W	123	AGT	surface
29.12.03	13:01	279-1	71°7.48'	11°29.91'W	120	AGT	on ground
29.12.03	13:13	279-1	71°7.44'	11°29.83'W	120	AGT	off ground
29.12.03	13:19	279-1	71°7.43'	11°29.83'W	119	AGT	on deck
29.12.03	13:48	280-1	71°7.35'	11°27.56'W	108	AGT	surface
29.12.03	13:58	280-1	71°7.20'	11°26.47'W	191	AGT	on ground
29.12.03	14:12	280-1	71°7.15'	11°26.23'W	228	AGT	off ground
29.12.03	14:22	280-1	71°7.14'	11°26.25'W	234	AGT	on deck
29.12.03	14:56	281-1	71°7.32'	11°28.45'W	82	RD	start dredging
29.12.03	14:56	281-1	71°7.32'	11°28.45'W	82	RD	start dredging
29.12.03	14:56	281-1	71°7.32'	11°28.45'W	82	RD	surface
29.12.03	15:10	281-1	71°7.30'	11°28.04'W	73	RD	hoisting
29.12.03	15:18	281-1	71°7.32'	11°27.99'W	74	RD	on deck
30.12.03	16:21	282-1	72°24.73'	16°59.29'W	316	MG	surface
30.12.03	16:47	282-1	72°24.85'	16°59.41'W	306	MG	at ground
30.12.03	16:59	282-1	72°24.95'	16°59.60'W	300	MG	on deck
30.12.03	19:09	283-1	72°31.72'	17°57.71'W	608	EBS	surface
30.12.03	19:29	283-1	72°32.16'	17°58.88'W	585	EBS	on ground
30.12.03	19:41	283-1	72°32.39'	17°59.34'W	554	EBS	start trawling
30.12.03	19:44	283-1	72°32.45'	17°59.37'W	542	EBS	end trawling
30.12.03	19:52	283-1	72°32.47'	17°59.41'W	542	EBS	off ground
30.12.03	20:04	283-1	72°32.48'	17°59.45'W	543	EBS	on deck
30.12.03	21:00	284-1	72°28.88'	17°51.26'W	882	EBS	surface
30.12.03	21:31	284-1	72°28.91'	17°51.28'W	882	EBS	on ground
30.12.03	21:46	284-1	72°29.12'	17°50.86'W	805	EBS	start trawling
30.12.03	21:56	284-1	72°29.26'	17°50.54'W	754	EBS	end trawling
30.12.03	22:18	284-1	72°29.30'	17°51.17'W	787	EBS	off ground

Date	Time ship	Stat. PS65/	Lat. (°S)	Long.	Depth (m)	Gear	Operation
30.12.03	22:51	284-1	72°29.56'	17°52.45'W	806	EBS	on deck
31.12.03	02:43	285-1	72°47.26'	19°29.32'W	910	CTD	surface
31.12.03	03:03	285-1	72°47.42'	19°29.71'W	920	CTD	at depth
31.12.03	03:22	285-1	72°47.60'	19°30.09'W	850	CTD	on deck
31.12.03	03:40	286-1	72°47.27'	19°29.72'W	956	MN_v	surface
31.12.03	04:11	286-1	72°47.49'	19°30.35'W	900	MN_v	at depth
31.12.03	04:43	286-1	72°47.73'	19°30.69'W	870	MN_v	on deck
31.12.03	04:56	287-1	72°47.71'	19°30.94'W	890	MN_v	surface
31.12.03	05:13	287-1	72°47.80'	19°31.32'W	892	MN_v	at depth
31.12.03	05:56	287-1	72°47.90'	19°32.19'W	924	MN_v	on deck
31.12.03	06:22	288-1	72°47.58'	19°29.86'W	847	Trap/F	surface
31.12.03	07:02	289-1	72°49.71'	19°30.57'W	515	Trap/F	surface
31.12.03	07:32	290-1	72°49.47'	19°30.27'W	519	LND	surface
31.12.03	07:51	291-1	72°49.60'	19°29.89'W	512	GWS	surface
31.12.03	08:17	291-1	72°49.69'	19°29.82'W	512	GWS	on deck
31.12.03	10:19	292-1	72°49.11'	19°33.60'W	638	GSN	cod end surface
31.12.03	10:30	292-1	72°49.62'	19°34.86'W	580	GSN	boards to surface
31.12.03	10:57	292-1	72°51.43'	19°38.62'W	598	GSN	on ground
31.12.03	11:05	292-1	72°51.84'	19°39.41'W	576	GSN	hook
31.12.03	11:26	292-1	72°51.42'	19°38.57'W	596	GSN	off ground
31.12.03	11:39	292-1	72°51.78'	19°39.30'W	588	GSN	boards on deck
31.12.03	11:53	292-1	72°52.20'	19°39.77'W	506	GSN	cod end on deck
31.12.03	12:50	293-1	72°51.42'	19°38.56'W	593	RD	surface
31.12.03	13:16	293-1	72°51.90'	19°39.31'W	542	RD	start dredging
31.12.03	13:31	293-1	72°52.07'	19°39.62'W	518	RD	stop dredging
31.12.03	14:00	293-1	72°52.13'	19°39.96'W	554	RD	on deck
01.01.04	09:04	294-1	72°49.71'	19°29.97'W	506	CTD	surface
01.01.04	09:16	294-1	72°49.75'	19°29.97'W	506	CTD	at depth
01.01.04	09:29	294-1	72°49.74'	19°30.05'W	506	CTD	on deck
01.01.04	09:40	295-1	72°49.70'	19°30.17'W	509	MN_v	surface
01.01.04	09:57	295-1	72°49.72'	19°30.20'W	507	MN_v	at depth
01.01.04	10:16	295-1	72°49.75'	19°30.16'W	513	MN_v	on deck
01.01.04	10:28	296-1	72°49.70'	19°30.22'W	519	BO_v	surface
01.01.04	10:41	296-1	72°49.70'	19°30.13'W	508	BO_v	at depth
01.01.04	11:00	296-1	72°49.71'	19°30.07'W	506	BO_v	on deck
01.01.04	11:31	296-2	72°49.81'	19°30.45'W	510	BO_v	surface
01.01.04	11:42	296-2	72°49.80'	19°30.46'W	510	BO_v	at depth
01.01.04	12:00	296-2	72°49.79'	19°30.58'W	511	BO_v	on deck
01.01.04	12:31	297-1	72°48.19'	19°30.89'W	726	RD	surface
01.01.04	13:05	297-1	72°48.50'	19°31.60'W	668	RD	start dredging
01.01.04	13:18	297-1	72°48.65'	19°31.85'W	631	RD	stop dredging
01.01.04	13:54	297-1	72°48.86'	19°32.20'W	585	RD	on deck
01.01.04	14:20	298-1	72°48.86'	19°32.16'W	579	CTD	surface
01.01.04	14:31	298-1	72°48.97'	19°32.38'W	573	CTD	at depth
01.01.04	14:42	298-1	72°49.01'	19°32.44'W	572	CTD	on deck
01.01.04	15:21	299-1	72°49.30'	19°32.88'W	556	BPT	cod end to surface
01.01.04	15:42	299-1	72°50.44'	19°35.86'W	519	BPT	boards to surface
01.01.04	15:53	299-1	72°51.26'	19°37.21'W	505	BPT	start trawling
01.01.04	16:19	299-1	72°53.07'	19°39.94'W	473	BPT	information
01.01.04	16:48	299-1	72°55.11'	19°43.26'W	460	BPT	information
01.01.04	17:06	299-1	72°56.19'	19°46.36'W	446	BPT	stop trawling
01.01.04	17:12	299-1	72°56.38'	19°47.07'W	450	BPT	boards on deck
01.01.04	17:27	299-1	72°56.68'	19°48.20'W	456	BPT	cod end on deck
01.01.04	17:47	300-1	72°56.86'	19°48.91'W	450	CTD	surface
01.01.04	17:59	300-1	72°56.90'	19°49.07'W	452	CTD	at depth
01.01.04	18:08	300-1	72°56.94'	19°49.19'W	454	CTD	on deck
01.01.04	19:14	301-1	72°49.26'	19°30.99'W	540	GWS	surface
01.01.04	19:27	301-1	72°49.22'	19°31.19'W	545	GWS	surface
01.01.04	19:37	301-1	72°49.18'	19°31.28'W	555	GWS	on deck
01.01.04	19:48	302-1	72°49.14'	19°31.26'W	548	CTD	surface
01.01.04	20:03	302-1	72°49.13'	19°31.47'W	553	CTD	at depth

Date	Time ship	Stat. PS65/	Lat. (°S)	Long.	Depth (m)	Gear	Operation
01.01.04	20:16	302-1	72°49.11'	19°31.52'W	553	CTD	on deck
01.01.04	20:46	303-1	72°47.22'	19°29.15'W	929	CTD	surface
01.01.04	21:05	303-1	72°47.24'	19°29.30'W	926	CTD	at depth
01.01.04	21:22	303-1	72°47.26'	19°29.33'W	922	CTD	on deck
01.01.04	21:35	304-1	72°47.23'	19°29.34'W	930	MN_v	surface
01.01.04	21:59	304-1	72°47.31'	19°29.61'W	942	MN_v	at depth
01.01.04	22:32	304-1	72°47.27'	19°29.82'W	978	MN_v	on deck
01.01.04	22:49	305-1	72°47.27'	19°29.57'W	940	BO_v	surface
01.01.04	22:59	305-1	72°47.26'	19°29.62'W	949	BO_v	at depth
01.01.04	23:17	305-1	72°47.24'	19°29.78'W	973	BO_v	on deck
01.01.04	23:23	306-1	72°47.23'	19°29.81'W	982	BO_v	surface
01.01.04	23:32	306-1	72°47.20'	19°29.83'W	988	BO_v	at depth
01.01.04	23:52	306-1	72°47.17'	19°29.91'W	1009	BO_v	on deck
02.01.04	00:41	307-1	72°47.50'	19°35.28'W	1396	RD	surface
02.01.04	01:51	307-1	72°47.12'	19°36.28'W	1668	RD	start dredging
02.01.04	02:24	307-1	72°46.91'	19°37.40'W	1866	RD	stop dredging
02.01.04	03:43	307-1	72°46.91'	19°38.60'W	1998	RD	on deck
02.01.04	04:16	308-1	72°50.29'	19°35.99'W	564	RD	surface
02.01.04	04:39	308-1	72°50.18'	19°35.94'W	622	RD	start dredging
02.01.04	04:50	308-1	72°50.09'	19°35.82'W	616	RD	hoisting
02.01.04	05:16	308-1	72°50.13'	19°36.20'W	674	RD	on deck
02.01.04	06:04	309-1	72°49.24'	19°33.02'W	562	CTD	surface
02.01.04	06:16	309-1	72°49.29'	19°33.20'W	562	CTD	at depth
02.01.04	06:26	309-1	72°49.29'	19°33.15'W	560	CTD	on deck
02.01.04	07:00	310-1	72°49.52'	19°32.62'W	534	BPT	cod end to surface
02.01.04	07:17	310-1	72°50.20'	19°34.29'W	518	BPT	boards to surface
02.01.04	07:37	310-1	72°51.52'	19°36.79'W	496	BPT	start trawling
02.01.04	08:08	310-1	72°53.52'	19°40.48'W	466	BPT	information
02.01.04	08:40	310-1	72°55.58'	19°45.24'W	448	BPT	information
02.01.04	09:00	310-1	72°56.81'	19°48.99'W	452	BPT	stop trawling
02.01.04	09:08	310-1	72°57.16'	19°50.16'W	452	BPT	boards on deck
02.01.04	09:20	310-1	72°57.26'	19°50.79'W	452	BPT	cod end on deck
02.01.04	09:33	311-1	72°57.29'	19°50.81'W	452	CTD	surface
02.01.04	09:42	311-1	72°57.25'	19°50.83'W	454	CTD	at depth
02.01.04	09:50	311-1	72°57.18'	19°50.71'W	453	CTD	on deck
02.01.04	10:47	312-1	72°56.81'	19°51.38'W	484	BPT	cod end to surface
02.01.04	10:57	312-1	72°56.45'	19°50.05'W	473	BPT	boards to surface
02.01.04	11:09	312-1	72°55.84'	19°47.97'W	454	BPT	start trawling
02.01.04	11:35	312-1	72°54.46'	19°43.56'W	463	BPT	information
02.01.04	12:09	312-1	72°52.30'	19°38.43'W	485	BPT	nformation
02.01.04	12:29	312-1	72°50.86'	19°35.77'W	506	BPT	stop trawling
02.01.04	12:34	312-1	72°50.67'	19°35.55'W	506	BPT	boards on deck
02.01.04	12:47	312-1	72°50.32'	19°35.55'W	517	BPT	cod end on deck
02.01.04	12:59	313-1	72°50.39'	19°36.13'W	543	CTD	surface
02.01.04	13:13	313-1	72°50.48'	19°36.56'W	589	CTD	at depth
02.01.04	13:25	313-1	72°50.65'	19°36.69'W	576	CTD	on deck
02.01.04	14:29	314-1	72°51.09'	19°36.21'W	504	BPT	cod end to surface
02.01.04	14:40	314-1	72°51.61'	19°37.41'W	499	BPT	boards to surface
02.01.04	15:05	314-1	72°53.20'	19°40.76'W	484	BPT	start trawling
02.01.04	15:58	314-1	72°55.98'	19°48.39'W	456	BPT	stop trawling
02.01.04	16:16	314-1	72°56.41'	19°49.85'W	468	BPT	boards on deck
02.01.04	16:36	314-1	72°56.81'	19°50.50'W	459	BPT	cod end on deck
02.01.04	16:50	315-1	72°56.63'	19°50.85'W	484	CTD	surface
02.01.04	17:01	315-1	72°56.67'	19°50.86'W	479	CTD	at depth
02.01.04	17:11	315-1	72°56.69'	19°50.83'W	476	CTD	on deck
02.01.04	18:39	316-1	72°47.24'	19°29.38'W	917	CTD	surface
02.01.04	19:00	316-1	72°47.29'	19°29.49'W	910	CTD	at depth
02.01.04	19:20	316-1	72°47.25'	19°29.55'W	928	CTD	on deck
02.01.04	19:27	317-1	72°47.29'	19°29.59'W	927	MN_v	surface
02.01.04	19:46	317-1	72°47.30'	19°29.75'W	954	MN_v	at depth
02.01.04	20:22	317-1	72°47.25'	19°29.52'W	920	MN_v	on deck

Date	Time ship	Stat. PS65/	Lat. (°S)	Long.	Depth (m)	Gear	Operation
02.01.04	20:37	318-1	72°47.27'	19°29.45'W	913	BO_v	surface
02.01.04	20:45	318-1	72°47.27'	19°29.39'W	907	BO_v	at depth
02.01.04	20:58	318-1	72°47.29'	19°29.38'W	904	BO_v	on deck
02.01.04	21:06	319-1	72°47.26'	19°29.40'W	909	BO_v	surface
02.01.04	21:14	319-1	72°47.28'	19°29.35'W	903	BO_v	at depth
02.01.04	21:25	319-1	72°47.28'	19°29.27'W	898	BO_v	on deck
02.01.04	21:33	320-1	72°47.27'	19°29.31'W	904	BO_v	surface
02.01.04	21:39	320-1	72°47.27'	19°29.33'W	907	BO_v	at depth
02.01.04	21:54	320-1	72°47.31'	19°29.28'W	888	BO_v	on deck
02.01.04	22:39	321-1	72°49.60'	19°33.06'W	536	CTD	surface
02.01.04	22:49	321-1	72°49.58'	19°33.28'W	540	CTD	at depth
02.01.04	23:02	321-1	72°49.58'	19°33.34'W	540	CTD	on deck
02.01.04	23:14	322-1	72°50.00'	19°34.30'W	521	BPT	cod end to surface
02.01.04	23:29	322-1	72°50.74'	19°36.34'W	511	BPT	boards to surface
02.01.04	23:37	322-1	72°51.28'	19°37.40'W	505	BPT	start trawling
03.01.04	00:02	322-1	72°52.88'	19°39.97'W	480	BPT	information
03.01.04	00:26	322-1	72°54.28'	19°43.05'W	0	BPT	information
03.01.04	00:44	322-1	72°55.26'	19°46.16'W	454	BPT	stop trawling
03.01.04	00:48	322-1	72°55.38'	19°46.62'W	457	BPT	boards on deck
03.01.04	00:55	322-1	72°55.47'	19°47.24'W	460	BPT	cod end on deck
03.01.04	01:10	323-1	72°55.63'	19°47.70'W	458	CTD	surface
03.01.04	01:21	323-1	72°55.66'	19°47.53'W	457	CTD	at depth
03.01.04	01:28	323-1	72°55.67'	19°47.37'W	455	CTD	on deck
03.01.04	01:51	324-1	72°54.47'	19°48.77'W	783	RD	surface
03.01.04	02:30	324-1	72°54.52'	19°47.74'W	694	RD	start dredging
03.01.04	02:42	324-1	72°54.55'	19°47.30'W	647	RD	stop dredging
03.01.04	03:16	324-1	72°54.67'	19°46.76'W	546	RD	on deck
03.01.04	03:28	325-1	72°55.00'	19°43.85'W	455	RD	surface
03.01.04	03:53	325-1	72°54.76'	19°43.48'W	458	RD	start dredging
03.01.04	04:02	325-1	72°54.67'	19°43.37'W	457	RD	stop dredging
03.01.04	04:03	325-1	72°54.67'	19°43.36'W	465	RD	hoisting
03.01.04	04:22	325-1	72°54.78'	19°43.84'W	461	RD	on deck
03.01.04	05:04	326-1	72°51.70'	19°39.22'W	605	RD	surface
03.01.04	05:41	326-1	72°51.43'	19°38.67'W	616	RD	start dredging
03.01.04	05:51	326-1	72°51.33'	19°38.44'W	606	RD	stop dredging
03.01.04	06:19	326-1	72°51.28'	19°38.51'W	630	RD	on deck
03.01.04	08:14	327-1	72°48.73'	19°26.56'W	526	ROV	surface
03.01.04	09:19	327-1	72°48.73'	19°26.58'W	526	ROV	on deck
03.01.04	10:02	328-1	72°49.56'	19°33.87'W	545	CTD	surface
03.01.04	10:14	328-1	72°49.53'	19°34.00'W	552	CTD	at depth
03.01.04	10:24	328-1	72°49.49'	19°33.98'W	557	CTD	on deck
03.01.04	10:41	329-1	72°49.63'	19°34.70'W	565	BPT	cod end to surface
03.01.04	10:53	329-1	72°50.28'	19°36.41'W	633	BPT	boards to surface
03.01.04	11:30	329-1	72°52.89'	19°39.92'W	478	BPT	start trawling
03.01.04	12:23	329-1	72°55.85'	19°46.86'W	456	BPT	stop trawling
03.01.04	12:44	329-1	72°56.50'	19°48.74'W	454	BPT	boards on deck
03.01.04	12:58	329-1	72°56.64'	19°50.04'W	455	BPT	cod end on deck
03.01.04	13:10	330-1	72°56.53'	19°50.25'W	471	CTD	surface
03.01.04	13:22	330-1	72°56.51'	19°50.31'W	476	CTD	at depth
03.01.04	13:31	330-1	72°56.45'	19°50.15'W	474	CTD	on deck
03.01.04	14:18	331-1	72°56.14'	19°49.10'W	464	MG	surface
03.01.04	14:50	331-1	72°56.15'	19°48.81'W	456	MG	at ground
03.01.04	15:07	331-1	72°56.13'	19°48.71'W	456	MG	on deck
03.01.04	18:37	332-1	72°48.47'	19°30.23'W	594	MG	surface
03.01.04	19:13	332-1	72°48.44'	19°30.31'W	600	MG	at ground
03.01.04	19:36	332-1	72°48.36'	19°30.41'W	626	MG	on deck
03.01.04	19:55	288-1	72°47.71'	19°30.25'W	835	Trap/F_rec	released
03.01.04	20:20	288-1	72°47.76'	19°30.82'W	874	Trap/F_rec	Information
03.01.04	20:34	288-1	72°47.63'	19°30.65'W	899	Trap/F_rec	on deck
03.01.04	21:00	290-1	72°49.46'	19°31.14'W	526	LND_rec	released
03.01.04	21:16	290-1	72°49.47'	19°31.05'W	526	LND_rec	Information

Date	Time ship	Stat. PS65/	Lat. (°S)	Long.	Depth (m)	Gear	Operation
03.01.04	21:29	290-1	72°49.47'	19°30.93'W	530	LND_rec	on deck
03.01.04	21:31	289-1	72°49.47'	19°31.02'W	526	Trap/F_rec	hyphone to water
03.01.04	21:32	289-1	72°49.48'	19°31.07'W	524	Trap/F_rec	released
03.01.04	21:34	289-1	72°49.48'	19°31.19'W	524	Trap/F_rec	hyphone on deck
03.01.04	21:45	289-1	72°49.61'	19°31.19'W	518	Trap/F_rec	Information
03.01.04	21:55	289-1	72°49.74'	19°31.24'W	514	Trap/F_rec	on deck
05.01.04	07:32	333-1	70°48.34'	10°46.57'W	503	MOR_rec	action
05.01.04	07:34	333-1	70°48.32'	10°46.52'W	501	MOR_rec	action
05.01.04	07:36	333-1	70°48.31'	10°46.54'W	504	MOR_rec	action
05.01.04	08:10	333-1	70°48.34'	10°46.47'W	500	MOR_rec	action
05.01.04	08:34	333-1	70°48.40'	10°47.07'W	490	MOR_rec	on deck
05.01.04	08:39	334-1	70°48.39'	10°47.11'W	486	CTD	surface
05.01.04	08:53	334-1	70°48.33'	10°47.48'W	494	CTD	at depth
05.01.04	09:13	334-1	70°48.33'	10°48.09'W	499	CTD	on deck
05.01.04	10:34	335-1	70°50.72'	10°29.02'W	254	ROV	surface
05.01.04	10:38	335-1	70°50.71'	10°28.90'W	258	ROV	depressor to water
05.01.04	11:30	335-1	70°50.67'	10°27.71'W	280	ROV	at depth
05.01.04	13:36	335-1	70°50.55'	10°29.75'W	247	ROV	back to surface
05.01.04	13:55	335-1	70°50.60'	10°29.62'W	250	ROV	depressor on deck
05.01.04	14:01	335-1	70°50.62'	10°29.61'W	250	ROV	on deck
05.01.04	15:11	336-1	70°50.62'	10°28.84'W	258	AGT	surface
05.01.04	15:21	336-1	70°50.70'	10°28.32'W	276	AGT	on ground
05.01.04	15:31	336-1	70°50.75'	10°28.01'W	281	AGT	off ground
05.01.04	15:44	336-1	70°50.80'	10°27.82'W	285	AGT	on deck
05.01.04	16:48	337-1	70°56.68'	10°32.13'W	307	MOR_rec	surface
05.01.04	16:57	337-1	70°56.69'	10°32.11'W	307	MOR_rec	action
05.01.04	16:57	337-1	70°56.69'	10°32.11'W	307	MOR_rec	action
05.01.04	17:11	337-1	70°56.67'	10°32.13'W	309	MOR_rec	action
05.01.04	17:12	337-1	70°56.67'	10°32.13'W	0	MOR_rec	at depth
05.01.04	17:18	337-1	70°56.70'	10°32.23'W	312	MOR_rec	on deck
05.01.04	17:26	338-1	70°56.92'	10°32.61'W	326	CTD	surface
05.01.04	17:34	338-1	70°56.96'	10°32.67'W	328	CTD	at depth
05.01.04	17:50	338-1	70°56.19'	10°33.13'W	0	CTD	on deck
05.01.04	19:04	339-1	70°50.75'	10°28.18'W	284	RD	surface
05.01.04	19:15	339-1	70°50.72'	10°28.26'W	277	RD	start dredging
05.01.04	19:25	339-1	70°50.68'	10°28.51'W	274	RD	start dredging
05.01.04	19:36	339-1	70°50.65'	10°28.48'W	277	RD	hoisting
05.01.04	20:00	339-1	70°50.65'	10°28.38'W	278	RD	on deck
07.01.04	04:11	340-1	70°32.73'	08°53.19'W	420	MOR	hyphone to water
07.01.04	04:13	340-1	70°32.72'	08°53.20'W	421	MOR	released
07.01.04	04:14	340-1	70°32.71'	08°53.20'W	421	MOR	on the surface
07.01.04	04:22	340-1	70°32.70'	08°53.14'W	420	MOR	action
07.01.04	04:42	340-1	70°32.64'	08°52.60'W	408	MOR	mooring on deck
07.01.04	04:50	341-1	70°32.59'	08°52.44'W	404	CTD	surface
07.01.04	05:01	341-1	70°32.55'	08°52.29'W	401	CTD	at depth
07.01.04	05:09	341-1	70°32.59'	08°52.19'W	400	CTD	on deck
07.01.04	06:56	045-1	70°31.63'	09°1.34'W	444	Trap/F_rec	Information
07.01.04	06:58	047-1	70°31.64'	09°1.19'W	446	Trap/A_rec	information
07.01.04	07:02	046-1	70°31.53'	09°0.43'W	472	Trap/F_rec	Information
11.01.04	05:00	342-1	54°53.73'	00°0.08'W	1469	HS	start track
11.01.04	08:34	342-1	54°44.05'	00°7.85'E	583	HS	profile end
11.01.04	08:53	343-1	54°43.92'	00°6.73'E	447	FTS	surface
11.01.04	09:01	343-1	54°43.89'	00°6.80'E	441	FTS	at ground
11.01.04	09:38	343-1	54°44.00'	00°7.34'E	511	FTS	off ground
11.01.04	09:47	343-1	54°43.98'	00°7.47'E	536	FTS	on deck
11.01.04	10:18	344-1	54°44.58'	00°9.55'E	784	AGT	surface
11.01.04	10:43	344-1	54°44.40'	00°8.38'E	575	AGT	on ground
11.01.04	10:55	344-1	54°44.32'	00°8.11'E	574	AGT	start hoisting
11.01.04	11:13	344-1	54°44.29'	00°8.13'E	568	AGT	off ground
11.01.04	11:36	344-1	54°44.20'	00°8.22'E	564	AGT	on deck
11.01.04	12:06	345-1	54°44.19'	00°8.95'E	704	RD	surface

Date	Time ship	Stat. PS65/	Lat. (°S)	Long.	Depth (m)	Gear	Operation
11.01.04	12:40	345-1	54°44.12'	00°8.31'E	629	RD	start dredging
11.01.04	12:46	345-1	54°44.12'	00°8.19'E	628	RD	stop dredging
11.01.04	13:43	345-1	54°43.93'	00°8.57'E	702	RD	on deck
11.01.04	14:04	346-1	54°44.18'	00°8.16'E	572	AGT	surface
11.01.04	14:22	346-1	54°43.95'	00°7.21'E	500	AGT	on ground
11.01.04	14:42	346-1	54°43.83'	00°6.90'E	441	AGT	off ground
11.01.04	14:59	346-1	54°43.73'	00°6.77'E	427	AGT	on deck
11.01.04	15:13	347-1	54°43.70'	00°6.85'E	450	DRG	surface
11.01.04	15:43	347-1	54°43.67'	00°6.60'E	406	DRG	start dredging
11.01.04	16:00	347-1	54°43.60'	00°6.49'E	413	DRG	stop dredging
11.01.04	16:10	347-1	54°43.60'	00°6.63'E	446	DRG	on deck

hyphone = hydrophone; boards = otter boards

3.3 Qualitative Visual Trawl Sample Analysis

AGT catches - visual check on deck

(++ very abundant, dominant; + abundant; - scarce; 0 missing)

Station			65-019	65-020	65-028	65-029	65-039	65-090	65-109	65-121	65-161	65-173	65-233	65-276	65-278	65-279	65-280	65-336	65-344
Haul			AGT 1	AGT 2	AGT 3	AGT 4	AGT 5	AGT 6	AGT 7	AGT 8	AGT 9	AGT 10	AGT 11	AGT 12	AGT 13	AGT 14	AGT 15	AGT 16	AGT 17
Porifera			-	-	0	+	-	++	-	+	++	+	++	+	+	++	++	-	0
Cnidaria	Hydroidea		-	0	+	-	+	0	0	-	-	-	0	-	+	-	-	-	0
	Actiniaria		-	0	+	-	-	-	-	+	-	-	-	+	-	-	-	-	-
	Gorgonaria		+	-	0	+	-	-	0	+	-	-	-	-	-	-	+	-	0
	Pennatularia		+	-	0	-	0	0	-	0	0	0	0	-	0	0	0	0	0
	Alcyonaria		0	0	+	-	0	0	0	-	0	0	-	0	0	0	0	0	0
	Scleractinia		-	0	0	-	0	-	0	0	-	-	0	0	0	0	-	0	0
Nemertini			+	-	-	-	-	-	-	-	-	-	-	-	0	0	0	-	0
Mollusca	Bivalvia		-	0	0	0	-	-	-	-	-	-	0	-	-	+	-	-	-
	Aplacophora		0	0	0	0	0	-	0	-	0	0	0	-	0	0	0	0	0
	Gastropoda	Prosobranchia	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
		Opisthobranchia	-	0	+	-	-	0	-	-	0	0	-	-	0	0	-	-	0
	Polyplacophora		-	-	0	-	0	-	0	-	0	0	-	-	0	0	-	0	0
	Cephalopoda		0	0	0	0	-	0	-	-	0	-	+	-	0	0	0	-	0
	Scaphopoda		0	0	0	0	0	-	0	0	-	0	0	0	0	0	0	0	0
Polychaeta	Sedentaria		-	0	++	-	-	-	0	-	-	-	-	-	-	0	-	-	0
	Errantia		-	-	+	-	-	-	-	-	-	-	-	-	0	-	-	-	0
Priapulida			0	0	0	0	0	0	-	0	0	0	0	0	0	0	0	0	0
Sipunculida			-	0	0	0	0	0	0	-	0	0	0	0	0	0	0	0	-
Echiurida			0	0	0	0	0	0	-	0	-	0	0	0	0	0	0	0	0
Crustacea	Cirripedia		-	0	0	-	0	0	0	0	0	0	0	0	0	0	0	0	+
	Amphipoda		-	0	+	-	++	-	0	-	-	-	-	++	-	+	-	-	-
	Isopoda		-	-	-	-	+	-	0	-	-	-	-	-	0	0	-	-	0
	Cumacea		0	0	0	0	0	-	0	0	0	0	0	-	0	-	0	0	0
	Mysidacea		0	0	0	-	0	0	0	0	0	0	-	0	0	0	0	0	0
	Decapoda	Natantia	0	-	0	0	-	-	++	-	0	-	++	-	0	-	+	-	-
		Reptantia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-
Pantopoda			-	-	+	-	+	+	-	-	-	-	+	+	-	-	+	-	0

			65-019	65-020	65-028	65-029	65-039	65-090	65-109	65-121	65-161	65-173	65-233	65-276	65-278	65-279	65-280	65-336	65-344
		Station	65-019	65-020	65-028	65-029	65-039	65-090	65-109	65-121	65-161	65-173	65-233	65-276	65-278	65-279	65-280	65-336	65-344
		Haul	AGT 1	AGT 2	AGT 3	AGT 4	AGT 5	AGT 6	AGT 7	AGT 8	AGT 9	AGT 10	AGT 11	AGT 12	AGT 13	AGT 14	AGT 15	AGT 16	AGT 17
Bryozoa			++	-	-	-	++	-	0	+	+	-	-	++	0	-	+	-	-
Brachiopoda			-	-	-	-	0	-	-	-	-	-	0	-	0	0	-	0	-
Pterobranchia			0	0	0	0	0	-	0	+	0	-	0	-	0	0	-	-	0
Echinodermata	Ophiuroidea		++	++	++	++	-	-	++	-	-	-	-	+	-	-	-	-	-
	Asteroidea		-	-	++	+	-	-	-	+	-	-	-	-	0	0	+	-	-
	Echinoidea	Regularia	0	-	0	0	-	+	-	+	-	+	-	+	-	-	-	-	-
		Irregularia	0	0	-	0	-	-	-	0	-	-	0	-	0	0	-	0	0
	Crinoidea		+	-	-	+	0	-	++	-	-	-	+	-	0	0	+	-	0
	Holothuroidea		+	+	++	+	-	+	+	-	-	+	+	-	-	0	-	-	-
Ascidiacea			-	-	-	-	-	+	0	-	-	+	-	-	0	-	-	-	0
Pisces			-		+	-	+	-	-	-	0	0	-	-	0	0	+	-	-

GSN catches - visual check on deck
(++ very abundant, dominant; + abundant; - scarce; 0 missing)

		Station	65-132	65-237	65-245	65-248	65-253	65-259	65-265	65-274	65-292
		Haul	BT 0	BT 1	BT 2	BT 3	BT 4	BT 5	BT 6	BT 7	BT 7
Porifera			++	Net	++	++	++	++	++	++	++
Cnidaria	Hydroidea		-		-	+	-	-	-	-	+
	Actiniaria		-		-	-	-	-	-	-	-
	Gorgonaria		-		-	++	+	-	+	+	+
	Pennatularia		-		-	-	-	0	-	-	-
	Alcyonaria		0		0	-	-	0	-	0	-
	Scleractinia		-		0	0	0	0	0	0	0
Nemertini			-		-	-	-	-	-	-	0
Mollusca	Bivalvia		-		-	-	-	-	-	-	-
	Aplacophora		0		0	0	-	0	0	-	0
	Gastropoda	Prosobranchia	-		-	-	-	-	-	-	-
		Opisthobranchia	-		-	+	-	-	+	-	-
	Polyplacophora		0		0	0	-	0	-	-	0
	Cephalopoda		-		-	0	-	0	-	-	-
	Scaphopoda		0		0	0	0	0	0	-	0
Polychaeta	Sedentaria		-		-	-	-	-	+	-	0
	Errantia		-		-	-	-	-	-	-	-
Priapulida			0		0	0	0	0	0	0	0
Sipunculida			0		0	0	0	0	0	0	0
Echiurida			0		0	0	0	0	0	0	0
Crustacea	Cirripedia		0		0	-	-	-	0	-	-
	Amphipoda		-		-	-	+	-	-	-	-
	Isopoda		-		-	0	-	-	-	-	0
	Cumacea		0		0	0	0	0	0	0	0
	Mysidacea		0		0	0	0	0	0	-	0
	Decapoda	Natantia	-		-	-	-	-	-	-	-
		Reptantia	0		0	0	0	0	0	0	0
Pantopoda			-		-	-	-	-	-	-	-
Bryozoa			-		-	-	++	+	-	-	-
Brachiopoda			0		0	0	0	0	0	-	0
Pterobranchia			-		-	0	-	-	-	-	-
Echinodermata	Ophiuroidea		-		-	-	-	-	-	-	++
	Asteroidea		-		-	-	-	+	+	+	-
	Echinoidea	Regularia	-		+	+	-	+	+	+	-
		Irregularia	0		0	0	-	-	-	-	0
	Crinoidea		-		+	-	-	-	+	-	0
	Holothuroidea		+		+	-	-	-	-	-	0
Ascidiacea			+		+	-	-	+	-	-	-
Pisces			-		+	-	+	+	-	-	-

3.4 Participants

Scientists

Name	First Name	Institution	Country
Arntz	Wolf	AWI	D
Avila	Conxita	CEAB-CSIC	E
Ballesteros	Manuel	CEAB-CSIC	E
Beyer	Kerstin	AWI	D
Bock	Christian	AWI	D
Bohlmann	Harald	AWI	D
Bornemann	Horst	AWI	D
Brey	Thomas	AWI	D
Brodte	Eva-Maria	AWI	D
Cope	Therese	BAS	UK
Debenham	Casey	UAF	USA
DeBroyer	Claude	IRSNB	B
Dimmler	Werner	FIELAX	D
Gerdes	Dieter	AWI	D
Gili	Josep-Maria	ICM/CSIC	E
Gutt	Julian	AWI	D
Heilmayer	Olaf	AWI	D
Hirse	Timo	AWI	D
Isla	Enrique	AWI	D
Jacob	Ute	AWI	D
Knust	Rainer	AWI	D
Koschnick	Niels	AWI	D
Lavaleye	Marc	NIOZ	NL
Liebsch	Nikolai	IFM	D
Linse	Katrin	BAS	UK
Mark	Felix	AWI	D
Michels	Jan	AWI	D
Mintenbeck	Katja	AWI	D
Mirhaj	Mandana	UHB	D
Nyssen	Fabienne	IRSNB	B
Pasternak	Anna	RAS	R
Plötz	Joachim	AWI	D
Potthoff	Michael	AWI	D
Raupach	Michael	RUB	D
Rauschert	Martin	AWI	D
Rodríguez	Estefanía	USE	E
Rodríguez y Baena	Alessia	IAEA	Monaco
Rose	Armin	DZMB	D
Rossi	Sergio	ICM/CSIC	E
Schulz	Harry	FIELAX	D
Simon	Joachim	OS	D
Simon	Elke	OS	D
Teixidó	Nuria	AWI	D
Thatje	Sven	AWI	D
Vareschi	Ekkehard	ICBM	D
Vendrell	Begoña	ICM/CSIC	E
Watanabe	Yuuki	ORI	J
Wevill	David	UYO	UK
Zauke	Gerd-Peter	ICBM	D

Helicopter crew, meteorologists, AWI-logistics

Name	First Name	Institution	Country
Ahammer	Heinz	AWI	D
Alm	Peter	HSW	D
Brauer	Jens	HSW	D
Hill	Heinz-Günther	DWD	D
Janneck	Jürgen	AWI	D
Kretschmann	Rolf-Paul	AWI	D
Redetzky	Jörg	HSW	D
Seidler	Kai	HSW	D
Sonnabend	Hartmut	DWD	D
Witt	Ralf	AWI	D

3.5 Participating Institutions

	Institution	Address
AWI	Alfred Wegener Institute for Polar and Marine Research	Columbusstrasse 27568 Bremerhaven, Germany
BAS	British Antarctic Survey	High Cross, Madingley Road Cambridge CB3 0ET, Great Britain
CEAB (CSIC)	Centro de Estudios Avanzados de Blanes	c/Accés a la Cala St. Francesc, 14, 17300 Blanes, Girona, Spain
DWD	Deutscher Wetterdienst	Jenfelder Allee 70a 22043 Hamburg, Germany
DZMB	Deutsches Zentrum für Marine Biodiversitätsforschung	Schleusenstr. 1, 26383 Wilhelmshaven
FIELAX	Gesellschaft f. wiss. Datenverarbeitung	Schifferstr. 10-14, 27568 Bremerhaven
IAEA	Marine Environment Laboratory	4 Quai Antoine Premier, MC 98000 Monaco
IFM	Institut für Meereskunde	Universität Kiel, Düsternbrooker Weg 20, 24105 Kiel, Germany
ICBM	Institute of Chemistry and Biology of the Marine Environment	Universität Oldenburg, POB 2503, 26111 Oldenburg, Germany
ICM (CSIC)	Institut de Ciències del Mar	Passeig Marítim de la Barceloneta, 37-49, 08003 Barcelona, Spain
IRSNB	Institut Royal des Sciences Naturelles de Belgique	Rue Vautier, 29, 1000 Bruxelles, Belgium
NIOZ	Royal Netherlands Institute for Sea Research	POB 59, 1790 AB Den Burg Texel, The Netherlands
OS	Optik Simon	Schildergasse 78-82, 50667 Köln, Germany
ORI	Ocean Research Institute	The University of Tokyo, 1-15-1 Minamidai, Nakano, Tokyo, 164-8639 Japan
RAS	Russian Academy of Science	P. P. Shirshov Institute of Oceanology, 36 Nakhimovski Prospekt, 117997 Moscow, Russia
RUB	Ruhr-Universität Bochum	ND05-788, 44780 Bochum, Germany
UAF	University of Alaska Fairbanks	School of Fisheries and Ocean Sciences, POB 757220, Fairbanks, AK 99775-7220
UHB	Universität Bremen	Bibliothekstraße 1, 28359 Bremen
USE	Universidad de Sevilla	Avd. Reina Mercedes No.6, 31012 Sevilla, Spain
UYO	University of York	Dept. of Chemistry, York YO10 5DD, UK

3.6 Ship's Crew

Name	First Name	Rank	Country
Domke	Udo	Master	D
Grundmann	Uwe	1. Offc.	D
Pluder	Andreas	Ch. Eng.	D
Spielke	Steffen	2. Offc.	D
Peine	Lutz	2. Offc.	D
Fallei	Holger	2. Offc.	D
Kohlberg	Eberhard	Doctor	D
Koch	Georg	R. Offc.	D
Delff	Wolfgang	1. Eng.	D
Ziemann	Olaf	2. Eng.	D
Kotnik	Herbert	3. Eng.	D
Muhle	Heiko	Electr.	D
Baier	Ulrich	FielaxElo	D
Fröb	Martin	FielaxElo	D
Muhle	Helmut	FielaxElo	D
Kahrs	Thomas	FielaxElo	D
Loidl	Reiner	Boatsw.	D
Reise	Lutz	Carpenter	D
Gil	Iglesias	A. B.	E
Pousada Martinez	Sato	A. B.	E
Winkler	Michael	A. B.	D
Guse	Hartmut	A. B.	D
Hagemann	Manfred	A. B.	D
Schmidt	Uwe	A. B.	D
Bastigkeit	Kai	A. B.	D
Freitag	Patrik	A. B.	D
Bäcker	Andreas	A. B.	D
Preußner	Jörg	Storek.	D
Ipsen	Michael	Mot-man	D
Voy	Bernd	Mot-man	D
Elsner	Klaus	Mot-man	D
Hartmann	Ernst-Uwe	Mot-man	D
Grafe	Jens	Mot-man	D
Haubold	Wolfgang	Cook	D
Völske	Thomas	Cooksmate	D
Silinski	Frank	Cooksmate	D
Jürgens	Monika	1. Stwdess	D
Wöckener	Martina	Stwdess/KS	D
Czyborra	Bärbel	2. Stwdess	D
Silinski	Carmen	2. Stwdess	D
Gaude	Hans-Jürgen	2. Steward	D
Möller	Wolfgang	2. Steward	D
Huang	Wu-Mei	2. Steward	China
Yu	Kwok Yuen	Laundrym.	Hongkong