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The Expedition of the Research Vessel "Polarstern" to the Arctic in 2012 (ARK-XXVII/2)

Edited by
Thomas Soltwedel
with contributions of the participants

HELMHOLTZ
GEMEINSCHAFT

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ARK-XXVII/2

15 July - 30 July 2012
Longyearbyen - Tromsø

Fahrtleiter / Chief scientist
Thomas Soltwedel

Koordinatoren / Coordinators
Eberhard Fahrbach
Rainer Knust

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1. ZUSAMMENFASSUNG UND FAHRTVERLAUF

Thomas Soltwedel AWI

Der zweite Fahrtabschnitt der 27. Expedition des *Polarstern* begann am 15. Juli 2012 in Longyearbyen auf Spitzbergen, führte in das Tiefsee-Observatorium HAUSGARTEN in der östlichen Framstraße und endete am 30. Juli 2012 in Tromsø, Norwegen (Abb. 1.1). Die Reise dauerte insgesamt 14,5 Tage, etwa 9,5 Tage wurden für Stationsarbeiten genutzt, die restliche Zeit wurde für die Anreise in das Untersuchungsgebiet, Transitstrecken zwischen den Stationen und die Abreise von etwa 79°N nach Tromsø benötigt. Die Expedition umfasste über 30 biologische und ozeanographische Stationen, an denen in der Regel jeweils eine Vielzahl von Geräten eingesetzt wurde. Während der Expedition wurden insgesamt ca. 1.300 Seemeilen zurückgelegt.

Die im Bereich des HAUSGARTENs durchgeführten Probennahmen und *in-situ* Experimente liefern wichtige Beiträge zu den ESFRI (European Strategy Forum on Research Infrastructures) Roadmap Projekten SIOS (Svalbard Integrated Arctic Earth Observing System) und ICOS (Integrated Carbon Observation System) sowie dem Anfang 2009 begonnenen Forschungsprogramm PACES (Polar regions And Coasts in the changing Earth System) des AWI. In PACES werden u.a. Beiträge zum Topic "The changing Arctic and Antarctic", und hier speziell zum Themenbereich ''Sea ice - atmosphere - ocean - ecosystem interactions in a bi-polar perspective" erbracht. Die durchgeführten Arbeiten stellen einen weiteren Beitrag zur Sicherstellung der Langzeitbeobachtung am HAUSGARTEN dar, um den Einfluss klimatisch induzierter Umweltveränderungen auf ein arktisches Tiefseeökosystem zu dokumentieren. Klimabedingte Veränderungen der Plankton-Zusammensetzung und des Kohlenstoffkreislaufs in der Framstraße wurden durch die am AWI etablierte Arbeitsgruppe PEBCAO (Phytoplankton Ecology and Biogeochemistry in the Changing Arctic Ocean) untersucht. Auf dem Svalbard-Schelf und im Bereich des Kongsfjords wurden biologische Langzeituntersuchungen fortgesetzt, die im Rahmen des mittlerweile beendeten KONGHAU-Projekts (Impact of climate change on Arctic marine community structures and food webs) in 2008 begonnen wurden. Das Projekt vereinigte Flachwasser- und Tiefsee-Daten, die seit Ende der 90’er Jahre in der östlichen Framstraße gewonnen wurden. Während des gesamten Fahrtabschnitts wurden die Beobachtungen von Seevögeln und marinen Säugetieren aus dem vorhergehenden Fahrtabschnitt fortgesetzt.

Durch die effektive Zusammenarbeit zwischen den wissenschaftlichen Arbeitsgruppen und der Schiffsbesatzung, und begünstigt durch das überwiegend gute Wetter, verlief die Expedition ARK-XXVII/2 außerordentlich erfolgreich. In der Kürze der zur Verfügung stehenden Zeit wurden über 30 Stationen mit unterschiedlichsten Mess-, Registrier- und Sammelgeräten beprobt. Die Untersuchungen in der Wassersäule und am Boden hielten sich dabei zeitlich in etwa die Waage.

Ein Höhepunkt der Reise war der Einsatz des autonomen Unterwasserfahrzeugs (Autonomous Underwater Vehicle, AUV) der Tiefseegruppe des AWI vor der

Insel Prins Carls Forlandet. In diesem Seegebiet vor Spitzbergen strömen noch unbekannte Mengen des klimarelevanten Treibhausgas Methan aus dem Meeresboden. Neben einem speziellen Wasserprobennehmer war das AUV mit einer Reihe von Sensoren ausgerüstet, die zeitgleich eine Vielzahl von Parametern im Meer erfassen, die für die Biologie, Chemie und Physik des Ozeans von Bedeutung sind. Die Untersuchungen werden dazu beitragen die Prozesse, die zum Ausgasen des Methans vor Spitzbergen führen, besser zu verstehen.

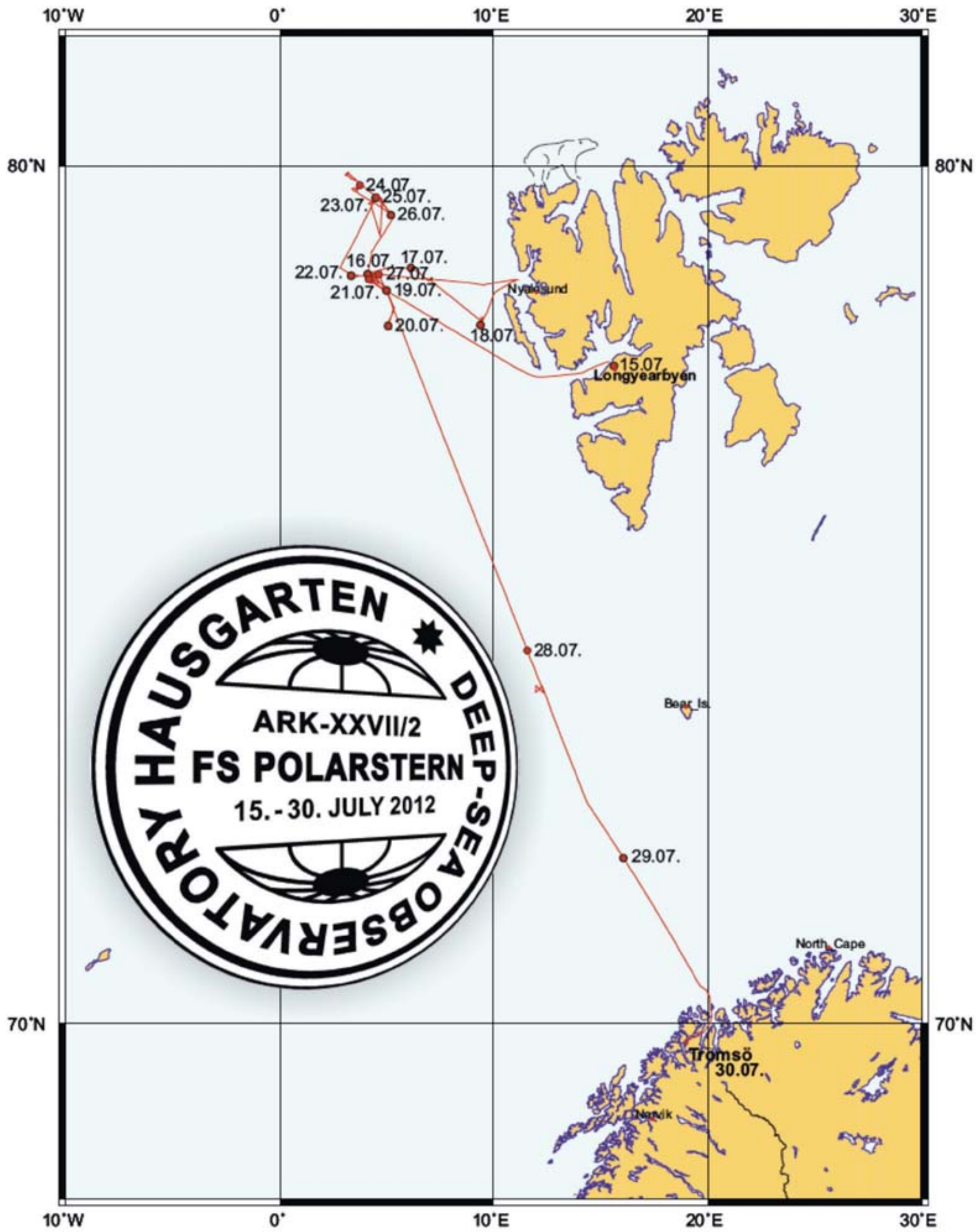

Abb. 1.1: Kurs der Polarstern Reise ARK-XXVII/2

Fig. 1.1: Cruise track of Polarstern during the expedition ARK-XXVII/2

ITINERARY AND SUMMARY

The second leg of the 27th *Polarstern* expedition to the Arctic started on 15th July 2012 in Longyearbyen (Spitsbergen) and ended on 30th July 2012 in Tromsø (Norway) (Fig. 1.1). The main working area of the cruise was the deep-sea observatory HAUSGARTEN in the eastern Fram Strait. The total duration of the expedition was 14.5 days; 9.5 days were spent for station work, the remaining time was used to reach the study area, for steaming between individual stations, and for transit from approx. 79°N to Tromsø. More than 30 stations were sampled, thereby usually deploying several instruments per sampling site. The total length of the expedition was approx. 1,300 nautical miles.

The work carried out at HAUSGARTEN observatory will contribute to the ESFRI (European Strategy Forum on Research Infrastructures) Roadmap projects SIOS (Svalbard Integrated Arctic Earth Observing System) and ICOS (Integrated Carbon Observation System) as well as to the AWI research programme PACES (Polar regions And Coasts in the changing Earth System), which started at the beginning of 2009. The work is embedded in various research activities through studies on changing Arctic sea ice conditions ("The changing Arctic and Antarctic") and their impact on ecosystems and food webs ("Sea ice - atmosphere - ocean - ecosystem interactions in a bi-polar perspective"). The research contributes to the time-series studies at HAUSGARTEN, where we investigate the impacts of Climate Change on an Arctic marine deep-sea ecosystem through field studies and models. Climate-induced variations in plankton communities of Fram Strait as well as shifts in the marine carbon cycle within the study area were investigated by the AWI research group PEBCAO (Phytoplankton Ecology and Biogeochemistry in the Changing Arctic Ocean). On the continental shelf off Svalbard and in the area of Kongsfjorden, we continued marine biological long-term investigations, which started in 2008 within the framework of the former KONGHAU project (Impact of climate change on Arctic marine community structures and food webs). KONGHAU combined shallow- and deep-water data collected since the late 90's from time-series work at Kongsfjorden and HAUSGARTEN. Observations and counts of sea birds and marine mammals, which had been already started during the previous leg, were continued.

The effective cooperation between the scientists and the ship's crew, in combination with perfect weather conditions during the cruise, made this expedition a great success. Within less than two weeks, over 30 stations could be sampled, each by a large variety of scientific instruments and sampling gear. Half of the time allocated for station work was used for water column studies, while the other half was spent for benthic investigations.

A highlight of the cruise was the mission of an Autonomous Underwater Vehicle (AUV), operated by the AWI Deep-Sea Research Group. The vehicle was used to profile an area off the island Prins Carls Forlandet, where huge amounts of the climate-relevant gas methane are released from the seafloor off Spitsbergen. Besides a special designed water sampling system, the payload section of the AUV was equipped with a total of 10 sensor packages to register various parameters important for the biology, chemistry and physics of the oceans. The analysis of all data and samples will help to understand the processes driving the release of methane off Spitsbergen.

2. WEATHER CONDITIONS

Harald Rentsch, Klaus Buldt DWD

At the beginning of the cruise ARK-XXVII/2 in Longyearbyen on 15th June 2012 at 18 MESZ a high pressure system over Greenland was weakening. Most parts of Fram Strait, Svalbard and the Barents Sea had only small cloud coverage, together with a weak breeze from northerly directions (Fig. 2.1). Already one day later the cold Arctic airflow became stronger, wind reached 5 to 6 Bft and temperatures decreased to 0°C. Almost at the same time many low clouds were a characteristic sign for upcoming high moisture in near-surface boundary layer.

On 17th July, with upcoming northerly wind flow, we got a weak upper trough which passed our working area towards the South. Some snow and rain showers reached the ship, but the restrictions for flights were not significant and the planned wide range observations of sea mammals could be carried out successfully. During the day, northerly winds of 5 Bft brought Arctic air masses to Greenland Sea, and we had a considerably increasing of air pressure east of Greenland. Our main working area, the deep-sea observatory HAUSGARTEN, was influenced by this extending ridge of high pressure during next day. While on 18th July we faced sunny periods close to Svalbard, one day later lower sea-surface temperatures interfered with the warm air, causing many low clouds and restricted the visibilities. In these conditions we could not perform any flight operations. On the other hand, a nearly calmed sea provided good conditions to conduct all planned station work carried out from board the ship.

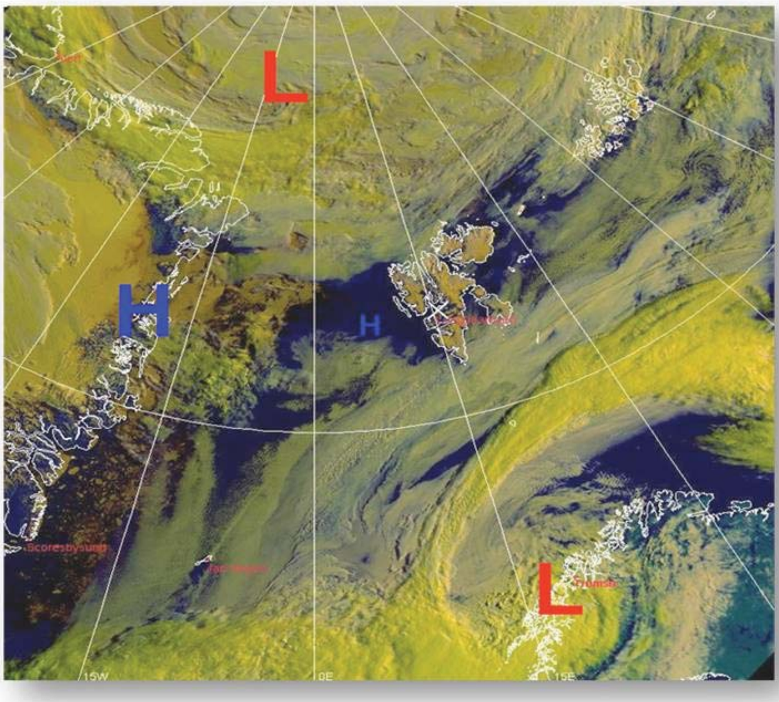

Fig. 2.1: VIS/IR satellite picture from 15.07.2012, 05:13 UTC (The position of Polarstern is marked by a white cross.)

A radical change in the weather situation occurred from 21st to 22nd July, caused by low pressure system entering the Svalbard region. One day later we faced a strengthening of the temperature-inversion, caused by warmer air aloft and an increasing wind speed of Bft 5 carrying colder air in lower layers.

Wave heights up to 1.5 m did not restrict station work, but low clouds and a bad visibility again caused appalling flight conditions. Unfortunately, this situation appeared to be rather stable and continued until the 25th July, when the ship finally left the ice-covered region in the north-eastern parts of the HAUSGARTEN area (Fig. 2.2).

Starting on 26th July, some Polar Lows crossed our working area. Together with snow, rain and low clouds and a cold north-westerly air flow of Bft 4, we got icing conditions for helicopters, which prevented all planned helicopter flights. Already the next day, flight weather conditions improved.

In the late afternoon of the 27th July, research work came to an end und we left the area. During our transit to Tromsø weak and variable winds were observed. Just before we reached our destination on Monday, 30th July, the north-easterly winds reached Bft 5-6 (Fig. 2.3) and the sea rose up to 2 to 3 m; at the same time, a high pressure system provided us with fine and even partly sunny weather conditions by the end of the cruise. Statistics of various other weather parameters are displayed in Figs 2.4 and 2.5.

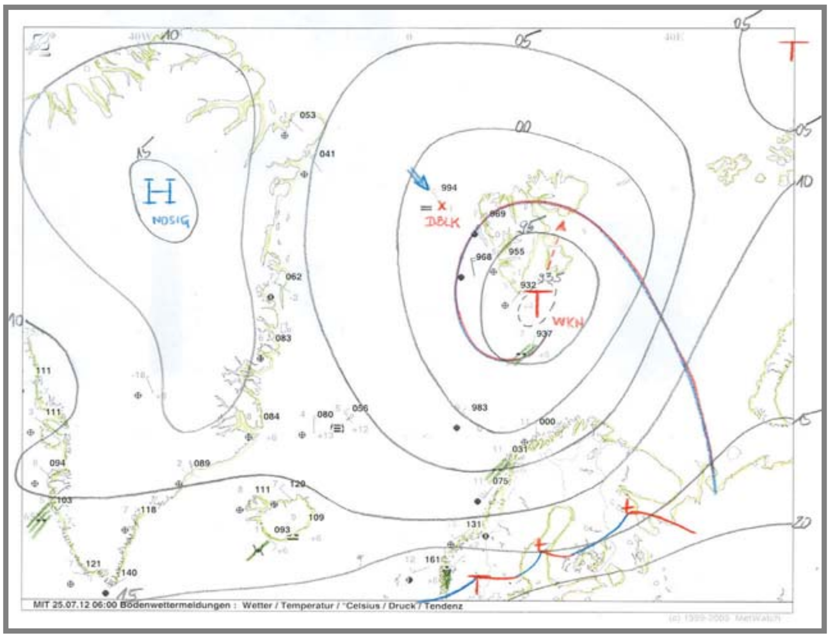

Fig. 2.2: Surface pressure chart for 25.07.2012, 06:00 UTC
(The position of Polarstern at that time is marked by a red cross.)

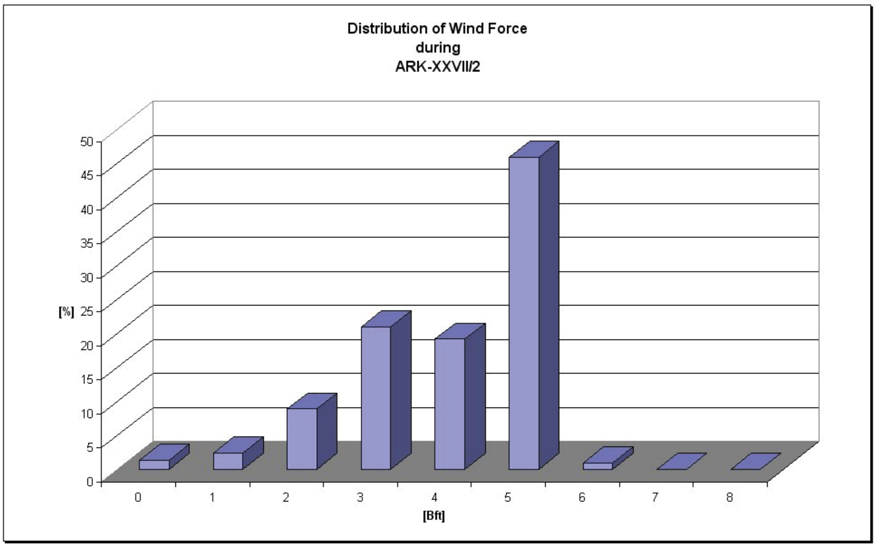

Fig. 2.3: Distribution of wind force during ARK-XXVII/2

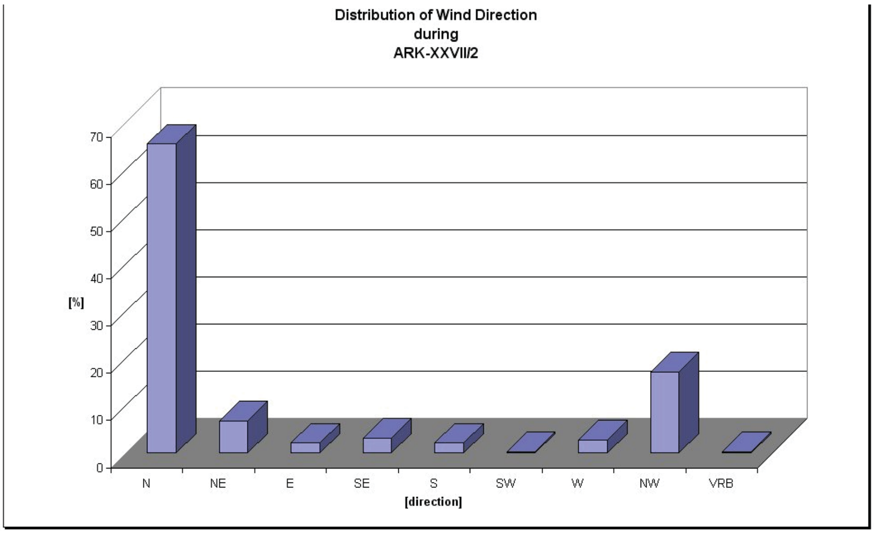

Fig. 2.4: Distribution of wind direction during ARK-XXVII/2

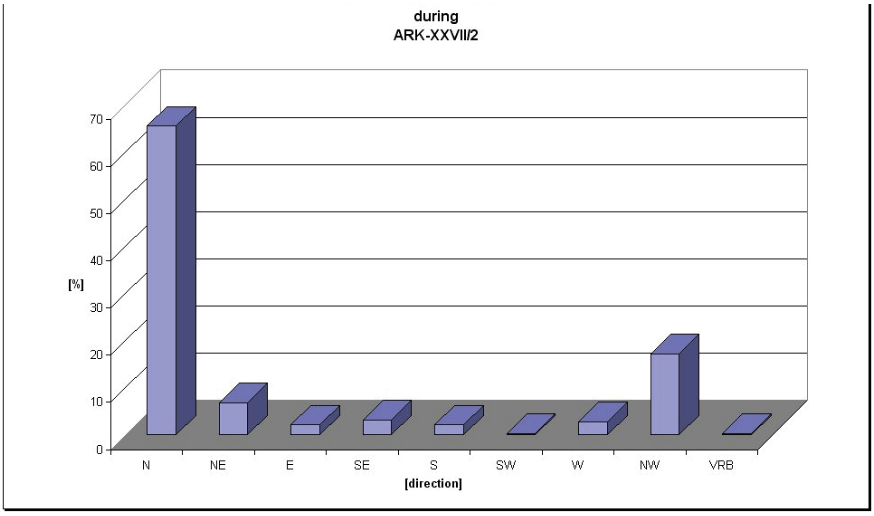

Fig. 2.5: Distribution of ceiling during ARK-XXVII/2

3. IMPACT OF CLIMATE CHANGE ON ARCTIC MARINE ECOSYSTEMS AT THE DEEP-SEA OBSERVATORY HAUSGARTEN

Deep-sea Research Group
Coordination Ingo Schewe AWI

Introduction

Since more than ten years the Deep-Sea Research Group of the Alfred Wegener Institute has been monitoring this first and - up to date - only deep-sea observatory at high latitudes. In an area of almost 8,000 square kilometres with water depths ranging between 1,000 and 5,500 m (Fig. 3.1), we study impacts of climate change on an Arctic marine ecosystem in a multidisciplinary approach. The so-called HAUSGARTEN observatory is located west of Spitsbergen in a region which is conspicuously affected by the adjacent marginal ice zone. The observatory includes 17 permanent sampling sites along a depth transect and along a latitudinal transect covering approximately 125 km and following the 2,500 m isobaths (Fig. 3.1). The central HAUSGARTEN station serves as an experimental area for unique biological short- and long-term experiments at the deep seafloor, simulating various scenarios in changing environmental settings. Multidisciplinary research activities at HAUSGARTEN started in 1999, covering almost all compartments of the marine ecosystem from the pelagic zone to the benthic realm, with some focus on benthic processes.

Concurrent with the efforts made by AWI at a northern polar deep-sea site, the Arctic Marine Ecosystem Research Network ARCTOS extensively studied the shallow Arctic pelagic and benthic ecosystems inside and off the Kongsfjord. The long-term co-operation of ARCTOS partners already provided good baseline data from the inner part of the fjord. In 1996, a transect of ten stations was established from Kongsfjord to outside the shelf break, covering five discrete depth strata. Stations along this transect have been sampled several times a year, and data have been continuously processed until summer 2006.

To assess how changes at one level impinge on other compartments of the ecosystem, we began to optimise the scientific outcome of the two sampling programmes by combining the Kongsfjord and HAUSGARTEN bathymetric transects. By chance, the shallowest AWI sampling station lies only some 25 nautical miles northwest of the deepest station of the Kongsfjord transect. The collaboration between AWI and ARCTOS yields a more complete data set spanning from shallow to deep water stations and rises in the KONGHAU project.

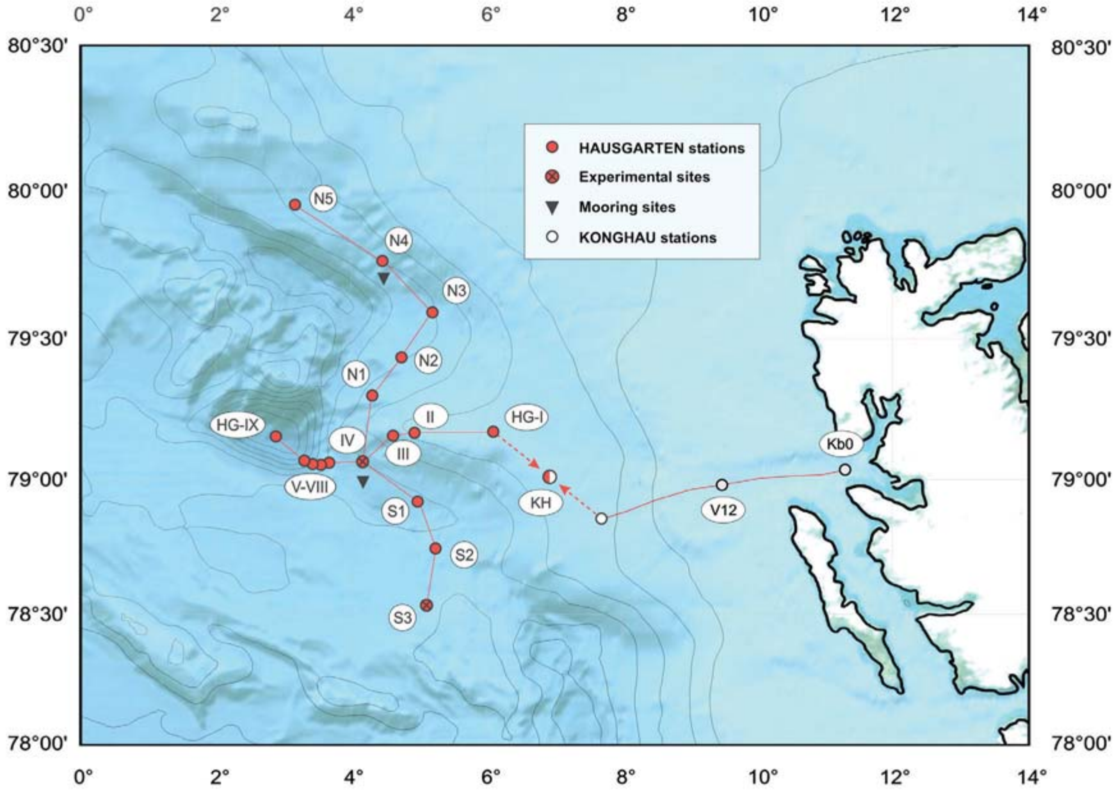

Fig. 3.1: HAUSGARTEN stations and sampling sites for the KONGHAU project

3.1 Water Column Characteristics and Water Sampling

Sebastian Albrecht[1], Levke Caesar[2], Jannes Kölling[2]

[1]FIELAX
[2]AWI

Objectives

Water column studies were carried out to investigate the variability of the oceanic fluxes through Fram Strait. The work contributes to long-term studies addressing the response of the various Arctic subsystems to the rigorous climatic changes of the last decades.

Work at sea

Water column characteristics were studied using a CTD/Rosette (Fig. 3.1.1). The CTD (Conductivity - Temperature - Depth) measures various physico-chemical properties and is combined with a rosette water sampling device.

During ARK-XXVII/2 we conducted a total of 24 CTD casts. Main objectives of these casts were the yearly monitoring at the permanent HAUSGARTEN sampling sites, to collect bacteria and phytoplankton in surface waters, and the recording of sound velocity profiles for underwater positioning and multi-beam echo sounder systems.

The CTD was equipped with a Sea-Bird Electronics, Inc. SBE 911+ system. The unit carried sensors for temperature (Sea-Bird SBE03+), conductivity (Sea-Bird SBE04C) and pressure (Digiquartz) along with additional sensors for oxygen (Sea-Bird SBE43), fluorescence (Wetlabs FLRTD) and transmission (Wetlabs CST). Temperature and conductivity were measured redundantly by a pair of sensors.

Fig. 3.1.1: Recovery of the CTD/Rosette at HAUSGARTEN observatory

The underwater unit was attached to a SBE 32 carousel water sampler that can remotely close 24 Niskin bottles à 12 litres. Derived variables from these raw parameters are salinity, hydrostatic pressure and the sound speed velocity. The collected data from each cast was processed using the software SBE Data Processing 7.19 (Sea-Bird) and ManageCTD (Rohardt, AWI). The results are available as data at 1 dbar intervals, graphical plots and bottle files containing averaged sensor values for each water sample taken.

For salinity sensor calibration water samples were taken regularly as a reference. The salinity was measured with the onboard Optimare Precision Salinometer (OPS).

Preliminary / expected results

Figure 3.1.2 exemplarily shows results from a CTD cast conducted at the central HAUSGARTEN site. Physico-chemical data assessed during ARK-XXVII/2 will be analysed in close cooperation between the Deep-sea Research Group and the Observational Oceanography Department at AWI.

Data management

The finally processed data will be submitted to the PANGAEA data library. The un-restricted availability from PANGAEA will depend on the required time and effort for acquisition of individual datasets and its status of scientific publication.

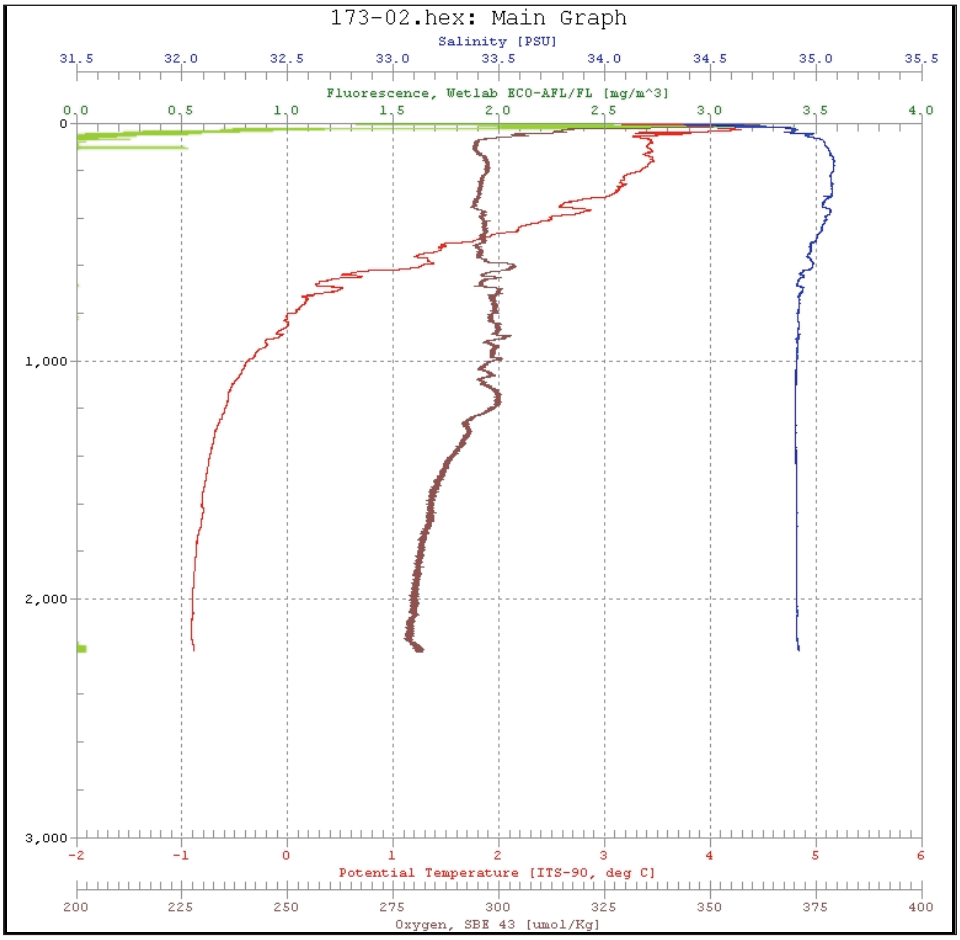

Fig. 3.1.2:

This graph exemplarily shows results from a CTD cast conducted at the central HAUSGARTEN site.

3.2 Surface-water Studies Using an Autonomous Underwater Vehicle (AUV)

Thorben Wulff[1], Ulrich Hoge[1], Sascha Lehmenhecker[1], Kimberly Shurn[2], Michael Klages[1]

[1]AWI
[2]Bluefin Robotics

Introduction

For the AUV Project, the *Polarstern* Expedition ARK-XXVII/2 marked a highlight in the already successful year 2012. The vehicle has left the phase of mere technical test operations and is increasingly considered to be a valuable tool in the scientific community. The integration of a nitrate sensor, a coloured dissolved organic matter (CDOM) sensor and a sensor module built by the Max Planck Institute for Marine Microbiology in Bremen has improved the payload of the vehicle. These sensors enable the vehicle to measure eleven independent, biochemical parameters *in-situ*. Along with this improvement in payload, significant advances in dive planning and vehicular control have bolstered the AUV's capabilities. Since 2010, the vehicle has been repeatedly used to carry out under ice operations and operations in parallel to ongoing research work onboard *Polarstern*.

Objectives

The main objectives of the AUV project at the AWI are the investigation of biogeochemical processes in the surface water, the analysis of the stratification of the upper water column in the ice-margin zone and the investigation of the dynamic interaction between ice and ocean. To achieve this goal the AUV performed a special dive manoeuvre which was developed and tested in spring 2012. In this manoeuvre the vehicle repeatedly drifts upwards and approaches the surface smoothly. Thus the vehicle can resolve the stratification of the water without causing greater disturbances and with a spatial resolution of 10 cm.

Work at sea

During ARK-XXVII/2, the AUV (Fig. 3.2.1) travelled a total distance of 80 kilometres in the sea between Greenland and Svalbard; Table 3.2.1 provides an overview about the dives conducted during the expedition. Compared to previous years, this represents a 40 % increase despite the lesser availability of ship time in 2012 – a clear indication of the increased reliability of the vehicle.

The AUV dives carried out during ARK-XXVII/2 (Tab. 3.2.1) covered a large spectrum of different vehicle behaviours. For example the vehicle accomplished dives in constant depth as well as dives in the so-called “attitude mode”, in which the vehicle follows the bathymetry of the seafloor at a constant distance. In addition, the last two dives led the vehicle below the Arctic sea ice. The main focus of all of these dives was surveying the uppermost water layers. To achieve this objective, a new manoeuvre was developed in the beginning of 2012 and finally performed in the Arctic during ARK-XXVII/2. In this “Free Float” manoeuvre the thruster of the vehicle is shut down. As the vehicle has a constant buoyancy of about 4.5 kg, it starts drifting upwards almost vertically and very slowly (10-12 m/min). While floating upwards the water layers are crossed with almost no disturbance and thus are surveyed with the highest possible resolution and accuracy. Especially in ice-covered regions exhibiting strongly stratified water masses underneath the sea ice, such a manoeuvre represents an appealing research opportunity. The “Free Float” manoeuvre was executed in each single dive. Starting at 50 m water depth, the vehicle floated up to 3 m in open water and up to 11 m under ice before descending again.

Fig. 3.2.1: Recovery of the AUV after a dive at HAUSGARTEN observatory

Tab. 3.2.1: AUV dives conducted during the *Polarstern* expedition ARK-XXVII/2

Date	Dive	Station No.	Run Time	Distance	max. Depth	Remarks
[dd.mm.yyyy]			[hh:mm]	[km]	[m]	
18.07.2012	1	PS80/170-4	03:47	19.2	325	Bubble Alley
20.07.2012	2	PS80/176-6	04:57	23.5	551	
22.07.2012	3	PS80/183-2	03:48	16.7	551	
24.07.2012	4	PS80/187-2	03:25	16.6	71	Under Ice
25.07.2012	5	PS80/190-1	00:50	3.6	52	Under Ice Mission aborted

Along with the sensor data, the vehicle collected 58 water samples with an overall volume of ~12 litres. The samples had been preserved on *Polarstern* and will undergo further analysis in the AWI´s laboratories.. In these analyses, scientists will focus on nutrients such as nitrate and phosphate and also on the amount of chlorophyll contained in surface waters.

AUV deployments in 2011 demonstrated the importance of tracking the moving ice edge; during ARK-XXVII/2, the technology to carry out relevant measurements was further developed. As the ice margin zone is a highly dynamic environment, it is of particular importance to know the positions of all objects involved in the dive (AUV, *Polarstern*, ice-edge, zodiac) and to combine and display them on a single computer screen.

One of the GPS transmitters tracking the moving sea-ice was deployed with a new-developed, remote-controlled flying drone, a so-called Hexacopter (Fig. 3.2.2.). The Hexacopter was launched from *Polarstern*, landed on the ice and started transmitting its own position via radio communication. While *Polarstern* was leaving the area, the Hexacopter was put into sleep mode in order to save energy and extend its endurance. In addition to the GPS transmitting unit, the Hexacopter carried a light sensor to conduct light measurements on the sea ice while the AUV was diving underneath it. After the AUV mission

Fig. 3.2.2: The Hexacopter on the ice

was completed, the Hexacopter was reactivated from its sleep mode and launched from the ice to land on *Polarstern´*s working deck just a few moments later. The deployment of the Hexacopter showed up an extremely effective way to mark the ice-edge and to bring instruments on the ice.

Preliminary / expected results

Missions containing the Float manoeuvre were conducted in the open water, at great distances to the ice edge, and in the ice-margin zone. As expected, the two parameters salinity and temperature decrease as the mission sites approach the ice. An interesting difference can be seen in the data of the two missions which were conducted under ice (24.07. and 25.07.). On July 24th the vehicle accomplished its first under ice mission, with data clearly indicating a stable stratification of the polar water (-1.7°C) body underneath the ice. Within 24 h the ice drifted 20 km southwards and thus covered a relatively warm (+3.1°C), Atlantic water body on July 25th. Due to this process the water stratification seems to be highly instable and is currently investigated in detail.

Data management

The finally processed data will be submitted to the PANGAEA data library. The unrestricted availability from PANGAEA will depend on the required time and effort for acquisition of individual datasets and its status of scientific publication.

3.3 Zooplankton studies using an innovative optical system

Eduard Bauerfeind[1], Heiko Lilienthal[2]
[1]AWI
[2]iSiTEC

Objectives

The quantity of Atlantic-derived water in the Arctic Ocean has increased considerably during the 1990's. In the Eurasian Basin, the Atlantic layer has become warmer and saltier. A strong, anomalously warm inflow of Atlantic water passed through the Fram Strait between 2005 and 2008. These changes may have serious consequences for pelagic ecosystems. An amplified advection and better survival of Atlantic populations may cause faunistic shifts in zooplankton communities through the replacement of arctic key-species by Atlantic fauna, the extinction of rare arctic deep-water species, and consequently changes in diversity. During the cruise ARK-XXVII/2, we had the opportunity to use the newly modified *in-situ* optical imaging system LOKI (Light frame On-sight Key species Investigation) to assess zooplankton communities in the HAUSGARTEN area.

Work at sea

After deploying LOKI at a test station, which was necessary to optimize the parameter settings of the instrument, we deployed the system at five stations in the HAUSGARTEN area, i.e. the central HG-station and the end positions of the E-W and N-S transects (Fig. 3.1). Deployment depths varied between 200 and 750 m and measurements were conducted when the system was hoisted at low speed (0.3 m/s). Several thousand images were taken and stored on site during each haul. After the recovery of the instrument, the gathered data was transferred from the instrument to a PC.

Preliminary / expected results

During the cruise, we could only check the images and got an impression of the presence of organisms, however, the data will be analysed in greater detail (e.g. size distribution) together with environmental datasets, e.g. to assign organisms or communities to different water masses or layers in the water column. Figure 3.3.1 shows a selection of organisms observed with the LOKI system. Copepods were the dominating organisms at all station. At some sites radiolarian colonies were found in comparably large quantities.

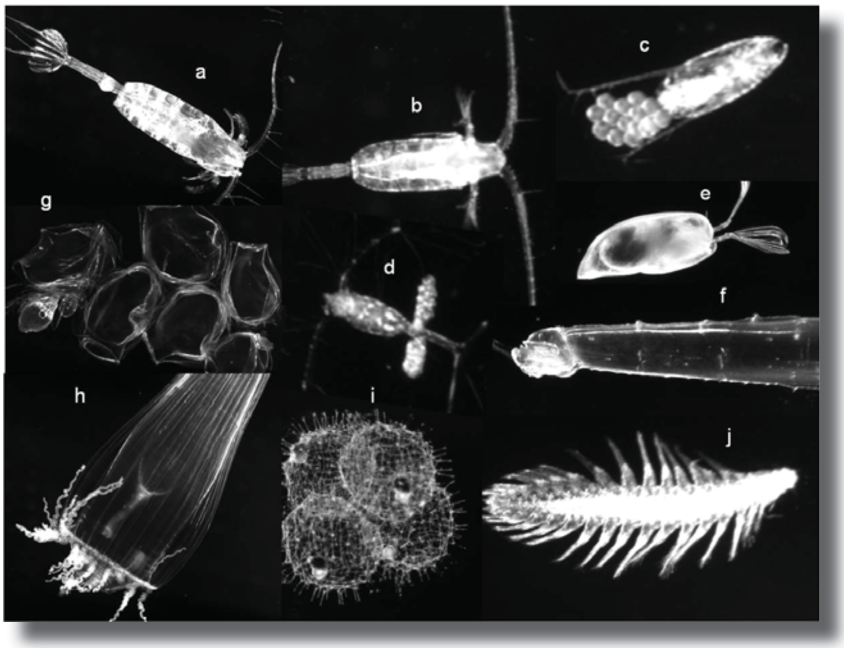

Fig. 3.3.1: Selection of images obtained in-situ in the HAUSGARTEN; a-d) copepods, e) ostracod, f) chaetognath, g) salp colony, h) medusae, i) radiolarian colony, j) polychaet larvae.

Data management

The finally processed data will be submitted to the PANGAEA data library. The unrestricted availability from PANGAEA will depend on the required time and effort for acquisition of individual datasets and its status of scientific publication.

3.4 Sedimentary Processes and Interactions

Eduard Bauerfeind, Normen Lochthofen AWI

Objectives

Organisms living in the deep sea mainly live on the organic matter that sinks out of the productive layer and finally reaches the sediments of the deep sea. Therefore the transfer of organic matter from the upper productive layer in the water column to the bottom of the Ocean is one of the key processes that facilitate life at the seafloor. Measurements of settling particles are performed by means of annually moored sediment traps Sedimentation studies, and chemical and biological analyses of trapped particles in the HAUSGARTEN area have been performed since the year 2000 to get insights into the amount, and composition of the settling material and its variability.

The results of this ongoing long-term study on sedimentation are the basis against which changes, which most likely will occur in the near future due to the proposed effect of global warming, can be judged.

Work at sea

During the *Polarstern* cruise ARK-XXVII/2, two deep-sea moorings equipped with sediment traps, self-recording CTDs and current meters were successfully recovered. These moorings were deployed during the *Polarstern* cruise ARK-XXVI/2 in 2011 at the central HAUSGARTEN site (HG-IV) and in the northern HAUSGARTEN region at station N-4 (Fig. 3.4.1). Seasonally resolved samples of the sediment traps were obtained from ~200 m and ~1,200 m below sea surface as well as 150 m above the seafloor at the central position, and from ~200 m below surface and 150 m above the seafloor at the northern position. Another sediment trap installed at 2 m above ground in a benthic lander system was successfully recovered at the central HAUSGARTEN station.

All the moorings were redeployed at the same positions during the cruise after refit and exchange of the instruments.

Preliminary results

First impressions of sedimentation and its seasonality during 2011/12 can be obtained from the amount of material collected in the sampling bottles (Fig. 3.4.1). The figure shows the sampling jars of the sediment trap obtained in ~200 m depth and 150 m above the seafloor at the northern HAUSGARTEN station N-4. A seasonal pattern in sedimentation can be clearly deduced in the upper trap (Fig. 3.4.1 a), with larger amounts of material in the sampling jars during August/September 2011. The amount of collected material decreased afterwards and stayed at a low amount during the winter period till February. During March 2012, the collected material increased and stayed at a low level thereafter up to the last collection period in July 2012, when the particle flux picked up again. In the samples obtained 150 m above the seafloor the amount of collected particles is apparently lower than in the shallow sediment trap (Fig. 3.4.1 b) and a seasonal pattern is not visible to the naked eye. However, more detailed information on sedimentation, the quantity and composition of the settled matter will be obtained after biochemical and microscopic analyses of the samples in the land-based laboratory.

Data management

The finally processed data will be submitted to the PANGAEA data library. The unrestricted availability from PANGAEA will depend on the required time and effort for acquisition of individual datasets and its status of scientific publication.

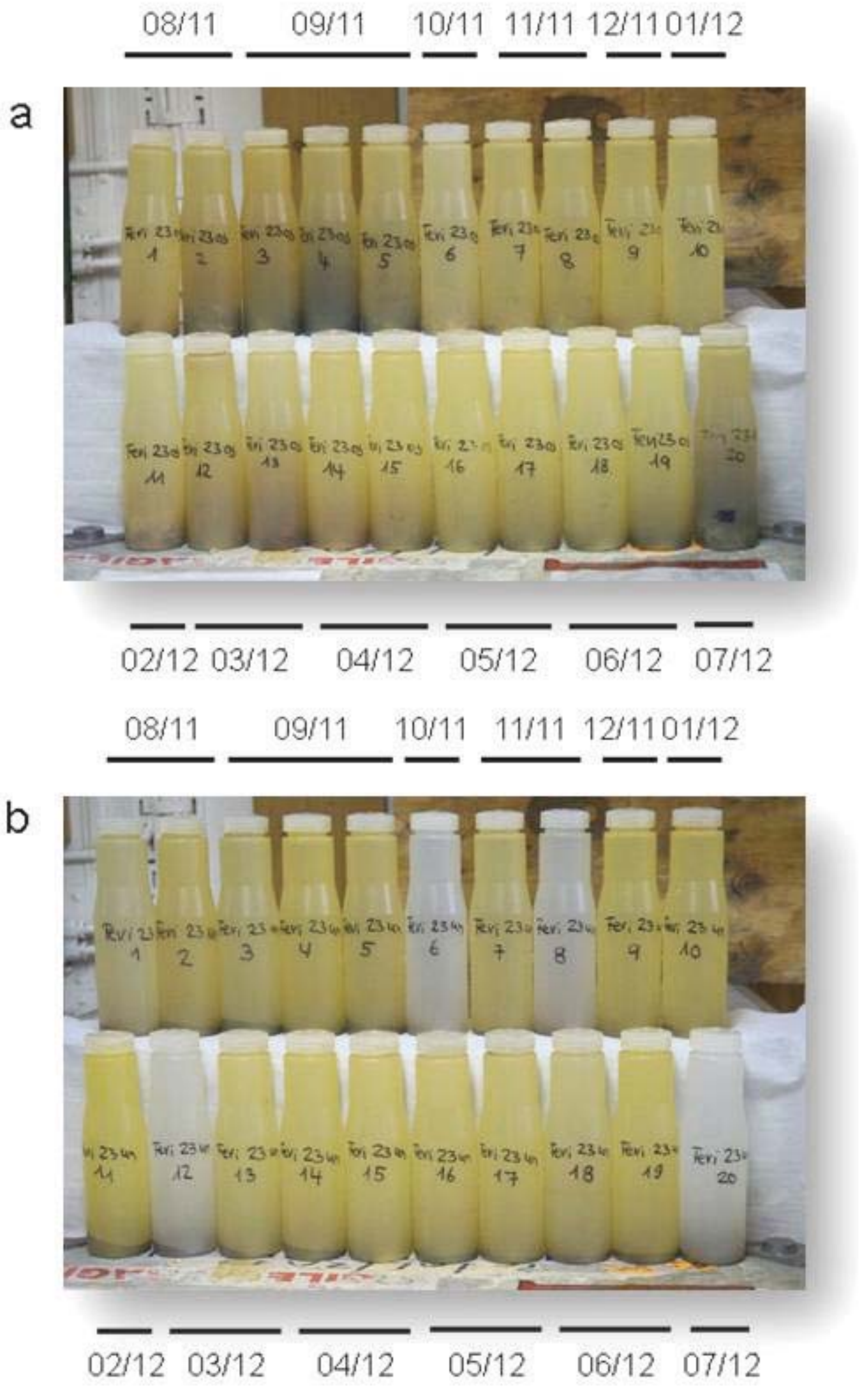

Fig. 3.4.1: Sampling jars of an annually moored sediment trap at Station N-4 from 08/2011 till 07/2012; samples from the trap moored at ~200 m below the surface (a) and from 150 m above the seafloor (b)

3.5 Biogenic Sediment Compounds and the Smallest Benthic Biota

Ingo Schewe, Christiane Hasemann, Anja Pappert, Annabel Lederich, Miriam Seifert, Ann-Kristin Siegmund
AWI

Objectives

Benthic investigations at HAUSGARTEN observatory comprise biochemical analyses to estimate the input of organic matter from phytodetritus sedimentation and to analyse the activity and biomass of the small sediment-inhabiting biota. Results from these studies will help to describe the eco-status of the benthic system.

Work at sea

Virtually undisturbed sediment samples were taken using a video-guided multiple corer (MUC) at 17 HAUSGARTEN stations along a bathymetric gradient between 1,000 and 5,500 m water depth, and a latitudinal transect along the 2,500 m isobaths. Three additional stations at 230, 280 and 1,200 m water depth were sampled as a continuation of the former KONGHAU project. The top five centimetres of the sediment were sub-sampled to analyse a variety of parameters, indicating the input of organic matter to the seafloor as well as sediment-bound biomass and benthic activity.

Chloroplastic pigments (chlorophyll *a* and its degradation products) represent a suitable indicator for the input of phytoplanktonic detritus to the seafloor. They can be analyzed with high sensitivity by fluorometric measurements. To acquire fast and reliable estimations about the total biomass of the microbial community in the sediment, we will analyse various biochemical bulk parameters

The determination of phospholipids, being typical cell wall compartments, provides good estimates about the biomass of living organism in the sediments (i.e. bacteria, yeasts, fungi, flagellates, ciliates, foraminiferans and metazoan meiofauna). To determine the total biomass in the sediments (organisms and detrital matter) we will analyse sediment-bound particulate proteins.

To estimate the potential heterotrophic activity of bacteria, we measured cleaving rates of extracellular enzymes using the model-substrate FDA (fluorescein-di-acetate) in incubation experiments. FDA was added in saturated concentration to obtain the maximum cleaving-rate of hydrolytic enzymes like esterases, lipases, proteases etc. To avoid losses in activity these analyses were done immediately after the recovery of the sediment samples on board *Polarstern*.

Preliminary results

Along the bathymetric HAUSGARTEN transect (Fig. 3.5.1), concentrations of sediment-bound chloroplastic pigments and the potential hydrolytic activity of sediment-inhabiting bacteria showed a nice gradient of decreasing values with increasing water depth (Figs 3.5.1 a,b), with expected very high concentrations on the shelf stations V12 and Kb0.

Upcoming analyses of additional parameters at the home laboratory will show whether the observed long-term trends at HAUSGARTEN observatory will continue and to which extend Climate Change induced processes might be responsible for the observed changes within the deep-sea ecosystem.

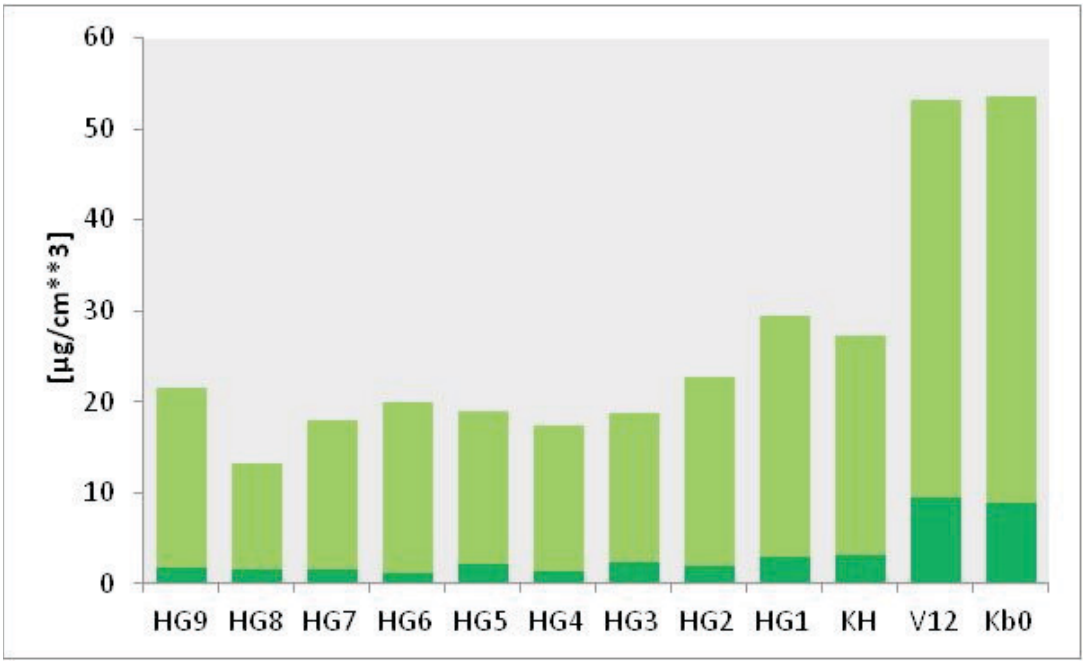

Fig. 3.5.1 a: Chloroplastic pigments bound in the first sediment centimetre (light green: phaeopigment; dark green: chlorophyll a)

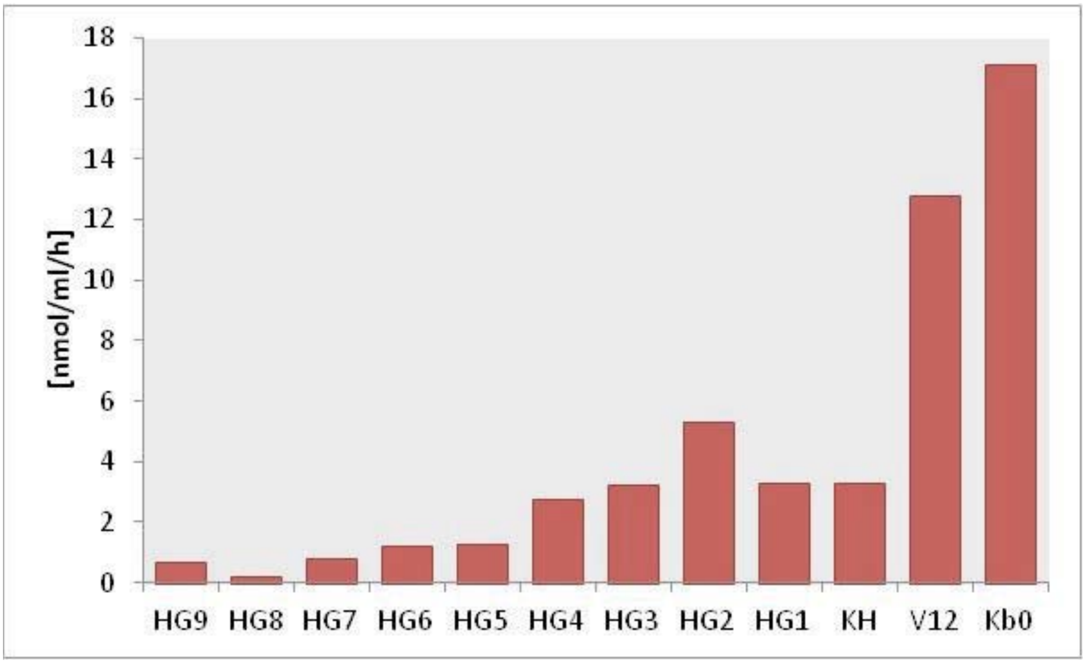

Fig. 3.5.1.b: Hydrolytic activity of bacteria within the first sediment

Data management

The finally processed data will be submitted to the PANGAEA data library. The unrestricted availability from PANGAEA will depend on the required time and effort for acquisition of individual datasets and its status of scientific publication.

3.6 Spatial and Temporal Variations in the Structure of Macrofaunal Benthic Communities

Nataliya Budaeva, Vadim Mokievsky, Andrey Vedenin — RAS

Objectives

Despite extensive sampling over more than 12 years, macrofauna studies at the deep-sea observatory HAUSGARTEN still remain insufficient for a complete understanding of the structure and composition of local deep-sea macrobenthic communities. HAUSGARTEN is located in the highly productive Marginal Ice Zone and harbours unusually high macrofauna densities (up to 3,200 ind./m²), biomass (6.4 g ww/m²), and species richness (Budaeva et al. 2008), compared to communities from ridges and basins of the permanently ice-covered Arctic Ocean (Kröncke 1994, 1998; Paul & Menzies 1974). Włodarska-Kowalczuk et al. (2004) reported community replacement along the bathymetric HAUSGARTEN transect with four different types of species compositions corresponding to so-called "shelf", "upper slope", "lower slope" and "rise" communities. Horizontal distributional patterns in the structure of macrofauna communities at 2,500 m water depth were analyzed by Budaeva et al. (2008). The analysis of macrofauna assemblages in a limited area (stations were approx. 26 km apart) revealed the presence of at least two different species assemblages in a presumably uniform environment. It still remains uncertain, whether these differences were due to varying distances to the ice edge, or whether they represented randomly distributed aggregations of species (Budaeva et al. 2008). Both studies were based on a limited set of samples and did not take into account temporal variations in local communities. The present study of spatial variation in the structure of macrofaunal communities along the latitudinal HAUSGARTEN transect (Fig. 3.6.1) aims to estimate the variability of major community parameters in a highly productive, high-latitude, deep-sea region.

Objectives of the macrofaunal work carried out during ARK-XXVII/2 include:

- the collection of box-core samples along the latitudinal HAUSGARTEN transect at varying distances to the ice edge;
- the structural analysis of deep arctic macrofauna communities at different spatial scales along the latitudinal transect;
- the assessment of temporal changes in deep-sea arctic benthic macrofauna communities (by species composition, richness, diversity, evenness, density, and biomass) over nine years in relation to changes in the position of the Marginal Ice Zone.

Work at sea

Eleven 0.25 m^2 box-core samples were collected during the Polarstern cruise ARK-XXVII/2 along the latitudinal HAUSGARTEN transect (Fig. 3.6). Each box-core sample was divided into eleven subsamples: one subsample of the water layer; four 0.03 m^2 of the surface sediment layer (0–4 cm); four 0.03 m^2 subsamples of the deeper sediment layer (4–14 cm); two subsamples 0.06 m^2 subsamples of the surface layer (0–4 cm). All samples were washed by hand through the 0.5 mm mesh size sieve and preserved on board. Water subsamples and 0.03 m^2 sediment subsamples were preserved in 10% formalin. Subsamples of 0.06 m^2 were preserved in 96% ethanol. Sample sorting, identification of species and assessment of species density and biomass will be performed in the laboratory after the cruise.

The following parameters will be estimated during the analytical phase of the project: species composition, species richness, density, biomass, species diversity expressed in Shannon–Wiener index, Pielou index, and Hulbert rarefaction index. The comparison of previously obtained data from the same area and similar studies conducted in tropical, temperate, and permanently ice-covered areas will enhance our understanding of spatial changes in deep-sea macrobenthic communities in general. The repeated sampling of the stations investigated by Budaeva et al. (2008) will provide a unique opportunity to evaluate changes in deep-sea macrofaunal communities exposed to Climate Change induced environmental changes over a nine-year time period. Knowledge gained on the spatial variations in macrofauna community structure at different spatial scales along the latitudinal transect will enable us to detect and separate the effects of the climate change from spatial heterogeneity in the distribution of deep-sea macrofauna.

Preliminary results

There are no preliminary results to be reported here because, all samples taken during *Polarstern* expedition ARK-XXVII/2 were preserved on board for later analyses at the home labs at the AWI in Bremerhaven and the P.P. Shirshov Institute of Oceanology, RAS, in Moscow.

Data management

The finally processed data will be submitted to the PANGAEA data library. The unrestricted availability from PANGAEA will depend on the required time and effort for acquisition of individual datasets and its status of scientific publication.

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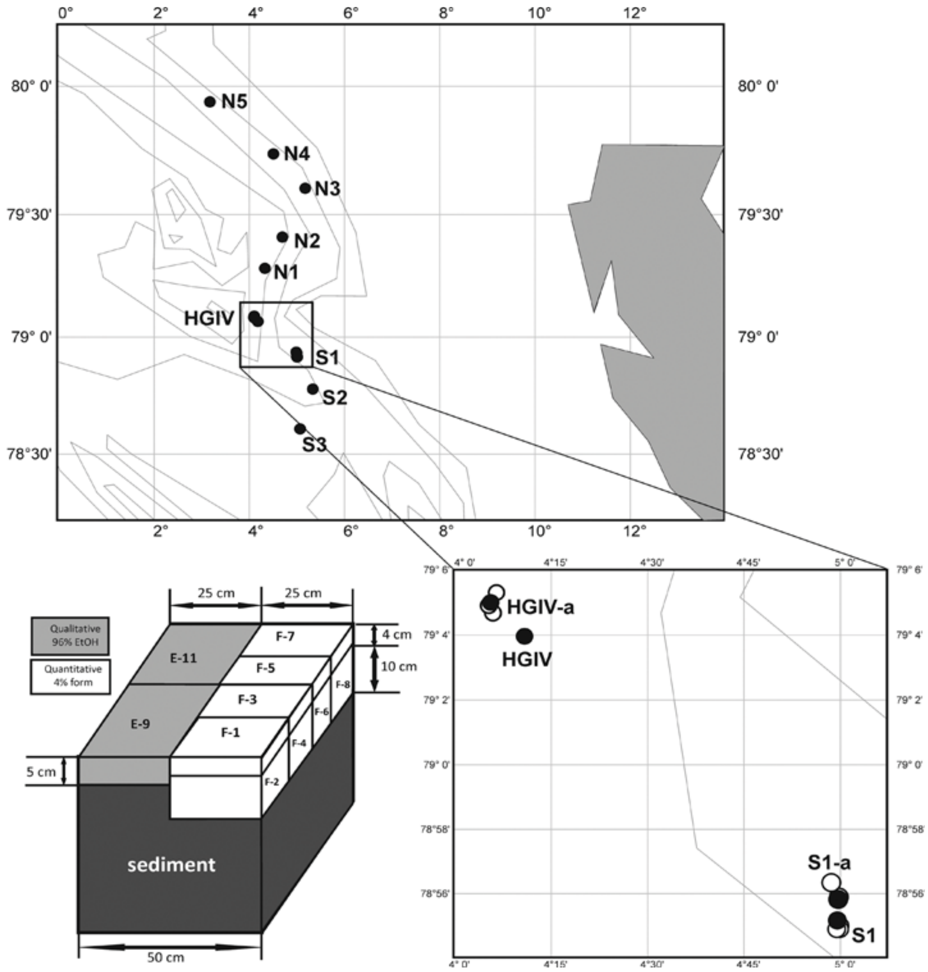

Fig. 3.6.1: Sampling area and scheme of collected subsamples; white circles represent samples from 2003; black circles represent samples from the current cruise, 2012

3.7 Megafaunal Dynamics and Ecology

Melanie Bergmann[1], Jennifer Dannheim[1], Kirstin Meyer[1], Kai Wätjen[1], Heiko Lilienthal[2]

[1]AWI
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Objectives

Through the continuous redistribution of organic matter, oxygen and other nutrients in surficial sediments by remineralisation, bioturbation and burial of sunken matter, benthic biota play an important role in the global carbon cycle. Epibenthic megafauna inhabit the sediment–water interface and are defined as the group of organisms ≥ 1 cm. They contribute considerably to benthic respiration and have a strong effect on the physical and biogeochemical micro-scale environment. Megafaunal organisms create pits, mounds and traces that enhance habitat heterogeneity and thus diversity of smaller sediment-inhabiting biota in otherwise apparently homogenous environments. Erect biota enhances 3D habitat complexity and provides shelter from predation. Megafaunal predators control the population dynamics of their prey and therefore shape benthic food webs and community structure. Sunken organic matter that is not converted into benthic biomass and forwarded along food chains might be actively transported from the water column-sediment interface into the sediment by bioturbation. Organic matter is then degraded/recycled into nutrients and CO_2. Mega- and macrofaunal species thus actively influence biogeochemical processes at the sediment–water interface. An understanding of megafaunal dynamics is therefore vital to our understanding of the fate of carbon at the deep seafloor, Earth's greatest carbon repository.

Benthic megafaunal communities sampled by deep-sea photography

Epibenthic megafauna, often arbitrarily defined as organisms large enough to be seen with a camera, play an important role in the deep-sea community. They influence benthic respiration, nutrient cycles and bioturbation and also provide structure at the sediment-water interface. Thus, it is important to understand variations in the megafaunal community with depth, latitude, time, and habitat features such as hard substrates.

Work at sea

To sample the benthic megafauna by a non-destructive method at a large scale and to gain *in-situ* views of the organisms, we used a towed camera (Ocean Floor Observation System, OFOS) alongside *Polarstern*. Photographed transects were located along both bathymetric and latitudinal transects and replicated sampling conducted in previous years to continue our image time series.

A total of six photographic transects were accomplished during ARK-XXVII/2 (Tab. 3.7.1). The central HAUSGARTEN station (HG-IV) was sampled to continue the annual time-series sampling regime at that station. In addition, the northerly station N-3 and southerly station S-3 were sampled for comparison of the megafauna along a latitudinal transect and also to continue the time series at each respective station. Because of favourable ice conditions, we were also able to conduct a transect at the northernmost HAUSGARTEN station, N-5, for the very first time. No formal transect was sampled here; rather, *Polarstern* was allowed to drift in an opening in the sea-ice. The resulting path of the OFOS was in a generally northwest-southeast direction.

The shallowest of the HAUSGARTEN stations, HG-I, was sampled in order to continue a time series of photographs collected from this station in 2002 and 2007; 2012 completes a 10-year time-series. Finally, an underwater rocky cliff was photographed at the so-called HG "Senke" station. The HG "Senke" transect yielded a rich collection of photographs, including views of numerous drop-stones, rocky overhangs, and the steep incline that characterizes the station.

Preliminary results

Results of time-series, latitudinal, and substrate analyses will only be available once the collected images will have been analysed and species present have been identified. However, a few selected images and photographed species are shown below (Figs. 3.7.1 A-D). Sadly, we photographed a few items of plastic on the seafloor again. At first impression, the nethermost station N-5 harboured more fish (*Lycodes frigidus*) and starfish (*Hymenaster pellucidus*) but only rigorous analysis will show if this notion is correct.

Tab. 3.7: Transects sampled by the OFOS during ARK-XXVII/2

Station number	Station name	Date	Start latitude (N)	Start longitude (E)	Start depth (m)	Start time	End latitude (N)	End longitude (E)	End depth (m)	End time
PS80/168-1	HG-I	17.07.2012	79°07.94'	06°15.70'	1321	08:41	79°08.00'	06°07.84'	1274	11:58
PS80/176-1	S-3	19.07.2012	78°37.04'	05°00.07'	2360	22:56	78°37.0'	05°08.56'	2352	01:59
PS80/179-3	HG-IV	21.07.2012	79°01.98'	04°09.75'	2630	14:34	79°03.88'	04°17.18'	2409	18:00
PS80/186-5	N-5	24.07.2012	79°56.07'	03°07.98'	2534	07:46	79°55.63'	03°05.69'	2554	09:16
PS80/193-1	N-3	26.07.2012	79°36.04'	05°09.88'	2748	10:56	79°33.53'	05°16.99'	2608	14:17
PS80/196-1	"Senke"	27.07.2012	79°05.98'	04°23.01'	2296	06:46	79°06.02'	04°33.92	2041	10:46

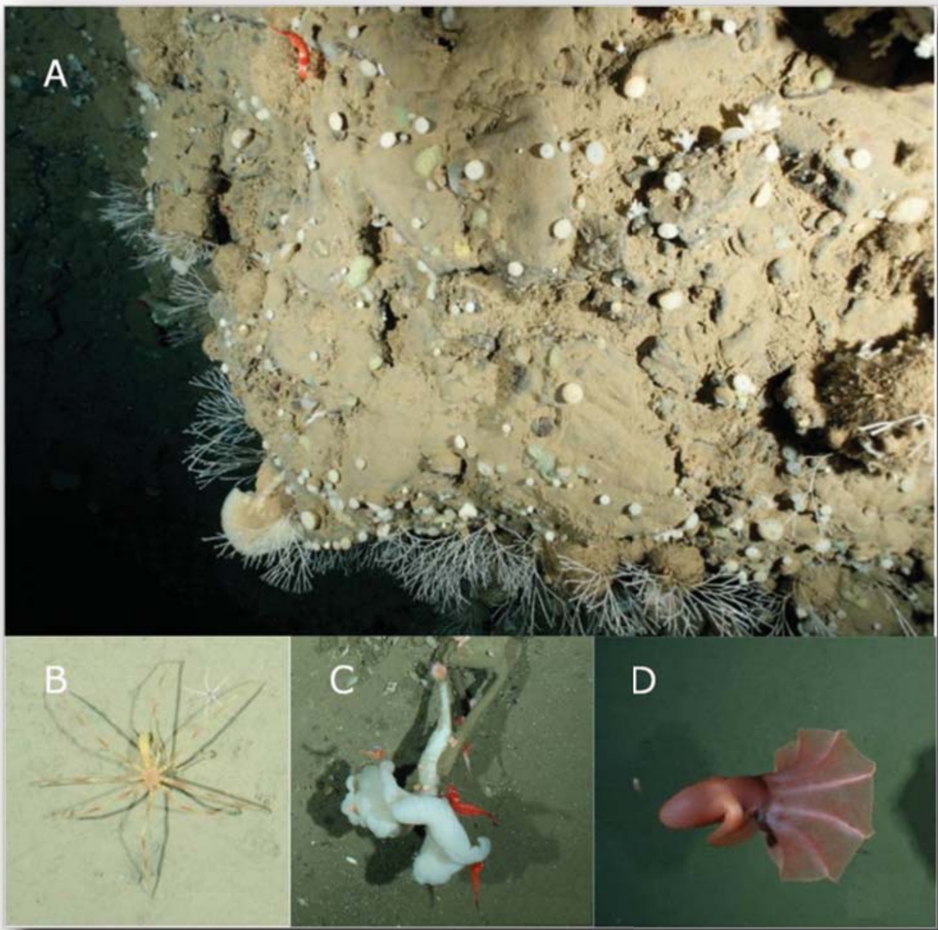

Fig. 3.7.1: (A) an overhang of the underwater cliff at station HG "Senke"; (B) a sea spider, Colossendeis proboscidea, at station HG-I; (C) a sponge, Caulophacus arcticus, with Bythocaris sp. and hormathid anemones at HG-IV; (D) a cephalopod (probably *Cirrotheutis mülleri) at N-5*

Ground-truthing and analysis of trophic interactions

Many megafaunal organisms cannot be identified from images alone. To gather physical specimens for ground-truthing, we used an Agassiz trawl (Fig. 3.7.2) at the shallowest HAUSGARTEN station HG-I and at selected stations along the latitudinal transect (N-4, HG-IV, S-3). The biota caught was washed over a 1-2 and a 0.5 mm sieve (sub-sample for species identification) and sorted into species/taxa. Specimens were then divided so as to have enough individuals for identification and different analyses. Tissue samples were taken for bulk stable isotope analysis to determine the trophic position of megafaunal species and characterize the food web. Comparison with previous results (Bergmann et al. 2009) will enable us to assess trophic changes. For the first time, we also took samples for the analysis of fatty acids and the ice diatom biomarker IP25 to determine the importance of ice algae to the deep-sea megafauna during an era of shrinking sea ice. Sediment samples from a multiple corer and filtered water samples from the CTD rosette

(POM) were also taken for these analyses. The tissues of fish (*Lycodes frigidus*) caught by baited traps fitted to a benthic lander (Fig. 3.7.2) were sampled to the same end. Comparison with previous samples will allow us to assess changes at higher trophic levels.

Fig. 3.7.2: Agassiz trawl retrieved at N-4 (left) and baited trap lander recovered at HG-IV (right)

Bioturbation in the deep Arctic sea

An *ex-situ* experiment was conducted to assess bioturbation (depth) over time (Fig. 3.7.3). To determine the depth of sediment reworking by mega- and macrofaunal species, luminophores were added to freshly collected, undisturbed sediment cores obtained by a multiple corer from the HAUSGARTEN station HG-I (ca. 1,200 m). Eight tubes were incubated oxygenated in the dark for 3 months at 0°C. Upon *Polarstern*'s arrival in Bremerhaven each of the eight cores will be sectioned into 0.5 cm layers and samples treated with 4% buffered formalin. We will then quantify luminophore abundance in the different sediment horizons and identify mega- and macrofaunal species present to determine bioturbation depth and bioturbators.

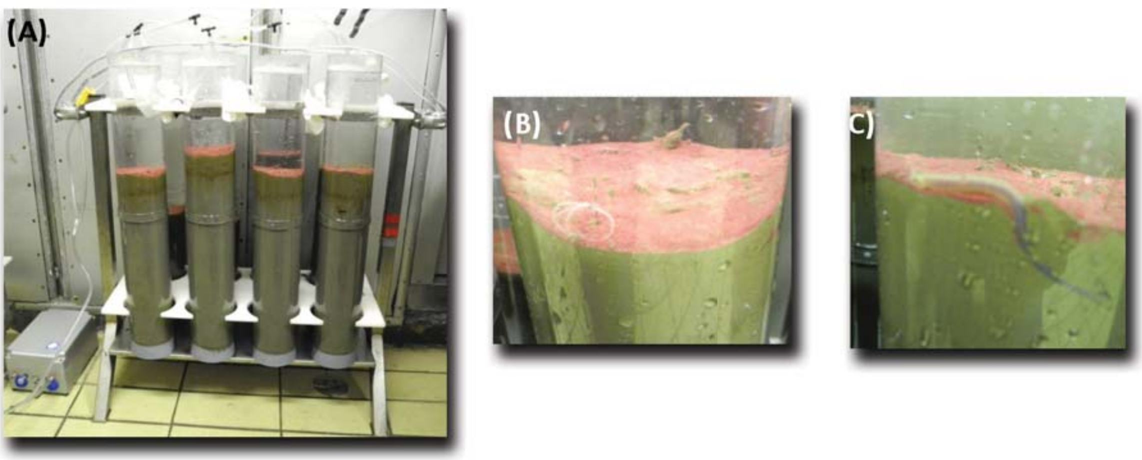

Fig. 3.7.3: (A) Setup used for incubation of bioturbation ex-situ experiment, (B) surface and (C) cross section of one of the experimental cores

(Micro-) Plastics

Recent research indicates an increase of litter at the seafloor of the central HAUSGARTEN station (HG-IV) between 2002 and 2011. Litter densities in 2011 exceeded even those reported from a canyon near the heavily populated and industrialised Portuguese capital Lisbon. During OFOS deployments, we observed again a number of litter items on the seafloor. However, to assess if this 'trend' persists, we will scan the new OFOS footage for litter. A few pieces of plastic were also caught by trawls and will be analysed. Recordings of litter floating at the water surface during transects of D'Hert et al. (this volume) will also be analysed. Where enough material could be spared samples of megafauna, fish (stomachs) and sediments, were also taken for the analysis of micro-plastics by colleagues from Helgoland (G. Gerdts, M. Löder).

Data management

The finally processed data will be submitted to the PANGAEA data library. The unrestricted availability from PANGAEA will depend on the required time and effort for acquisition of individual datasets and its status of scientific publication.

4. PLANKTON ECOLOGY AND BIOGEOCHEMISTRY IN THE CHANGING ARCTIC OCEAN

PEBCAO group
Coordination Eva-Maria Nöthig (not on board) AWI
Katja Metfies, Sonja Endres, Nicole Hildebrandt,
Carolin Mages, Sandra Murawski, Imke Petersen,
Jon Roa, Maria Winkler

Objectives

Acknowledging the sensitivity of the Arctic to global environmental change, the project PEBCAO (Plankton Ecology and Biogeochemistry in a Changing Arctic Ocean) is dedicated to study plankton communities and microbial processes relevant for biogeochemical cycles of the Arctic Ocean. It is expected that the Arctic is facing rising temperatures, a decline of sea ice or a decrease in seawater pH in the future. In order to understand and track potential consequences for the pelagic ecosystem in the Arctic Ocean, both long-term field observations and experimental work with Arctic plankton species and communities are needed to gain knowledge about the biological feedback potential of pelagic communities in the future Arctic Ocean. During this cruise leg, samples have been collected in the area of the deep-sea observatory HAUSGARTEN located in Fram Strait between 78-80°N and 2-6°E.

Biogeochemistry & Phytoplankton

Recent investigations have shown that rising temperatures as well as the freshening of surface waters promote a shift in phytoplankton communities towards a dominance of smaller cells. A change in size of the primary producers could have significant consequences for the entire food web in polar waters as well as for the cycling and sequestering of organic matter. An increase in ice-free water surface as well as CO_2- and temperature-related changes in the carbonate chemistry of the ocean will also affect the cycling of biogenic elements. Because of the vast spatial dimensions of the oceanic system, even small changes in the biological pump could significantly affect atmospheric CO_2 concentration.

Bacterioplankton

Based on the awareness that global change has increasingly changed marine ecosystems, we also intend to examine the 'present day' situation of pelagic microbiogeochemistry in the Arctic Ocean, with emphasis on the turnover of organic matter during production and decomposition processes. The data shall serve as a database for a better evaluation of the relevance of changes that are determined in perturbation experiments, such as the Svalbard CO_2 mesocosm study 2010 (European Project on Ocean Acidification, EPOCA). Our overarching goal is to contribute to a better understanding of the direction and strength of biogeochemical and microbiological feedback processes in the future ocean.

The bio-reactivity of particulate and dissolved organic matter is determined by its biochemical composition and digenetic state. The loss of organic matter within and below the euphotic zone is mainly mediated by the degradation activity of heterotrophic bacteria, colonizing sinking particles and their surroundings (Cho & Azam 1988, Karl et al. 1988, Smith et al. 1992). Hence, bacterial activity co-determines the efficiency of carbon export to the deep ocean. Furthermore, the bacterioplankton plays an important role in the fate of organic matter in the ocean and is substantially contributing to oxygen consumption and CO_2-release in the ocean. Dissolved organic matter is almost exclusively accessible for bacterial cells that make it available for higher trophic levels by the production of bacterial biomass. Effects of increasing temperature and decreasing pH on bacterial communities and their activity are thereby of outstanding importance, but yet hardly considered. Studies conducted in the past decades revealed strong physiological responses of marine bacteria to changing temperature and pH, but their relevance for biogeochemical cycles in the future ocean is only poorly investigated.

Zooplankton

Zooplankton species are associated with different water masses. Rising water temperatures due to climate change might result in a shift in the zooplankton species composition in the Fram Strait. Furthermore, the organisms might be affected by seawater pH, which decreases due to uptake of anthropogenic carbon dioxide (ocean acidification). This could have severe consequences for the ecosystem functioning. To detect possible impacts of these environmental changes, we studied the zooplankton community composition and depth distribution in the HAUSGARTEN area during ARK-XXVII/2 and compare these with previous studies from the same region. In addition, we investigated the effects of ocean acidification on calanoid copepods, which dominate the zooplankton in the study area, by means of incubation experiments.

Work at sea

Biogeochemistry & Phytoplankton

We sampled seawater of 5-8 water depths by a CTD/Rosette water sampler (Fig. 3.1.1) in the HAUSGARTEN area to determine the impact of microbial processes on the aggregation of sedimentation of organic matter. Samples were taken for various biogeochemical parameters such as chlorophyll *a* and pigments (HPLC), seston, dissolved and particulate organic carbon (DOC and POC), dissolved and particulate organic nitrogen (DON and PON) and particulate biogenic silica (PbSi). Additional samples were taken by CTD/Rosette casts for microscopy and flow cytometry, and at selected stations with a hand net to examine the phytoplankton and protozooplankton abundance. All samples were preserved or frozen at -20°C or -80°C. Samples for carbohydrates and amino acids were collected and stored at -20°C. Concentrations of carbohydrates and amino acids will be determined using IC and HPLC, respectively. Samples for transparent exopolymer particles (TEP) and Coomassie stainable particles (CSP) were taken and stored at -20°C until analysis by photometry and microscopy back at the institute. Samples for total alkalinity (TA) were collected at all stations and stored refrigerated. Additionally, water samples were collected from the CTD/Rosette from the top 100 m depth in order to assess differences in the phytoplankton community (eukaryotes and cyanobacteria) composition by automated ribosomal intragenic spacer analysis (ARISA) and 454-next generation sequencing. The samples were fractionated by three filtrations on 10.0 µm, 3.0 µm and 0.2 µm filters and stored at -80°C until further analysis in the laboratory. Isolates of the polar prymnesiophyte *Phaeocystis* *pouchetii* sampled on ARK-XXVII/1 and ARK-XXVII/2 have been inoculated and will be genetically and physiologically investigated at the Alfred Wegener Institute in Bremerhaven.

Bacterioplankton

Rates of bacterial extracellular enzymes (phosphatase, a- and b-glucosidase, and leucine-aminopeptidase), were determined in samples from all CTD/Rosette casts. Additional samples were taken to determine bacterial abundance by flow cytometry.

Zooplankton

To investigate community composition and depth distribution of the mesozooplankton in the HAUSGARTEN area, we used a multi net (Fig. 4.1) equipped with five nets (mesh size: 150 µm). Vertical net hauls sampling five different depth strata (1500-1000-500-200-50-0 m) were conducted at a total of five HAUSGARTEN stations (HG-I, HG-IV, HG-IX, S-3, N-4; Fig. 3.1). The samples were immediately preserved in formalin buffered with hexamethylenetetramine and will be analyzed at the AWI laboratories in Bremerhaven.

Fig. 4.1: Deployment of the Multi net to collect mesozooplankton in the HAUSGARTEN area

To study the effects of ocean acidification on food uptake of dominant calanoid copepods, grazing experiments were set up during ARK-XXVII/1 and continued during ARK-XXVII/2. Living individuals of *Calanus finmarchicus* and *C. glacialis* were sorted from Bongo net (Fig. 4.2) hauls and incubated in filtered seawater treated with different CO_2 partial pressures (390, 1120, and 3000 µatm) at ambient temperatures (0°C and 5°C, respectively). Copepods were fed *ad libitum* with the diatom *Thalassiosira weissflogii* cultured onboard. Every 3 to 4 days, 30 individuals per CO_2 treatment were transferred to bottles containing filtered seawater with the respective CO_2 partial pressures and *T. weissflogii* in a concentration of 2000 c/ml. The bottles were mounted to a plankton wheel to keep the algae in suspension. After ~20 h the experiment was stopped and the copepods were deep-frozen for carbon and nitrogen measurements. Subsamples for chlorophyll *a* measurement and cell counts of the water used in the experiments were taken at the beginning and in the end of each experiment in order to calculate grazing rates. In addition, copepods were deep-frozen at the beginning and at the end of the incubation period (~2 weeks) for carbon and nitrogen content analyses as well as for enzyme activity measurements.

Fig. 4.2: Deployment of the Bongo net to collect zooplankton species

Samplings accomplished by the PEBCAO team from CTD casts and by net hauls are summarized in Tables 4.1 and 4.2.

Preliminary / expected results

All samples taken during *Polarstern* expedition ARK-XXVII/2 were preserved on board for later analyses at the home labs at the AWI in Bremerhaven and the GEOMAR | Helmholtz-Zentrum für Ozeanforschung in Kiel. Thus, there are no first results to be reported at this stage.

Tab. 4.1: Biogeochemical parameters sampled from CTD casts (Chl *a*: chlorophyll *a*; HPLC: chromatographic pigment analysis; POC: particulate organic carbon; PON: particulate organic nitrogen; bPSi: biogenic particulate silica; DOC: dissolved organic carbon; DON: dissolved organic nitrogen; TEP: transparent exopolymer particles; CSP: Coomassie stainable particles; CHO: carbohydrates; AA: amino acids; TA: total alkalinity).

	Chl *a* HPLC	**POC** PON	**bPSi**	**DOC DON**	**TEP** CSP	**CHO** AA	**TA**
HG-I	x	x	x	x	x	x	x
HG-II	x	x	x	x	x	x	x
HG-III	x	x	x	x	x	x	x
HG-IV	x	x	x	x	x	x	x
HG-V	x	x	x	x	x	x	x
HG-VI	x	x	x	x	x	x	x
HG-VII	x	x	x	x	x	x	x
HG-VIII	x	x	x	x	x	x	x
HG-IX	x	x	x	x	x	x	x
N-5	x	x	x	x	x	x	x
N-4	x	x	x	x	x	x	x
N-3	x	x	x	x	x	x	x
N-2	x	x	x	x	x	x	x
N-1	x	x	x	x	x	x	x
S-1	x	x	x	x	x	x	x
S-2	x	x	x	x	x	x	x
S-3	x	x	x	x	x	x	x
KH	x	x	x	x	x	x	x
Kb0	x	x	x	x	x	x	x

Tab. 4.2: Biological parameters from net hauls (BacCells: bacterial cell numbers; PhytoCells: phytoplankton cell numbers).

	Bac- Cells	**Phyto-Cells**	**DNA** Cyano-bacteria	**DNA** Euka-ryotes	**Exo-enzy-matic Activity**	**Net Hauls**	**Micro-scopy**
HG-I	x	x	x	x	x	x	x
HG-II	x	x			x		
HG-III	x	x			x		
HG-IV	x	x	x	x	x	x	x
HG-V	x	x			x		
HG-VI	x	x			x		
HG-VII	x	x			x		
HG-VIII	x	x		x	x		
HG-IX	x	x		x	x	x	x

	Bac- Cells	**Phyto-Cells**	**DNA** Cyano-bacteria	**DNA** Euka-ryotes	**Exo-enzy-matic Activity**	**Net Hauls**	**Micro-scopy**
N-5	x	x			x		
N-4	x	x	x	x	x	x	x
N-3	x	x			x		
N-2	x	x			x		
N-1	x	x			x		
S-1	x	x			x		
S-2	x	x			x		
S-3	x	x	x	x	x	x	x
KH	x	x			x		
Kb0	x	x			x		

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5. HIGHER TROPHIC LEVELS: AT-SEA DISTRIBUTION OF SEABIRDS AND MARINE MAMMALS

Diederik D'Hert, Damien Sevrin, PolE
Quentin Goffette,Claude R. Joiris (not on board)

Objectives

This campaign was part of a long-term study of seabirds and marine mammals in the Arctic as well as the Antarctic Polar Regions (Joiris 2000).
The main objective was to improve the knowledge of and quantify the at-sea distribution of seabirds, cetaceans and pinnipeds water) and ice conditions (Outer Marginal Ice Zone, Closed Pack ice), as well as and detect possible links with main hydrological parameters (water temperature and salinity, ice coverage) that identify the main water masses (Atlantic, Pacific oceanic, polar fronts between water masses or ice edge. The integration of the data into a time series running since 1973 might unravel possible changes in numbers and distribution that might be caused by climate changes and pack ice extend during the last 30-35 years.

Work at sea

Birds and mammals were recorded by 30'-transect counts from the bridge while sailing with a minimum speed of 5 knots, in a 90° angle on either starboard of portside of the *Polarstern* (depending on the light condition) without width limitation. Animals were detected with naked eye, observations being confirmed and detailed with high quality binoculars (Swarovski and Kite, 10 x 42 and 10 x 50) or telescope (Swarovski or Zeiss, 25-50 x-80). When the *Polarstern* was not sailing, additional sightings were done to improve and refine the distributional knowledge of marine mammals and birds. Additional helicopter-based counts were done as to cover a wider working area and investigate regions and habitats out of range of the ship, and to allow comparison between data obtained from different observation platforms. On multiple occasions, a digital camera was used to ease and strengthen the identification of some animals.

Preliminary results

A total of 218 periods of data recording, each consisting of 30 minutes were conducted. During the effort counts, 16 bird species and 7 species of marine mammals (6 cetaceans and 1 species of pinniped) where observed.
The total number of seabirds observed was 7,582 (see Table 5.1). The mean number of seabirds was nearly 35 per count, which is more than the mean number during the first leg (22). However, one should bear in mind that this mean number is largely influenced due to high numbers of Little Auks (*Alle alle*) and Brünnich's Guillemots (*Uria lomvia*) observed when the *Polarstern* was at station close to land, which makes it not a good representative for the number of birds encountered offshore.
The species composition seems to be similar to previous campaigns, but in general

the numbers of each species were lower. This might be the result of spending less time near the ice edge or close to land, but therefore the data of previous campaigns should be investigated in more detail.

The most numerous species is the same as recorded during previous censuses, being the Little Auk (*Alle alle*), Brünnich's Guillemot (*Uria lomvia*) and the Northern Fulmar (*Fulmarus glacialis*). The number of Glaucous Gull (*Larus hyperboreus*) further – strongly - decreased compared to the censuses of 2010, which was also noted on ARK-XXVII/1.

Tab. 5.1: Numbers of birds seen during the 218 recording periods from the moving ship (RP) as well as observations outside these periods (ORP).

English name	German name	Scientific name	RP	ORP
King Eider	Prachteiderente	*Somateria spectabilis*	2	0
Common Eider	Eiderente	*Somateria mollissima*	1	1
Northern Fulmar	Eissturmvogel	*Fulmarus glacialis*	1434	313
Black-legged Kittiwake	Dreizehenmöwe	*Rissa tridactyla*	691	131
Ivory Gull	Elfenbeinmöwe	*Pagophila eburnea*	4	7
Sabine's Gull	Schwalbenmöwe	*Xema sabini*	0	1
Great Black-backed Gull	Mantelmöwe	*Larus marinus*	19	0
Glaucous Gull	Eismöwe	*Larus hyperboreus*	25	5
European Herring Gull	Silbermöwe	*Larus argentatus*	2	0
Arctic Tern	Küstenseeschwalbe	*Sterna paradisaea*	20	1
Great Skua	Skua	*Stercorarius skua*	2	4
Pomarine Skua	Spatelraubmöwe	*Stercorarius pomarinus*	0	2
Arctic Skua	Schmarotzerraubmöwe	*Stercorarius parasiticus*	1	2
Long-tailed Skua	Falkenraubmöwe	*Stercorarius longicaudus*	0	1
Little Auk	Krabbentaucher	*Alle alle*	2794	573
Brünnich's Guillemot	Dickschnabellumme	*Uria lomvia*	2356	87
Guillemot	Trottellumme	*Uria aalge*	2	0
Black Guillemot	Gryllteiste	*Cepphus grylle*	16	5
Atlantic Puffin	Papageientaucher	*Fratercula arctica*	213	292

One of the most important finding of this long-term study is the remarkably increase of cetaceans in the Greenland and Norwegian seas since 2005. As a consequence of the decrease of pack-ice coverage in the Arctic and a severe Atlantic Oscillation in 2005, the ice coverage in the study area was extremely low in 2005, leading to the opening of both the north-eastern and north-western passages, enabling the rich North Pacific stock to merge with the depleted populations of the NE Atlantic. During ARK-XXVII/2 a total of 486 marine mammals were identified, belonging to 12 species (177 individuals of 7 species during recording periods; see Table 5.2). The helicopter-based surveys proved to be extremely efficient in quantifying and qualifying distribution of cetaceans, as in 20 hours of flight more species and individuals sightings were done compared to the sightings from the *Polarstern* itself.

The most numerous species was White-beaked Dolphin (*Lagenorhynchus albirostris*), which was predominantly found along the south-east of Svalbard. 103 Fin Whales (*Balaenoptera physalus*) were recorded, which is only one individual less than in 2010, but only 34 of them were seen during effort counts (compared to 75 in 2010). The number of Blue Whales (*Balaenoptera musculus;* 32) encountered was exceptionally high, and might fit in the increase of the numbers due to the connections of the Atlantic with Pacific waters as a result of the reduction of the pack ice. Sei Whale (*Balaenoptera borealis*; Figs 5.1, 5.2) were recorded and documented at two different times and locations (both observations consisted of 2 animals) from the helicopter, and together with one or two probable sightings from the *Polarstern* (pictures should still be analysed in detail for confirmation), these sightings present probably the most northern records of this species ever (79°29'N). It is not yet clear whether the presence of this species in northern areas was simply overlooked, or whether this represent a northern shift of the populations due to an increase of water temperature, driving food stocks further north in the Atlantic Ocean.

The most spectacular sighting of ARK-XXVII/2 concerned a group of 23 male Narwhals (*Monodon monoceros*; Fig. 5.3) heading straight to Svalbard. The circumpolar population is estimated to 80,000 individuals (Jefferson et al. 2012) with Western Greenland population around 300 individuals (Shiriai & Jarret 2006).

This observation was done approximately 20 miles of the Svalbard coast, which is a long way out of the usual occurrence of the Western Greenland population (polynya's in the Greenland Sea). This species is rarely seen around the Svalbard archipelago and the population is poorly known but sightings exist. This observation was done in open sea, whereas this species is known to be closely associated with ice (polynya's) or the ice-edge. However, in the Baffin Bay, Narwhals spend the summer time in the ice-free shallow water of fjords where they stay until September (Heide-Jørgensen et al. 2002). This observation might indicate a migration between different populations, or that part of the animals spends some time in ice-free water as well.

In addition 1 dolphin (probably White-beaked Dolphin) and 79 large cetaceans (most probably Fin Whales) were left unidentified.

In comparison to previous expeditions, only low numbers of pinnipeds were seen, with no Ringed (*Phoca hispida*) and Hooded Seals (*Cystophora cristata*) completely lacking and only one sighting of Bearded Seal (*Erignathus barbatus*). This could, however, be due to a limited time spend in the vicinity of the ice edge. While at station in the ice, 2 Walruses (*Odobenus rosmarus*) where briefly seen and one Polar Bear (*Ursus maritimus*) was found sleeping on the ice.

Tab. 5.2: Numbers of mammals seen during the 218 recording periods from the moving ship during ARK-XXVII/2

English name	German name	Scientific name	RP	Heli	ORP
Northern Minke Whale	Zwergwal	*Balaenoptera acutorostrata*	5	2	1
Sei Whale	Seiwal	*Balaenoptera borealis*	0	4	(1)
Blue Whale	Blauwal	*Balaenoptera musculus*	3	12	17
Fin whale	Finnwal	*Balaenoptera physalus*	34	43	26
Humpback Whale	Buckelwal	*Megaptera novaeangliae*	0	4	0
Sperm Whale	Pottwal	*Physeter macrocephalus*	4	9	2
Narwhal	Narwal	*Monodon monoceros*	0	23	0
White-beaked Dolphin	Weißschnauzendelfin	*Lagenorhynchus albirostris*	124	117	17
Killer Whale	Schwertwal	*Orcinus orca*	3	0	0
Harp Seal	Sattelrobbe	*Phoca groenlandica*	4	0	27
Bearded Seal	Bartrobbe	*Erignathus barbatus*	0	0	1
Walrus	Walross	*Odobenus rosmarus*	0	0	2
Polar Bear	Eisbär	*Ursus maritimus*	0	0	1

Data management

All mammal and seabird data are available in the PolE data set (joiriscr@gmail.com).

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Photos taken by D. D'Hert during the ARK-XXVII/2 expedition:

Fig. 5.1: On at least two occasions, Sei Whales where observed during helicopter surveys; note the very high and sickle-shaped dorsal fin and the lack of a white right jaw

Fig. 5.2: One of the observations represents probably the northernmost sighting of a Sei Whale ever

Fig. 5.3: A male Narwhal unexpectedly found approximately 30 miles woff the Svalbard coast

APPENDIX

A.1 Beteiligte Institute / Participating institutions

A.2 Fahrtteilnehmer / Cruise participants

A.3 Schiffsbesatzung / Ship's crew

A.4 Stationsliste / Station list

A.1 BETEILIGTE INSTITUTE / PARTICIPATING INSTITUTIONS

Adresse Address	
AWI	Alfred-Wegener-Institut für Polar- und Meeresforschung in der Helmholtz-Gemeinschaft Am Handelshafen 12 27570 Bremerhaven / Germany
Bluefin	Bluefin Robotics Corporation 237 Putnam Avenue Cambridge, MA 02139 / USA
DWD	Deutscher Wetterdienst Geschäftsbereich Wettervorhersage Seeschifffahrtsberatung Bernhard-Nocht-Strasse 76 20359 Hamburg / Germany
FILEAX	FIELAX Gesellschaft für wissenschaftliche Datenverarbeitung mbH Schleusenstrasse 14 27568 Bremerhaven / Germany
HeliService	HeliService international Am Luneort 15 27572 Bremerhaven / Germany
IORAS	P.P. Shirshov Institute of Oceanology, Russian Academy of Sciences 36, Nakhimovskiy Prospect 117997 Moscow / Russia
ISITEC	iSiTEC GmbH Stresemannstraße 46 27570 Bremerhaven / Germany
PolE	Laboratory for Polar Ecology Vrije Universiteit Brussel Rue du Fodia 18 1367 Ramillies / Belgium

A.2 FAHRTTEILNEHMER / CRUISE PARTICIPANTS

Name	First Name	Institute	Profession
Bauerfeind	Eduard	AWI	Biologist
Bergmann	Melanie	AWI	Biologist
Budaeva	Nataliya	IORAS	Biologist
Buldt	Klaus	DWD	Technician
Ceasar	Levke	AWI	Student apprentice
Dannheim	Jennifer	AWI	Biologist
D'Hert	Diederik	PolE	Biologist
Endres	Sonja	AWI	Biologist
Gall	Fabian	HeliService	Mechanic
Goffette	Quentin	PolE	Biologist
Hagemann	Jonas	AWI	Student apprentice
Hasemann	Christiane	AWI	Biologist
Heckmann	Hans	HeliService	Pilot
Hildebrandt	Nicole	AWI	Biologist
Hoge	Ulrich	AWI	Engineer, biology
Klages	Michael	AWI	Biologist
Kölling	Jannes	AWI	Student apprentice
Ledrich	Annabel	AWI	Technician, biology
Lehmenhecker	Sascha	AWI	Engineer, biology
Lilienthal	Heiko	iSiTEC	Technician
Lochthofen	Normen	AWI	Engineer, biology
Mages	Carolin	AWI	Biologist
Metfies	Katja	AWI	Biologist
Meyer	Kirstin	AWI	Biologist
Mokievsky	Vadim	IORAS	Biologist
Murawski	Sandra	AWI	Technician, biology
Pappert	Anja	AWI	Technician, biology
Petersen	Imke	AWI	Biologist
Rentsch	Harald	DWD	Meteorologist
Roa	Jon	AWI	Technician, biology
Sablotny	Burkhard	AWI	Engineer, biology
Schewe	Ingo	AWI	Biologist
Schier	Felix	HeliService	Pilot
Seifert	Miriam	AWI	Student apprentice
Sévrin	Damien	PolE	Biologist
Shurn	Kimberly	Bluefin	Technician
Short	Nikolaj	FIELAX	Technician apprentice

Name	First Name	Institute	Profession
Siegmund	Ann-Kristin	AWI	Student apprentice
Soltwedel	Thomas	AWI	Biologist, cruise leader
Tardeck	Frederic	FIELAX	Technician, oceanography
Vedenin	Andrey	IORAS	Biologist
Walter	Jens	HeliService	Inspector
Wätjen	Kai	AWI	Biologist
Winkler	Maria	AWI	Biologist

A.3 SCHIFFSBESATZUNG / SHIP'S CREW

No.	Name	Rank
01.	Schwarze, Stefan	Master
02.	Grundmann, Uwe	1. Offc.
03.	Farysch, Bernd	Ch. Eng.
04.	Fallei, Holger	2. Offc.
05.	Lesch, Florian	2. Offc.
06.	Rackete, Carola	2. Offc.
07.	Pohl, Claus	Doctor
08.	Hecht, Andreas	R. Offc.
09.	Sümnicht, Stefan	2. Eng.
10.	Minzlaff, Hans-Ulrich	2. Eng.
11.	Holst, Wolfgang	3. Eng.
12.	Scholz, Manfred	Elec. Tech.
13.	Dimmler, Werner	Electron.
14.	Hebold, Catharina	Electron.
15.	Himmel, Frank	Electron.
16.	Nasis, Ilias	Electron.
17.	Voy, Bernd	Boatsw.
18.	Reise, Lutz	Carpenter
19.	Bäcker, Andreas	A.B.
20.	Brickmann, Peter	A.B.
21.	Guse, Hartmut	A.B.
22.	Hagemann, Manfred	A.B.
23.	Scheel, Sebastian	A.B.
24.	Schmidt, Uwe	A.B.
25.	Wende, Uwe	A.B.
26.	Winkler,Michael	A.B.
27	Preußner, Jörg	Storek.
28.	Elsner, Klaus	Mot-man
29.	Pinske, Lutz	Mot-man
30.	Plehn, Markus	Mot-man
31.	Schütt, Norbert	Mot-man
32.	Teichert, Uwe	Mot-man
33.	Müller-Homburg, Ralf-Dieter	Cook
34.	Martens, Michael	Cooksmate
35.	Silinski, Frank	Cooksmate
36.	Czyborra, Bärbel	1.Stwdess
37.	Wöckener, Martina	Stwdss/KS
38.	Silinski, Carmen	2.Stwdess
39.	Gaude, Hans-Jürgen	2.Steward
40.	NN	2.Steward
41.	Möller, Wolfgang	2.Steward
42.	Sun, Yong Shen	2.Stwdess
43.	Yu, Kwok Yuen	Laundrym.

A.4 STATIONSLISTE / STATION LIST PS 80

Station PS80/	Date	Time	Gear Abbr.	Action	Position Latitude	Position Longitude	Water Depth [m]
0165-1	16.07.12	03:56	MOR	information	79° 0.16' N	4° 19.75' E	2612
0165-1	16.07.12	03:59	MOR	action	79° 0.19' N	4° 19.48' E	2612
0165-1	16.07.12	04:04	MOR	action	79° 0.19' N	4° 19.21' E	2615
0165-1	16.07.12	04:09	MOR	at surface	79° 0.16' N	4° 18.93' E	2617
0165-1	16.07.12	04:12	MOR	action	79° 0.11' N	4° 19.03' E	2612
0165-1	16.07.12	04:29	MOR	action	79° 0.38' N	4° 20.15' E	2604
0165-1	16.07.12	04:30	MOR	action	79° 0.39' N	4° 20.18' E	2603
0165-1	16.07.12	04:31	MOR	on deck	79° 0.39' N	4° 20.20' E	2603
0165-1	16.07.12	04:36	MOR	on deck	79° 0.34' N	4° 20.26' E	2605
0165-1	16.07.12	04:39	MOR	on deck	79° 0.36' N	4° 20.07' E	2605
0165-1	16.07.12	04:46	MOR	on deck	79° 0.27' N	4° 19.79' E	2609
0165-1	16.07.12	04:59	MOR	on deck	79° 0.08' N	4° 19.27' E	2617
0165-1	16.07.12	05:05	MOR	on deck	79° 0.04' N	4° 18.83' E	2621
0165-1	16.07.12	05:18	MOR	on deck	78° 59.91' N	4° 17.85' E	2633
0165-1	16.07.12	05:28	MOR	on deck	78° 59.77' N	4° 17.32' E	2642
0165-1	16.07.12	05:37	MOR	on deck	78° 59.70' N	4° 16.76' E	2649
0165-1	16.07.12	05:44	MOR	on ground/ max depth	78° 59.58' N	4° 16.50' E	2655
0165-1	16.07.12	05:44	MOR	on deck	78° 59.58' N	4° 16.50' E	2655
0165-2	16.07.12	06:18	CTD/RO	in the water	79° 0.59' N	4° 19.93' E	2599
0165-2	16.07.12	06:47	CTD/RO	on ground/ max depth	79° 0.46' N	4° 19.89' E	2603
0165-2	16.07.12	06:47	CTD/RO	hoisting	79° 0.46' N	4° 19.89' E	2603
0165-2	16.07.12	07:09	CTD/RO	at surface	79° 0.46' N	4° 20.04' E	2603
0165-2	16.07.12	07:10	CTD/RO	on deck	79° 0.46' N	4° 20.05' E	2602
0165-3	16.07.12	07:55	MN	in the water	79° 4.51' N	4° 7.07' E	2504
0165-3	16.07.12	08:42	MN	on ground/ max depth	79° 4.62' N	4° 5.93' E	2509
0165-3	16.07.12	08:43	MN	hoisting	79° 4.63' N	4° 5.93' E	2509
0165-3	16.07.12	09:31	MN	at surface	79° 4.68' N	4° 5.67' E	2510
0165-3	16.07.12	09:33	MN	on deck	79° 4.69' N	4° 5.66' E	2510
0165-4	16.07.12	10:00	BL-LT	on ground/ max depth	79° 3.82' N	4° 9.03' E	2496
0165-4	16.07.12	10:06	BL-LT	action	79° 3.76' N	4° 8.47' E	2508
0165-4	16.07.12	10:08	BL-LT	information	79° 3.73' N	4° 8.24' E	2513
0165-4	16.07.12	10:45	BL-LT	at surface	79° 3.75' N	4° 9.63' E	2492
0165-4	16.07.12	11:00	BL-LT	information	79° 3.84' N	4° 9.99' E	2480

Station PS80/	Date	Time	Gear Abbr.	Action	Position Latitude	Position Longitude	Water Depth [m]
0165-4	16.07.12	11:02	BL-LT	on deck	79° 3.84' N	4° 10.04' E	2479
0165-5	16.07.12	11:41	BONGO	in the water	79° 4.66' N	4° 6.76' E	2499
0165-6	16.07.12	11:46	HN	in the water	79° 4.66' N	4° 6.72' E	2499
0165-6	16.07.12	11:53	HN	on ground/ max depth	79° 4.68' N	4° 6.64' E	2499
0165-6	16.07.12	11:55	HN	on deck	79° 4.67' N	4° 6.61' E	2500
0165-5	16.07.12	12:01	BONGO	on ground/ max depth	79° 4.69' N	4° 6.66' E	2499
0165-5	16.07.12	12:01	BONGO	hoisting	79° 4.69' N	4° 6.66' E	2499
0165-5	16.07.12	12:15	BONGO	on deck	79° 4.69' N	4° 6.75' E	2497
0165-7	16.07.12	14:09	AGT	in the water	78° 59.64' N	4° 37.33' E	2530
0165-7	16.07.12	14:13	AGT	lowering	78° 59.83' N	4° 37.39' E	2522
0165-7	16.07.12	14:20	AGT	lowering	79° 0.19' N	4° 36.92' E	2516
0165-7	16.07.12	15:04	AGT	on ground/ max depth	79° 1.46' N	4° 28.76' E	2488
0165-7	16.07.12	15:21	AGT	profile start	79° 1.78' N	4° 25.70' E	2504
0165-7	16.07.12	15:51	AGT	profile end	79° 2.07' N	4° 22.67' E	2512
0165-7	16.07.12	15:52	AGT	hoisting	79° 2.07' N	4° 22.63' E	2508
0165-7	16.07.12	16:37	AGT	hoisting	79° 2.19' N	4° 22.50' E	2503
0165-7	16.07.12	17:41	AGT	at surface	79° 2.34' N	4° 22.03' E	2494
0165-7	16.07.12	17:46	AGT	on deck	79° 2.35' N	4° 21.99' E	2493
0165-8	16.07.12	18:49	MUC	in the water	79° 3.87' N	4° 10.57' E	2470
0165-8	16.07.12	19:37	MUC	on ground/ max depth	79° 3.86' N	4° 10.85' E	2467
0165-8	16.07.12	19:38	MUC	hoisting	79° 3.87' N	4° 10.85' E	2467
0165-8	16.07.12	20:23	MUC	at surface	79° 3.89' N	4° 10.90' E	2465
0165-8	16.07.12	20:26	MUC	on deck	79° 3.90' N	4° 10.92' E	2464
0165-9	16.07.12	20:48	BC	in the water	79° 3.90' N	4° 10.73' E	2466
0165-9	16.07.12	21:20	BC	on ground/ max depth	79° 3.91' N	4° 10.73' E	2466
0165-9	16.07.12	21:21	BC	hoisting	79° 3.92' N	4° 10.73' E	2466
0165-9	16.07.12	21:56	BC	at surface	79° 3.95' N	4° 10.84' E	2463
0165-9	16.07.12	21:58	BC	on deck	79° 3.96' N	4° 10.83' E	2463
0166-1	16.07.12	23:08	CTD/RO	in the water	79° 6.46' N	4° 36.26' E	1917
0166-1	16.07.12	23:48	CTD/RO	on ground/ max depth	79° 6.48' N	4° 36.12' E	1914
0166-1	16.07.12	23:49	CTD/RO	hoisting	79° 6.48' N	4° 36.12' E	1894

Station PS80/	Date	Time	Gear Abbr.	Action	Position Latitude	Position Longitude	Water Depth [m]
0166-1	17.07.12	00:22	CTD/RO	on deck	79° 6.41' N	4° 36.19' E	1927
0166-2	17.07.12	00:37	MUC	in the water	79° 6.47' N	4° 36.08' E	1905
0166-2	17.07.12	01:17	MUC	on ground/ max depth	79° 6.48' N	4° 36.12' E	1907
0166-2	17.07.12	01:17	MUC	hoisting	79° 6.48' N	4° 36.12' E	1907
0166-2	17.07.12	01:17	MUC	off ground	79° 6.48' N	4° 36.12' E	1907
0166-2	17.07.12	01:56	MUC	on deck	79° 6.48' N	4° 35.99' E	1908
0167-1	17.07.12	02:39	LOKI	in the water	79° 7.81' N	4° 54.18' E	1550
0167-1	17.07.12	02:45	LOKI	on ground/ max depth	79° 7.82' N	4° 54.31' E	1548
0167-1	17.07.12	02:48	LOKI	hoisting	79° 7.81' N	4° 54.39' E	1547
0167-1	17.07.12	02:48	LOKI	profile start	79° 7.81' N	4° 54.39' E	1547
0167-1	17.07.12	02:59	LOKI	profile end	79° 7.84' N	4° 54.55' E	1543
0167-1	17.07.12	03:01	LOKI	on deck	79° 7.84' N	4° 54.57' E	1542
0167-2	17.07.12	03:12	CTD/RO	in the water	79° 7.85' N	4° 54.73' E	1539
0167-2	17.07.12	03:47	CTD/RO	on ground/ max depth	79° 7.81' N	4° 56.24' E	1522
0167-2	17.07.12	03:47	CTD/RO	hoisting	79° 7.81' N	4° 56.24' E	1522
0167-2	17.07.12	04:18	CTD/RO	on deck	79° 7.80' N	4° 56.76' E	1515
0167-3	17.07.12	04:37	MUC	in the water	79° 7.80' N	4° 53.30' E	1563
0167-3	17.07.12	05:10	MUC	on ground/ max depth	79° 7.80' N	4° 53.99' E	1553
0167-3	17.07.12	05:11	MUC	hoisting	79° 7.80' N	4° 54.00' E	1552
0167-3	17.07.12	05:43	MUC	on deck	79° 7.80' N	4° 54.92' E	1540
0168-1	17.07.12	07:40	OFOS	action	79° 7.91' N	6° 15.64' E	1319
0168-1	17.07.12	07:48	OFOS	in the water	79° 7.95' N	6° 15.69' E	1322
0168-1	17.07.12	08:41	OFOS	on ground/ max depth	79° 7.94' N	6° 15.70' E	1322
0168-1	17.07.12	08:41	OFOS	profile start	79° 7.94' N	6° 15.70' E	1322
0168-1	17.07.12	11:58	OFOS	profile end	79° 8.00' N	6° 7.84' E	1274
0168-1	17.07.12	11:58	OFOS	hoisting	79° 8.00' N	6° 7.84' E	1274
0168-1	17.07.12	12:47	OFOS	on deck	79° 8.23' N	6° 7.08' E	1283
0168-2	17.07.12	13:05	MN	in the water	79° 8.12' N	6° 6.30' E	1281
0168-2	17.07.12	13:46	MN	on ground/ max depth	79° 8.11' N	6° 6.29' E	1281
0168-2	17.07.12	14:30	MN	at surface	79° 8.11' N	6° 6.19' E	1282
0168-2	17.07.12	14:32	MN	on deck	79° 8.11' N	6° 6.19' E	1282
0168-3	17.07.12	14:43	CTD/RO	in the water	79° 8.10' N	6° 6.21' E	1282

Station PS80/	Date	Time	Gear Abbr.	Action	Position Latitude	Position Longitude	Water Depth [m]
0168-4	17.07.12	14:56	HN	in the water	79° 8.11' N	6° 6.24' E	1282
0168-4	17.07.12	15:06	HN	on ground/ max depth	79° 8.11' N	6° 6.21' E	1282
0168-4	17.07.12	15:06	HN	on deck	79° 8.11' N	6° 6.21' E	1282
0168-3	17.07.12	15:18	CTD/RO	on ground/ max depth	79° 8.11' N	6° 6.31' E	1281
0168-3	17.07.12	15:20	CTD/RO	hoisting	79° 8.11' N	6° 6.32' E	1281
0168-3	17.07.12	15:53	CTD/RO	on deck	79° 8.07' N	6° 6.29' E	1282
0168-5	17.07.12	16:03	LOKI	in the water	79° 8.09' N	6° 6.28' E	1282
0168-5	17.07.12	16:20	LOKI	on ground/ max depth	79° 8.10' N	6° 6.26' E	1281
0168-5	17.07.12	16:23	LOKI	hoisting	79° 8.09' N	6° 6.26' E	1281
0168-5	17.07.12	16:23	LOKI	profile start	79° 8.09' N	6° 6.26' E	1281
0168-5	17.07.12	16:52	LOKI	profile end	79° 8.11' N	6° 6.22' E	1281
0168-5	17.07.12	16:55	LOKI	on deck	79° 8.11' N	6° 6.14' E	1282
0168-6	17.07.12	17:23	AGT	in the water	79° 6.56' N	6° 4.38' E	1268
0168-6	17.07.12	17:25	AGT	lowering	79° 6.65' N	6° 4.42' E	1267
0168-6	17.07.12	17:31	AGT	lowering	79° 6.97' N	6° 4.68' E	1266
0168-6	17.07.12	17:53	AGT	on ground/ max depth	79° 8.06' N	6° 5.40' E	1279
0168-6	17.07.12	17:56	AGT	profile start	79° 8.17' N	6° 5.46' E	1281
0168-6	17.07.12	18:10	AGT	lowering	79° 8.48' N	6° 5.77' E	1290
0168-6	17.07.12	18:26	AGT	profile end	79° 8.73' N	6° 6.07' E	1299
0168-6	17.07.12	18:27	AGT	hoisting	79° 8.74' N	6° 6.08' E	1300
0168-6	17.07.12	18:51	AGT	off ground	79° 8.76' N	6° 6.25' E	1301
0168-6	17.07.12	19:26	AGT	at surface	79° 9.07' N	6° 5.86' E	1314
0168-6	17.07.12	19:30	AGT	on deck	79° 9.12' N	6° 5.79' E	1315
0168-7	17.07.12	20:26	MUC	in the water	79° 8.08' N	6° 6.18' E	1283
0168-7	17.07.12	20:52	MUC	on ground/ max depth	79° 8.11' N	6° 6.12' E	1283
0168-7	17.07.12	20:53	MUC	hoisting	79° 8.11' N	6° 6.12' E	1282
0168-7	17.07.12	21:18	MUC	at surface	79° 8.12' N	6° 6.02' E	1283
0168-7	17.07.12	21:21	MUC	on deck	79° 8.12' N	6° 6.03' E	1283
0168-8	17.07.12	21:40	MUC	in the water	79° 8.13' N	6° 6.15' E	1282
0168-8	17.07.12	22:05	MUC	on ground/ max depth	79° 8.13' N	6° 6.13' E	1282
0168-8	17.07.12	22:05	MUC	hoisting	79° 8.13' N	6° 6.13' E	1282
0168-8	17.07.12	22:55	MUC	on deck	79° 8.31' N	6° 6.06' E	1285

Station PS80/	Date	Time	Gear Abbr.	Action	Position Latitude	Position Longitude	Water Depth [m]
0169-1	18.07.12	00:41	CTD/ RO	in the water	79° 1.74' N	6° 59.91' E	1304
0169-1	18.07.12	01:10	CTD/ RO	on ground/ max depth	79° 1.77' N	6° 59.87' E	1305
0169-1	18.07.12	01:11	CTD/RO	hoisting	79° 1.77' N	6° 59.87' E	1305
0169-1	18.07.12	01:37	CTD/RO	on deck	79° 1.78' N	6° 59.94' E	1305
0169-2	18.07.12	01:44	MUC	in the water	79° 1.79' N	6° 59.97' E	1306
0169-2	18.07.12	02:08	MUC	on ground/ max depth	79° 1.78' N	6° 59.94' E	1306
0169-2	18.07.12	02:11	MUC	hoisting	79° 1.78' N	6° 59.97' E	1305
0169-2	18.07.12	02:35	MUC	at surface	79° 1.81' N	6° 59.97' E	1306
0169-2	18.07.12	02:37	MUC	on deck	79° 1.81' N	6° 59.96' E	1306
0170-1	18.07.12	06:44	FES	action	78° 39.23' N	9° 24.58' E	256
0170-1	18.07.12	07:00	FES	profile start	78° 39.13' N	9° 26.14' E	244
0170-1	18.07.12	07:33	FES	profile end	78° 40.13' N	9° 26.01' E	289
0170-1	18.07.12	07:50	FES	profile start	78° 40.18' N	9° 25.84' E	293
0170-1	18.07.12	08:12	FES	profile end	78° 39.19' N	9° 25.81' E	245
0170-2	18.07.12	09:08	CTD/RO	in the water	78° 38.46' N	9° 25.61' E	242
0170-2	18.07.12	09:19	CTD/RO	on ground/ max depth	78° 38.46' N	9° 25.68' E	241
0170-2	18.07.12	09:20	CTD/RO	hoisting	78° 38.46' N	9° 25.69' E	240
0170-3	18.07.12	09:20	CAL	profile start	78° 38.46' N	9° 25.69' E	240
0170-2	18.07.12	09:26	CTD/RO	at surface	78° 38.46' N	9° 25.73' E	240
0170-2	18.07.12	09:26	CTD/RO	on deck	78° 38.46' N	9° 25.73' E	240
0170-4	18.07.12	10:09	AUV	in the water	78° 38.46' N	9° 26.07' E	239
0170-4	18.07.12	10:17	AUV	profile start	78° 38.40' N	9° 26.20' E	236
0170-4	18.07.12	10:27	AUV	profile end	78° 38.29' N	9° 26.06' E	231
0170-4	18.07.12	10:33	AUV	on deck	78° 38.22' N	9° 25.85' E	234
0170-3	18.07.12	10:44	CAL	on ground/ max depth	78° 38.21' N	9° 25.41' E	257
0170-3	18.07.12	10:45	CAL	profile end	78° 38.25' N	9° 25.42' E	249
0170-5	18.07.12	11:13	AUV	in the water	78° 37.51' N	9° 25.67' E	350
0170-5	18.07.12	11:18	AUV	in the water	78° 37.47' N	9° 25.64' E	352
0170-5	18.07.12	11:50	AUV	profile start	78° 37.17' N	9° 23.82' E	397
0170-5	18.07.12	11:52	AUV	on ground/ max depth	78° 37.15' N	9° 23.70' E	399
0170-5	18.07.12	11:58	AUV	on deck	78° 37.10' N	9° 23.37' E	401
0170-5	18.07.12	13:44	AUV	information	78° 41.45' N	9° 24.58' E	355

Station PS80/	Date	Time	Gear Abbr.	Action	Position Latitude	Position Longitude	Water Depth [m]
0170-5	18.07.12	14:00	AUV	alter course	78° 41.40' N	9° 24.50' E	360
0170-5	18.07.12	15:28	AUV	profile end	78° 37.11' N	9° 24.23' E	393
0170-5	18.07.12	15:33	AUV	at surface	78° 37.18' N	9° 24.68' E	389
0170-5	18.07.12	15:48	AUV	in the water	78° 37.30' N	9° 25.52' E	368
0170-5	18.07.12	15:54	AUV	action	78° 37.30' N	9° 25.59' E	367
0170-5	18.07.12	15:57	AUV	on deck	78° 37.30' N	9° 25.54' E	369
0170-5	18.07.12	16:00	AUV	on deck	78° 37.29' N	9° 25.49' E	370
0170-5	18.07.12	16:22	AUV	action	78° 37.33' N	9° 25.16' E	375
0171-1	18.07.12	20:10	CTD/RO	in the water	79° 1.68' N	11° 4.62' E	286
0171-2	18.07.12	20:15	HN	in the water	79° 1.68' N	11° 4.59' E	285
0171-2	18.07.12	20:16	HN	on ground/ max depth	79° 1.67' N	11° 4.57' E	286
0171-1	18.07.12	20:22	CTD/RO	on ground/ max depth	79° 1.68' N	11° 4.54' E	286
0171-2	18.07.12	20:22	HN	on deck	79° 1.68' N	11° 4.54' E	286
0171-1	18.07.12	20:25	CTD/RO	hoisting	79° 1.68' N	11° 4.52' E	286
0171-1	18.07.12	20:35	CTD/RO	at surface	79° 1.68' N	11° 4.43' E	286
0171-1	18.07.12	20:36	CTD/RO	on deck	79° 1.68' N	11° 4.42' E	286
0171-3	18.07.12	20:44	MUC	in the water	79° 1.69' N	11° 4.43' E	286
0171-3	18.07.12	20:52	MUC	on ground/ max depth	79° 1.71' N	11° 4.48' E	286
0171-3	18.07.12	20:53	MUC	hoisting	79° 1.71' N	11° 4.47' E	286
0171-3	18.07.12	20:59	MUC	at surface	79° 1.73' N	11° 4.45' E	286
0171-3	18.07.12	21:02	MUC	on deck	79° 1.75' N	11° 4.49' E	286
0172-1	18.07.12	23:14	CTD/RO	in the water	78° 58.89' N	9° 31.59' E	229
0172-1	18.07.12	23:25	CTD/RO	on ground/ max depth	78° 58.85' N	9° 30.94' E	229
0172-1	18.07.12	23:25	CTD/RO	hoisting	78° 58.85' N	9° 30.94' E	229
0172-1	18.07.12	23:34	CTD/RO	on deck	78° 58.83' N	9° 31.07' E	234
0172-2	18.07.12	23:40	MUC	in the water	78° 58.82' N	9° 31.09' E	234
0172-2	18.07.12	23:48	MUC	on ground/ max depth	78° 58.82' N	9° 31.04' E	233
0172-2	18.07.12	23:49	MUC	hoisting	78° 58.82' N	9° 31.04' E	234
0172-2	18.07.12	23:49	MUC	off ground	78° 58.82' N	9° 31.04' E	234
0172-2	18.07.12	23:59	MUC	on deck	78° 58.81' N	9° 31.16' E	233
0172-3	19.07.12	00:06	MUC	in the water	78° 58.81' N	9° 31.21' E	233

Station PS80/	Date	Time	Gear Abbr.	Action	Position Latitude	Position Longitude	Water Depth [m]
0172-3	19.07.12	00:17	MUC	on ground/ max depth	78° 58.82' N	9° 31.11' E	234
0172-3	19.07.12	00:17	MUC	hoisting	78° 58.82' N	9° 31.11' E	234
0172-3	19.07.12	00:18	MUC	off ground	78° 58.82' N	9° 31.09' E	234
0172-3	19.07.12	00:25	MUC	on deck	78° 58.83' N	9° 30.89' E	233
0173-1	19.07.12	07:06	BL-FT	action	79° 4.97' N	4° 20.64' E	2277
0173-1	19.07.12	07:09	BL-FT	in the water	79° 4.95' N	4° 20.79' E	2276
0173-1	19.07.12	07:09	BL-FT	in the water	79° 4.95' N	4° 20.79' E	2276
0173-1	19.07.12	07:11	BL-FT	on ground/ max depth	79° 4.93' N	4° 20.94' E	2277
0173-2	19.07.12	07:35	CTD/RO	in the water	79° 4.91' N	4° 21.29' E	2278
0173-2	19.07.12	08:24	CTD/RO	on ground/ max depth	79° 4.84' N	4° 21.48' E	2279
0173-2	19.07.12	08:26	CTD/RO	hoisting	79° 4.83' N	4° 21.48' E	2279
0173-2	19.07.12	09:09	CTD/RO	at surface	79° 4.85' N	4° 21.31' E	2279
0173-2	19.07.12	09:12	CTD/RO	on deck	79° 4.85' N	4° 21.28' E	2279
0173-3	19.07.12	09:23	LOKI	in the water	79° 4.86' N	4° 21.28' E	2279
0173-3	19.07.12	09:46	LOKI	profile start	79° 4.86' N	4° 21.34' E	2279
0173-3	19.07.12	09:48	LOKI	on ground/ max depth	79° 4.85' N	4° 21.36' E	2279
0173-3	19.07.12	10:31	LOKI	profile end	79° 4.81' N	4° 21.18' E	2280
0173-3	19.07.12	10:32	LOKI	on deck	79° 4.81' N	4° 21.15' E	2280
0174-1	19.07.12	11:59	BC	in the water	78° 56.03' N	4° 59.40' E	2609
0174-1	19.07.12	12:40	BC	on ground/ max depth	78° 56.01' N	4° 59.58' E	2609
0174-1	19.07.12	12:41	BC	hoisting	78° 56.01' N	4° 59.58' E	2609
0174-1	19.07.12	12:42	BC	off ground	78° 56.01' N	4° 59.58' E	2609
0174-1	19.07.12	13:18	BC	on deck	78° 55.99' N	4° 59.60' E	2610
0175-1	19.07.12	14:25	CTD/RO	in the water	78° 46.81' N	5° 19.84' E	2469
0175-1	19.07.12	15:21	CTD/RO	on ground/ max depth	78° 46.81' N	5° 19.85' E	2468
0175-1	19.07.12	15:21	CTD/RO	hoisting	78° 46.81' N	5° 19.85' E	2468
0175-1	19.07.12	16:06	CTD/RO	on deck	78° 46.82' N	5° 19.94' E	2466
0175-2	19.07.12	16:13	MUC	in the water	78° 46.83' N	5° 19.95' E	2467
0175-2	19.07.12	17:04	MUC	on ground/ max depth	78° 46.83' N	5° 19.91' E	2467

Station PS80/	Date	Time	Gear Abbr.	Action	Position Latitude	Position Longitude	Water Depth [m]
0175-2	19.07.12	17:06	MUC	hoisting	78° 46.83' N	5° 19.91' E	2467
0175-2	19.07.12	17:51	MUC	at surface	78° 46.84' N	5° 19.93' E	2466
0175-2	19.07.12	17:54	MUC	on deck	78° 46.84' N	5° 19.91' E	2467
0175-3	19.07.12	18:05	BC	in the water	78° 46.83' N	5° 19.87' E	2469
0175-3	19.07.12	18:46	BC	on ground/ max depth	78° 46.82' N	5° 20.14' E	2461
0175-3	19.07.12	18:46	BC	hoisting	78° 46.82' N	5° 20.14' E	2461
0175-3	19.07.12	19:20	BC	at surface	78° 46.81' N	5° 20.33' E	2457
0175-3	19.07.12	19:24	BC	on deck	78° 46.81' N	5° 20.39' E	2456
0176-1	19.07.12	21:02	OFOS	in the water	78° 37.04' N	4° 59.49' E	2366
0176-1	19.07.12	21:07	OFOS	hoisting	78° 37.04' N	4° 59.49' E	2366
0176-1	19.07.12	21:11	OFOS	at surface	78° 37.03' N	4° 59.54' E	2366
0176-1	19.07.12	21:12	OFOS	on deck	78° 37.03' N	4° 59.56' E	2366
0176-1	19.07.12	21:16	OFOS	in the water	78° 37.02' N	4° 59.62' E	2366
0176-1	19.07.12	22:42	OFOS	on ground/ max depth	78° 37.03' N	4° 59.99' E	2366
0176-1	19.07.12	22:56	OFOS	profile start	78° 37.04' N	5° 0.07' E	2361
0176-1	20.07.12	01:59	OFOS	profile end	78° 37.00' N	5° 8.56' E	2352
0176-1	20.07.12	01:59	OFOS	hoisting	78° 37.00' N	5° 8.56' E	2352
0176-1	20.07.12	03:11	OFOS	on deck	78° 36.81' N	5° 5.80' E	2341
0176-2	20.07.12	03:24	MN	in the water	78° 36.60' N	5° 4.03' E	2340
0176-2	20.07.12	04:11	MN	on ground/ max depth	78° 36.81' N	5° 4.09' E	2340
0176-2	20.07.12	04:11	MN	hoisting	78° 36.81' N	5° 4.09' E	2340
0176-2	20.07.12	05:02	MN	on deck	78° 36.67' N	5° 3.94' E	2340
0176-3	20.07.12	05:16	CTD/RO	in the water	78° 36.62' N	5° 4.10' E	2339
0176-4	20.07.12	05:33	HN	in the water	78° 36.63' N	5° 4.20' E	2339
0176-4	20.07.12	05:44	HN	on ground/ max depth	78° 36.60' N	5° 4.03' E	2339
0176-4	20.07.12	05:45	HN	on deck	78° 36.60' N	5° 4.02' E	2339
0176-3	20.07.12	06:05	CTD/RO	on ground/ max depth	78° 36.61' N	5° 4.08' E	2339
0176-3	20.07.12	06:06	CTD/RO	hoisting	78° 36.61' N	5° 4.09' E	2339
0176-5	20.07.12	06:23	MOR	action	78° 36.60' N	5° 4.18' E	2339
0176-5	20.07.12	06:25	MOR	on ground/ max depth	78° 36.60' N	5° 4.18' E	2339
0176-5	20.07.12	06:47	MOR	at surface	78° 36.62' N	5° 4.20' E	2339

Station PS80/	Date	Time	Gear Abbr.	Action	Position Latitude	Position Longitude	Water Depth [m]
0176-3	20.07.12	06:50	CTD/RO	at surface	78° 36.62' N	5° 4.20' E	2339
0176-3	20.07.12	06:51	CTD/RO	on deck	78° 36.62' N	5° 4.20' E	2339
0176-5	20.07.12	07:19	MOR	on deck	78° 36.28' N	5° 4.95' E	2340
0176-5	20.07.12	07:19	MOR	hoisting	78° 36.28' N	5° 4.95' E	2340
0176-5	20.07.12	07:21	MOR	on deck	78° 36.29' N	5° 5.04' E	2340
0176-6	20.07.12	08:18	AUV	action	78° 37.88' N	5° 3.36' E	2353
0176-6	20.07.12	08:18	AUV	in the water	78° 37.88' N	5° 3.36' E	2353
0176-6	20.07.12	08:22	AUV	in the water	78° 37.88' N	5° 3.36' E	2353
0176-6	20.07.12	08:39	AUV	at surface	78° 37.88' N	5° 3.38' E	2353
0176-6	20.07.12	08:48	AUV	profile start	78° 37.87' N	5° 3.36' E	2353
0176-6	20.07.12	08:51	AUV	on deck	78° 37.86' N	5° 3.33' E	2353
0176-7	20.07.12	09:34	MUC	action	78° 36.64' N	5° 3.91' E	2340
0176-7	20.07.12	09:40	MUC	in the water	78° 36.63' N	5° 3.86' E	2340
0176-7	20.07.12	10:26	MUC	on ground/ max depth	78° 36.59' N	5° 3.96' E	2340
0176-7	20.07.12	10:26	MUC	hoisting	78° 36.59' N	5° 3.96' E	2340
0176-7	20.07.12	11:09	MUC	on deck	78° 36.56' N	5° 4.37' E	2340
0176-8	20.07.12	11:22	BC	in the water	78° 36.54' N	5° 4.22' E	2340
0176-8	20.07.12	11:57	BC	on ground/ max depth	78° 36.56' N	5° 4.25' E	2340
0176-8	20.07.12	11:58	BC	hoisting	78° 36.56' N	5° 4.25' E	2340
0176-8	20.07.12	11:58	BC	off ground	78° 36.56' N	5° 4.25' E	2340
0176-8	20.07.12	12:30	BC	on deck	78° 36.53' N	5° 4.67' E	2341
0176-6	20.07.12	13:40	AUV	profile end	78° 37.17' N	5° 4.86' E	2342
0176-6	20.07.12	13:43	AUV	at surface	78° 37.19' N	5° 5.19' E	2341
0176-6	20.07.12	13:53	AUV	in the water	78° 37.28' N	5° 6.97' E	2339
0176-6	20.07.12	13:55	AUV	information	78° 37.28' N	5° 7.02' E	2339
0176-6	20.07.12	13:58	AUV	hoisting	78° 37.27' N	5° 7.02' E	2339
0176-6	20.07.12	14:00	AUV	on deck	78° 37.26' N	5° 6.97' E	2339
0176-6	20.07.12	14:04	AUV	on deck	78° 37.25' N	5° 6.79' E	2339
0176-6	20.07.12	14:55	AUV	in the water	78° 37.14' N	5° 8.51' E	2352
0176-6	20.07.12	15:11	AUV	information	78° 37.05' N	5° 8.06' E	2351
0176-6	20.07.12	15:15	AUV	on deck	78° 37.03' N	5° 7.95' E	2339
0176-9	20.07.12	15:46	AGT	in the water	78° 35.19' N	5° 10.50' E	2353
0176-9	20.07.12	15:53	AGT	lowering	78° 35.44' N	5° 9.41' E	2353

Station PS80/	Date	Time	Gear Abbr.	Action	Position Latitude	Position Longitude	Water Depth [m]
0176-9	20.07.12	16:50	AGT	on ground/ max depth	78° 37.37' N	5° 0.55' E	2365
0176-9	20.07.12	16:52	AGT	profile start	78° 37.42' N	5° 0.29' E	2366
0176-9	20.07.12	17:22	AGT	profile end	78° 37.80' N	4° 58.38' E	2374
0176-9	20.07.12	17:23	AGT	hoisting	78° 37.81' N	4° 58.34' E	2374
0176-9	20.07.12	18:02	AGT	off ground	78° 37.86' N	4° 57.79' E	2374
0176-9	20.07.12	18:03	AGT	hoisting	78° 37.86' N	4° 57.77' E	2374
0176-9	20.07.12	19:04	AGT	at surface	78° 38.05' N	4° 56.23' E	2372
0176-9	20.07.12	19:09	AGT	on deck	78° 38.07' N	4° 56.05' E	2372
0176-10	20.07.12	20:34	BC	in the water	78° 36.59' N	5° 3.95' E	2340
0176-10	20.07.12	21:10	BC	on ground/ max depth	78° 36.60' N	5° 3.98' E	2340
0176-10	20.07.12	21:11	BC	hoisting	78° 36.60' N	5° 3.98' E	2340
0176-10	20.07.12	21:40	BC	at surface	78° 36.63' N	5° 4.02' E	2340
0176-10	20.07.12	21:43	BC	on deck	78° 36.63' N	5° 4.03' E	2340
0177-1	20.07.12	23:00	BC	in the water	78° 46.78' N	5° 19.92' E	2466
0177-1	20.07.12	23:40	BC	on ground/ max depth	78° 46.83' N	5° 19.92' E	2470
0177-1	20.07.12	23:40	BC	hoisting	78° 46.83' N	5° 19.92' E	2470
0177-1	21.07.12	00:18	BC	on deck	78° 46.85' N	5° 19.95' E	2470
0178-1	21.07.12	01:29	CTD/RO	in the water	78° 55.01' N	5° 0.04' E	2637
0178-1	21.07.12	02:23	CTD/RO	on ground/ max depth	78° 55.01' N	5° 0.14' E	2637
0178-1	21.07.12	02:24	CTD/RO	hoisting	78° 55.01' N	5° 0.14' E	2637
0178-1	21.07.12	03:10	CTD/RO	on deck	78° 55.03' N	5° 0.05' E	2637
0178-2	21.07.12	03:16	LOKI	in the water	78° 55.04' N	5° 0.05' E	2636
0178-2	21.07.12	03:24	LOKI	on ground/ max depth	78° 55.05' N	5° 0.10' E	2636
0178-2	21.07.12	03:24	LOKI	profile start	78° 55.05' N	5° 0.10' E	2636
0178-2	21.07.12	03:24	LOKI	hoisting	78° 55.05' N	5° 0.10' E	2636
0178-2	21.07.12	03:33	LOKI	profile end	78° 55.04' N	5° 0.15' E	2636
0178-2	21.07.12	03:34	LOKI	lowering	78° 55.03' N	5° 0.16' E	2636
0178-2	21.07.12	03:43	LOKI	on ground/ max depth	78° 55.04' N	5° 0.23' E	2635
0178-2	21.07.12	03:43	LOKI	profile start	78° 55.04' N	5° 0.23' E	2635
0178-2	21.07.12	03:45	LOKI	hoisting	78° 55.05' N	5° 0.24' E	2635
0178-2	21.07.12	04:00	LOKI	on deck	78° 55.04' N	5° 0.27' E	2635
0178-3	21.07.12	04:11	MUC	in the water	78° 55.04' N	5° 0.29' E	2635

Station PS80/	Date	Time	Gear Abbr.	Action	Position Latitude	Position Longitude	Water Depth [m]
0178-3	21.07.12	05:03	MUC	on ground/ max depth	78° 55.05' N	5° 0.03' E	2636
0178-3	21.07.12	05:04	MUC	hoisting	78° 55.05' N	5° 0.03' E	2635
0178-3	21.07.12	06:00	MUC	on deck	78° 55.05' N	5° 0.37' E	2634
0179-1	21.07.12	06:44	MOR	action	78° 57.96' N	4° 38.45' E	2583
0179-1	21.07.12	07:20	MOR	in the water	79° 0.46' N	4° 19.79' E	2602
0179-1	21.07.12	07:24	MOR	in the water	79° 0.47' N	4° 19.78' E	2602
0179-1	21.07.12	07:26	MOR	lowering	79° 0.45' N	4° 19.75' E	2603
0179-1	21.07.12	07:32	MOR	in the water	79° 0.37' N	4° 19.69' E	2605
0179-1	21.07.12	07:32	MOR	lowering	79° 0.37' N	4° 19.69' E	2605
0179-1	21.07.12	07:40	MOR	in the water	79° 0.44' N	4° 19.87' E	2602
0179-1	21.07.12	07:40	MOR	lowering	79° 0.44' N	4° 19.87' E	2602
0179-1	21.07.12	07:45	MOR	in the water	79° 0.49' N	4° 19.95' E	2601
0179-1	21.07.12	07:46	MOR	lowering	79° 0.48' N	4° 19.96' E	2601
0179-1	21.07.12	07:59	MOR	in the water	79° 0.44' N	4° 19.92' E	2602
0179-1	21.07.12	08:00	MOR	lowering	79° 0.44' N	4° 19.92' E	2602
0179-1	21.07.12	08:12	MOR	in the water	79° 0.42' N	4° 19.96' E	2603
0179-1	21.07.12	08:15	MOR	lowering	79° 0.41' N	4° 19.96' E	2603
0179-1	21.07.12	08:18	MOR	in the water	79° 0.41' N	4° 19.95' E	2603
0179-1	21.07.12	08:20	MOR	lowering	79° 0.41' N	4° 19.95' E	2603
0179-1	21.07.12	08:35	MOR	in the water	79° 0.42' N	4° 19.94' E	2603
0179-1	21.07.12	08:36	MOR	lowering	79° 0.42' N	4° 19.94' E	2603
0179-1	21.07.12	08:48	MOR	in the water	79° 0.42' N	4° 20.00' E	2603
0179-1	21.07.12	08:49	MOR	lowering	79° 0.42' N	4° 20.01' E	2603
0179-1	21.07.12	09:04	MOR	in the water	79° 0.42' N	4° 19.81' E	2604
0179-1	21.07.12	09:09	MOR	in the water	79° 0.43' N	4° 19.78' E	2603
0179-1	21.07.12	09:10	MOR	on ground/ max depth	79° 0.43' N	4° 19.78' E	2604
0179-1	21.07.12	09:11	MOR	on deck	79° 0.42' N	4° 19.77' E	2604
0179-2	21.07.12	10:00	BL-FT	on ground/ max depth	79° 4.80' N	4° 21.55' E	2280
0179-2	21.07.12	10:08	BL-FT	action	79° 4.83' N	4° 21.56' E	2279
0179-2	21.07.12	10:11	BL-FT	off ground	79° 4.78' N	4° 21.52' E	2280

Station PS80/	Date	Time	Gear Abbr.	Action	Position Latitude	Position Longitude	Water Depth [m]
0179-2	21.07.12	10:44	BL-FT	at surface	79° 4.72' N	4° 21.00' E	2285
0179-2	21.07.12	10:57	BL-FT	action	79° 4.73' N	4° 20.66' E	2287
0179-2	21.07.12	10:58	BL-FT	on deck	79° 4.73' N	4° 20.64' E	2287
0179-3	21.07.12	11:40	OFOS	in the water	79° 1.98' N	4° 10.01' E	2628
0179-3	21.07.12	12:31	OFOS	on ground/ max depth	79° 2.01' N	4° 9.92' E	2628
0179-3	21.07.12	12:32	OFOS	profile start	79° 2.01' N	4° 9.92' E	2628
0179-3	21.07.12	13:55	OFOS	hoisting	79° 2.35' N	4° 8.48' E	2629
0179-3	21.07.12	13:58	OFOS	alter course	79° 2.36' N	4° 8.53' E	2628
0179-3	21.07.12	14:30	OFOS	lowering	79° 1.98' N	4° 9.77' E	2630
0179-3	21.07.12	14:34	OFOS	profile start	79° 1.98' N	4° 9.75' E	2630
0179-3	21.07.12	16:06	OFOS	action	79° 2.67' N	4° 12.63' E	2557
0179-3	21.07.12	17:45	OFOS	action	79° 3.67' N	4° 16.44' E	2431
0179-3	21.07.12	18:00	OFOS	profile end	79° 3.88' N	4° 17.18' E	2409
0179-3	21.07.12	18:01	OFOS	hoisting	79° 3.89' N	4° 17.22' E	2409
0179-3	21.07.12	18:54	OFOS	at surface	79° 3.81' N	4° 16.84' E	2418
0179-3	21.07.12	18:56	OFOS	on deck	79° 3.81' N	4° 16.75' E	2419
0180-1	21.07.12	20:00	CTD/RO	in the water	79° 3.78' N	3° 39.11' E	3137
0180-1	21.07.12	21:05	CTD/RO	on ground/ max depth	79° 3.82' N	3° 38.74' E	3152
0180-1	21.07.12	21:06	CTD/RO	hoisting	79° 3.82' N	3° 38.74' E	3151
0180-1	21.07.12	21:57	CTD/RO	at surface	79° 3.83' N	3° 38.62' E	3156
0180-1	21.07.12	21:58	CTD/RO	on deck	79° 3.83' N	3° 38.62' E	3157
0180-2	21.07.12	22:13	MUC	in the water	79° 3.79' N	3° 39.40' E	3109
0180-2	21.07.12	23:08	MUC	on ground/ max depth	79° 3.79' N	3° 39.39' E	3114
0180-2	21.07.12	23:09	MUC	hoisting	79° 3.79' N	3° 39.38' E	3125
0180-2	21.07.12	23:53	MUC	on deck	79° 3.93' N	3° 38.83' E	3140
0181-1	22.07.12	00:18	CTD/RO	in the water	79° 3.66' N	3° 34.72' E	3453
0181-1	22.07.12	01:27	CTD/RO	on ground/ max depth	79° 3.65' N	3° 34.79' E	3448
0181-1	22.07.12	01:28	CTD/RO	hoisting	79° 3.65' N	3° 34.81' E	3444
0181-1	22.07.12	02:22	CTD/RO	on deck	79° 3.63' N	3° 34.68' E	3494
0181-2	22.07.12	02:28	MUC	in the water	79° 3.61' N	3° 34.72' E	3483
0181-2	22.07.12	03:27	MUC	on ground/ max depth	79° 3.62' N	3° 34.85' E	3457
0181-2	22.07.12	03:28	MUC	hoisting	79° 3.62' N	3° 34.86' E	3500

Station PS80/	Date	Time	Gear Abbr.	Action	Position Latitude	Position Longitude	Water Depth [m]
0181-2	22.07.12	04:12	MUC	at surface	79° 3.65' N	3° 33.44' E	3609
0181-2	22.07.12	04:15	MUC	on deck	79° 3.65' N	3° 33.33' E	3615
0182-1	22.07.12	04:38	CTD/RO	in the water	79° 3.64' N	3° 29.33' E	3970
0182-1	22.07.12	05:58	CTD/RO	on ground/ max depth	79° 3.62' N	3° 28.57' E	3997
0182-1	22.07.12	05:59	CTD/RO	hoisting	79° 3.62' N	3° 28.57' E	4004
0182-1	22.07.12	07:07	CTD/RO	at surface	79° 3.60' N	3° 28.51' E	4020
0182-1	22.07.12	07:10	CTD/RO	on deck	79° 3.61' N	3° 28.50' E	4014
0182-2	22.07.12	07:16	MUC	in the water	79° 3.62' N	3° 28.49' E	4023
0182-2	22.07.12	08:25	MUC	on ground/ max depth	79° 3.60' N	3° 28.46' E	4042
0182-2	22.07.12	08:25	MUC	hoisting	79° 3.60' N	3° 28.46' E	4042
0182-2	22.07.12	09:20	MUC	at surface	79° 3.63' N	3° 28.01' E	4067
0182-2	22.07.12	09:24	MUC	on deck	79° 3.62' N	3° 27.92' E	4083
0183-1	22.07.12	09:51	CTD/RO	in the water	79° 3.84' N	3° 20.12' E	5084
0183-1	22.07.12	11:33	CTD/RO	on ground/ max depth	79° 3.86' N	3° 19.97' E	5111
0183-1	22.07.12	11:33	CTD/RO	hoisting	79° 3.86' N	3° 19.97' E	5111
0183-1	22.07.12	13:03	CTD/RO	on deck	79° 3.87' N	3° 20.15' E	5085
0183-2	22.07.12	13:34	AUV	in the water	79° 3.88' N	3° 20.06' E	5095
0183-2	22.07.12	13:37	AUV	in the water	79° 3.87' N	3° 20.07' E	5090
0183-2	22.07.12	14:06	AUV	information	79° 3.86' N	3° 20.32' E	5089
0183-2	22.07.12	14:13	AUV	on deck	79° 3.85' N	3° 20.22' E	5088
0183-2	22.07.12	14:20	AUV	profile start	79° 3.86' N	3° 20.18' E	5091
0183-3	22.07.12	14:24	MUC	in the water	79° 3.85' N	3° 20.19' E	5095
0183-3	22.07.12	15:59	MUC	on ground/ max depth	79° 3.84' N	3° 20.23' E	5089
0183-3	22.07.12	16:00	MUC	hoisting	79° 3.84' N	3° 20.24' E	5084
0183-2	22.07.12	16:32	AUV	at surface	79° 3.81' N	3° 20.37' E	5076
0183-3	22.07.12	17:07	MUC	at surface	79° 3.86' N	3° 20.18' E	5091
0183-3	22.07.12	17:10	MUC	on deck	79° 3.85' N	3° 20.21' E	5092
0183-2	22.07.12	17:50	AUV	profile end	79° 3.87' N	3° 20.08' E	5079
0183-2	22.07.12	17:56	AUV	at surface	79° 3.85' N	3° 20.07' E	5084
0183-2	22.07.12	18:05	AUV	in the water	79° 3.93' N	3° 20.88' E	5037
0183-2	22.07.12	18:15	AUV	on deck	79° 3.92' N	3° 20.88' E	5018
0183-2	22.07.12	18:17	AUV	on deck	79° 3.92' N	3° 20.89' E	5031

Station PS80/	Date	Time	Gear Abbr.	Action	Position Latitude	Position Longitude	Water Depth [m]
0184-1	22.07.12	19:27	CTD/RO	in the water	79° 8.01' N	2° 50.54' E	5561
0184-2	22.07.12	19:43	HN	in the water	79° 8.00' N	2° 50.33' E	5562
0184-2	22.07.12	19:43	HN	on ground/ max depth	79° 8.00' N	2° 50.33' E	5562
0184-2	22.07.12	19:47	HN	on deck	79° 8.00' N	2° 50.34' E	5560
0184-1	22.07.12	21:15	CTD/RO	on ground/ max depth	79° 8.03' N	2° 50.46' E	5561
0184-1	22.07.12	21:16	CTD/RO	hoisting	79° 8.03' N	2° 50.45' E	5564
0184-1	22.07.12	22:44	CTD/RO	on deck	79° 8.03' N	2° 50.45' E	5562
0184-3	22.07.12	23:00	LOKI	in the water	79° 8.02' N	2° 50.49' E	5563
0184-3	22.07.12	23:01	LOKI	profile start	79° 8.02' N	2° 50.52' E	5560
0184-3	22.07.12	23:22	LOKI	on ground/ max depth	79° 8.02' N	2° 50.48' E	5562
0184-3	22.07.12	23:26	LOKI	hoisting	79° 8.02' N	2° 50.53' E	5563
0184-3	23.07.12	00:00	LOKI	profile end	79° 8.02' N	2° 50.52' E	5563
0184-3	23.07.12	00:04	LOKI	on deck	79° 8.02' N	2° 50.49' E	5562
0184-4	23.07.12	00:17	MN	in the water	79° 8.01' N	2° 50.52' E	5563
0184-4	23.07.12	01:08	MN	on ground/ max depth	79° 7.99' N	2° 50.54' E	5564
0184-4	23.07.12	01:08	MN	hoisting	79° 7.99' N	2° 50.54' E	5564
0184-4	23.07.12	01:57	MN	on deck	79° 7.99' N	2° 50.54' E	5563
0184-5	23.07.12	02:08	MUC	in the water	79° 8.01' N	2° 50.52' E	5563
0184-5	23.07.12	03:34	MUC	on ground/ max depth	79° 8.03' N	2° 50.53' E	5561
0184-5	23.07.12	03:34	MUC	hoisting	79° 8.03' N	2° 50.53' E	5561
0184-5	23.07.12	04:52	MUC	at surface	79° 8.02' N	2° 50.42' E	5564
0184-5	23.07.12	04:55	MUC	on deck	79° 8.02' N	2° 50.40' E	5562
0185-1	23.07.12	11:00	MOR	on ground/ max depth	79° 44.19' N	4° 29.51' E	2669
0185-1	23.07.12	11:07	MOR	action	79° 44.12' N	4° 29.23' E	2663
0185-1	23.07.12	11:09	MOR	at surface	79° 44.11' N	4° 29.38' E	2675
0185-1	23.07.12	11:28	MOR	action	79° 44.25' N	4° 30.07' E	2674
0185-1	23.07.12	11:32	MOR	on deck	79° 44.19' N	4° 29.81' E	2683
0185-1	23.07.12	11:35	MOR	on deck	79° 44.18' N	4° 29.57' E	2674
0185-1	23.07.12	11:42	MOR	on deck	79° 44.16' N	4° 29.17' E	2650
0185-1	23.07.12	11:56	MOR	on deck	79° 44.08' N	4° 28.61' E	2643
0185-1	23.07.12	12:06	MOR	on deck	79° 44.01' N	4° 28.29' E	2642
0185-1	23.07.12	12:19	MOR	on deck	79° 44.03' N	4° 28.03' E	2630

Station PS80/	Date	Time	Gear Abbr.	Action	Position Latitude	Position Longitude	Water Depth [m]
0185-1	23.07.12	12:26	MOR	on deck	79° 43.99' N	4° 27.78' E	2631
0185-1	23.07.12	12:31	MOR	on deck	79° 43.97' N	4° 27.65' E	2634
0185-1	23.07.12	12:33	MOR	on deck	79° 43.97' N	4° 27.61' E	2634
0185-2	23.07.12	12:45	BL-MP	on ground/ max depth	79° 43.69' N	4° 27.46' E	2667
0185-2	23.07.12	12:46	BL-MP	action	79° 43.66' N	4° 27.46' E	2669
0185-2	23.07.12	13:35	BL-MP	at surface	79° 43.57' N	4° 26.67' E	2668
0185-2	23.07.12	13:47	BL-MP	action	79° 43.70' N	4° 27.13' E	2660
0185-2	23.07.12	13:55	BL-MP	on deck	79° 43.59' N	4° 26.74' E	2668
0185-3	23.07.12	14:18	HN	in the water	79° 44.40' N	4° 30.32' E	2664
0185-4	23.07.12	14:22	CTD/RO	in the water	79° 44.39' N	4° 30.34' E	2663
0185-3	23.07.12	14:24	HN	on ground/ max depth	79° 44.39' N	4° 30.33' E	2664
0185-3	23.07.12	14:24	HN	on deck	79° 44.39' N	4° 30.33' E	2664
0185-4	23.07.12	14:47	CTD/RO	on ground/ max depth	79° 44.38' N	4° 30.32' E	2665
0185-4	23.07.12	14:48	CTD/RO	hoisting	79° 44.38' N	4° 30.31' E	2666
0185-4	23.07.12	15:08	CTD/RO	on deck	79° 44.38' N	4° 30.23' E	2662
0185-5	23.07.12	18:08	MUC	in the water	79° 44.36' N	4° 30.35' E	2670
0185-5	23.07.12	18:58	MUC	on ground/ max depth	79° 44.37' N	4° 30.33' E	2668
0185-5	23.07.12	18:59	MUC	hoisting	79° 44.37' N	4° 30.33' E	2668
0185-5	23.07.12	19:48	MUC	at surface	79° 44.36' N	4° 30.34' E	2670
0185-5	23.07.12	19:51	MUC	on deck	79° 44.37' N	4° 30.36' E	2669
0185-6	23.07.12	19:58	BC	in the water	79° 44.36' N	4° 30.35' E	2671
0185-6	23.07.12	20:39	BC	on ground/ max depth	79° 44.36' N	4° 30.31' E	2668
0185-6	23.07.12	20:40	BC	hoisting	79° 44.36' N	4° 30.31' E	2668
0185-6	23.07.12	20:41	BC	hoisting	79° 44.36' N	4° 30.30' E	2668
0185-6	23.07.12	21:18	BC	at surface	79° 44.39' N	4° 30.38' E	2667
0185-6	23.07.12	21:20	BC	on deck	79° 44.39' N	4° 30.39' E	2667
0186-1	24.07.12	00:10	CTD/RO	in the water	79° 56.24' N	3° 11.53' E	2509
0186-1	24.07.12	01:04	CTD/RO	on ground/ max depth	79° 55.99' N	3° 10.78' E	2520
0186-1	24.07.12	01:05	CTD/RO	hoisting	79° 55.99' N	3° 10.77' E	2517
0186-1	24.07.12	01:50	CTD/RO	on deck	79° 55.80' N	3° 9.84' E	2526
0186-2	24.07.12	02:05	LOKI	in the water	79° 56.45' N	3° 12.53' E	2502

Station PS80/	Date	Time	Gear Abbr.	Action	Position Latitude	Position Longitude	Water Depth [m]
0186-2	24.07.12	02:35	LOKI	on ground/ max depth	79° 56.42' N	3° 12.10' E	2502
0186-2	24.07.12	02:37	LOKI	hoisting	79° 56.42' N	3° 12.08' E	2501
0186-2	24.07.12	02:37	LOKI	profile start	79° 56.42' N	3° 12.08' E	2501
0186-2	24.07.12	03:21	LOKI	profile end	79° 56.29' N	3° 11.92' E	2505
0186-2	24.07.12	03:22	LOKI	on deck	79° 56.28' N	3° 11.91' E	2508
0186-3	24.07.12	03:36	MUC	in the water	79° 56.49' N	3° 11.32' E	2503
0186-3	24.07.12	04:25	MUC	on ground/ max depth	79° 56.42' N	3° 10.79' E	2511
0186-3	24.07.12	04:25	MUC	hoisting	79° 56.42' N	3° 10.79' E	2511
0186-3	24.07.12	04:58	MUC	at surface	79° 56.49' N	3° 10.41' E	2510
0186-3	24.07.12	05:01	MUC	on deck	79° 56.49' N	3° 10.38' E	2510
0186-4	24.07.12	05:09	BC	in the water	79° 56.48' N	3° 10.34' E	2511
0186-4	24.07.12	05:48	BC	on ground/ max depth	79° 56.43' N	3° 10.37' E	2513
0186-4	24.07.12	05:48	BC	hoisting	79° 56.43' N	3° 10.37' E	2513
0186-4	24.07.12	06:21	BC	at surface	79° 56.36' N	3° 9.66' E	2516
0186-4	24.07.12	06:23	BC	on deck	79° 56.36' N	3° 9.64' E	2518
0186-5	24.07.12	06:50	OFOS	in the water	79° 56.29' N	3° 9.10' E	2525
0186-5	24.07.12	07:45	OFOS	on ground/ max depth	79° 56.08' N	3° 7.99' E	2536
0186-5	24.07.12	07:46	OFOS	profile start	79° 56.07' N	3° 7.98' E	2534
0186-5	24.07.12	09:16	OFOS	profile end	79° 55.63' N	3° 5.69' E	2554
0186-5	24.07.12	09:17	OFOS	hoisting	79° 55.62' N	3° 5.66' E	2552
0186-5	24.07.12	10:02	OFOS	on deck	79° 55.39' N	3° 4.18' E	2564
0187-1	24.07.12	12:12	CTD/RO	in the water	79° 50.26' N	3° 43.60' E	2482
0187-1	24.07.12	12:19	CTD/RO	on ground/ max depth	79° 50.25' N	3° 43.38' E	2481
0187-1	24.07.12	12:19	CTD/RO	hoisting	79° 50.25' N	3° 43.38' E	2481
0187-1	24.07.12	12:22	CTD/RO	on deck	79° 50.20' N	3° 43.22' E	2485
0187-2	24.07.12	12:33	AUV	in the water	79° 50.01' N	3° 42.63' E	2472
0187-2	24.07.12	12:41	AUV	action	79° 49.97' N	3° 42.33' E	2496
0187-2	24.07.12	12:46	AUV	on deck	79° 49.90' N	3° 42.08' E	2498
0187-2	24.07.12	13:31	AUV	action	79° 49.80' N	3° 40.64' E	2512
0187-2	24.07.12	13:52	AUV	in the water	79° 49.45' N	3° 39.12' E	2546
0187-2	24.07.12	13:56	AUV	in the water	79° 49.42' N	3° 38.92' E	2549

Station PS80/	Date	Time	Gear Abbr.	Action	Position Latitude	Position Longitude	Water Depth [m]
0187-2	24.07.12	14:22	AUV	action	79° 49.29' N	3° 38.29' E	2561
0187-2	24.07.12	14:25	AUV	action	79° 49.28' N	3° 38.28' E	2565
0187-2	24.07.12	14:25	AUV	profile start	79° 49.28' N	3° 38.28' E	2565
0187-2	24.07.12	14:28	AUV	on deck	79° 49.27' N	3° 38.30' E	2567
0187-2	24.07.12	16:00	AUV	profile end	79° 48.84' N	3° 38.98' E	2598
0187-2	24.07.12	16:07	AUV	at surface	79° 48.57' N	3° 39.84' E	2616
0187-2	24.07.12	16:30	AUV	action	79° 48.46' N	3° 39.46' E	2626
0187-2	24.07.12	16:35	AUV	profile start	79° 48.47' N	3° 39.16' E	2624
0187-2	24.07.12	18:09	AUV	profile end	79° 47.70' N	3° 37.85' E	2713
0187-2	24.07.12	18:10	AUV	at surface	79° 47.69' N	3° 37.99' E	2720
0187-2	24.07.12	18:22	AUV	in the water	79° 47.88' N	3° 35.98' E	2674
0187-2	24.07.12	18:32	AUV	action	79° 47.84' N	3° 35.66' E	2683
0187-2	24.07.12	18:36	AUV	on deck	79° 47.82' N	3° 35.44' E	2685
0187-2	24.07.12	18:37	AUV	hoisting	79° 47.82' N	3° 35.38' E	2690
0187-2	24.07.12	19:55	AUV	on deck	79° 48.44' N	3° 22.80' E	3173
0188-1	24.07.12	22:34	CTD/RO	in the water	79° 36.23' N	5° 10.03' E	2745
0188-1	24.07.12	23:35	CTD/RO	on ground/ max depth	79° 36.22' N	5° 10.28' E	2743
0188-1	24.07.12	23:36	CTD/RO	hoisting	79° 36.22' N	5° 10.27' E	2742
0188-1	25.07.12	00:24	CTD/RO	on deck	79° 36.22' N	5° 10.28' E	2742
0188-2	25.07.12	00:31	MUC	in the water	79° 36.22' N	5° 10.28' E	2746
0188-2	25.07.12	01:16	MUC	on ground/ max depth	79° 36.23' N	5° 10.23' E	2742
0188-2	25.07.12	01:16	MUC	hoisting	79° 36.23' N	5° 10.23' E	2742
0188-2	25.07.12	02:03	MUC	on deck	79° 36.24' N	5° 10.22' E	2743
0188-3	25.07.12	02:12	BC	in the water	79° 36.28' N	5° 10.38' E	2741
0188-3	25.07.12	02:51	BC	on ground/ max depth	79° 36.27' N	5° 10.41' E	2741
0188-3	25.07.12	02:52	BC	hoisting	79° 36.27' N	5° 10.40' E	2742
0188-3	25.07.12	03:33	BC	on deck	79° 36.29' N	5° 10.34' E	2742
0188-4	25.07.12	03:41	BC	in the water	79° 36.27' N	5° 10.29' E	2743
0188-4	25.07.12	04:16	BC	on ground/ max depth	79° 36.26' N	5° 10.34' E	2742
0188-4	25.07.12	04:18	BC	hoisting	79° 36.25' N	5° 10.32' E	2741
0188-4	25.07.12	04:57	BC	on deck	79° 36.27' N	5° 10.38' E	2742
0189-1	25.07.12	06:14	MN	in the water	79° 44.25' N	4° 30.53' E	2702

Station PS80/	Date	Time	Gear Abbr.	Action	Position Latitude	Position Longitude	Water Depth [m]
0189-1	25.07.12	07:00	MN	on ground/ max depth	79° 44.31' N	4° 30.01' E	2663
0189-1	25.07.12	07:50	MN	at surface	79° 44.36' N	4° 29.29' E	2611
0189-1	25.07.12	07:55	MN	on deck	79° 44.37' N	4° 29.23' E	2603
0189-2	25.07.12	08:05	CTD/RO	in the water	79° 44.35' N	4° 30.07' E	2661
0189-2	25.07.12	09:00	CTD/RO	on ground/ max depth	79° 44.42' N	4° 30.22' E	2652
0189-2	25.07.12	09:02	CTD/RO	hoisting	79° 44.41' N	4° 30.18' E	2652
0189-2	25.07.12	09:47	CTD/RO	at surface	79° 44.43' N	4° 30.10' E	2641
0189-2	25.07.12	09:50	CTD/RO	on deck	79° 44.42' N	4° 30.13' E	2644
0189-3	25.07.12	10:18	MOR	information	79° 44.38' N	4° 30.39' E	2666
0189-3	25.07.12	10:20	MOR	in the water	79° 44.39' N	4° 30.40' E	2669
0189-3	25.07.12	10:22	MOR	in the water	79° 44.40' N	4° 30.42' E	2666
0189-3	25.07.12	10:29	MOR	in the water	79° 44.40' N	4° 30.40' E	2664
0189-3	25.07.12	10:38	MOR	in the water	79° 44.40' N	4° 30.30' E	2660
0189-3	25.07.12	10:42	MOR	in the water	79° 44.39' N	4° 30.35' E	2664
0189-3	25.07.12	10:51	MOR	in the water	79° 44.39' N	4° 30.42' E	2669
0189-3	25.07.12	11:02	MOR	in the water	79° 44.36' N	4° 30.25' E	2664
0189-3	25.07.12	11:24	MOR	in the water	79° 44.37' N	4° 30.38' E	2668
0189-3	25.07.12	11:36	MOR	in the water	79° 44.38' N	4° 30.29' E	2661
0189-3	25.07.12	11:45	MOR	in the water	79° 44.37' N	4° 30.37' E	2664
0189-3	25.07.12	11:45	MOR	lowering	79° 44.37' N	4° 30.37' E	2664
0189-3	25.07.12	11:50	MOR	on ground/ max depth	79° 44.37' N	4° 30.37' E	2667
0189-3	25.07.12	11:54	MOR	on deck	79° 44.39' N	4° 30.38' E	2666
0190-1	25.07.12	12:32	AUV	action	79° 44.05' N	4° 26.32' E	2611
0190-1	25.07.12	14:22	AUV	in the water	79° 42.33' N	4° 22.70' E	2820
0190-1	25.07.12	14:25	AUV	in the water	79° 42.31' N	4° 22.70' E	2818
0190-1	25.07.12	14:51	AUV	action	79° 42.06' N	4° 22.77' E	2840
0190-1	25.07.12	15:10	AUV	action	79° 41.83' N	4° 22.49' E	2861
0190-1	25.07.12	15:12	AUV	profile start	79° 41.81' N	4° 22.45' E	2862
0190-1	25.07.12	15:15	AUV	on deck	79° 41.79' N	4° 22.36' E	2862

Station PS80/	Date	Time	Gear Abbr.	Action	Position Latitude	Position Longitude	Water Depth [m]
0190-1	25.07.12	16:20	AUV	profile end	79° 41.67' N	4° 18.14' E	2914
0190-1	25.07.12	16:23	AUV	at surface	79° 41.73' N	4° 17.75' E	2913
0190-1	25.07.12	17:19	AUV	in the water	79° 41.10' N	4° 9.25' E	3102
0190-1	25.07.12	17:28	AUV	on deck	79° 41.00' N	4° 8.83' E	3130
0190-1	25.07.12	17:30	AUV	on deck	79° 40.99' N	4° 8.77' E	3131
0190-1	25.07.12	17:40	AUV	action	79° 40.96' N	4° 8.79' E	3144
0190-1	25.07.12	18:05	AUV	on deck	79° 40.44' N	4° 15.12' E	3000
0191-1	25.07.12	20:05	CTD/RO	in the water	79° 24.61' N	4° 41.80' E	2504
0191-1	25.07.12	20:59	CTD/RO	on ground/ max depth	79° 24.59' N	4° 41.87' E	2544
0191-1	25.07.12	20:59	CTD/RO	hoisting	79° 24.59' N	4° 41.87' E	2544
0191-1	25.07.12	21:44	CTD/RO	at surface	79° 24.60' N	4° 41.74' E	2544
0191-1	25.07.12	21:45	CTD/RO	on deck	79° 24.60' N	4° 41.75' E	2544
0191-2	25.07.12	21:52	MUC	in the water	79° 24.60' N	4° 41.80' E	2544
0191-2	25.07.12	22:33	MUC	on ground/ max depth	79° 24.60' N	4° 41.76' E	2504
0191-2	25.07.12	22:33	MUC	hoisting	79° 24.60' N	4° 41.76' E	2504
0191-2	25.07.12	23:17	MUC	on deck	79° 24.60' N	4° 41.61' E	2505
0191-3	25.07.12	23:24	BC	in the water	79° 24.61' N	4° 41.32' E	2506
0191-3	26.07.12	00:01	BC	on ground/ max depth	79° 24.60' N	4° 41.58' E	2506
0191-3	26.07.12	00:01	BC	hoisting	79° 24.60' N	4° 41.58' E	2506
0191-3	26.07.12	00:02	BC	off ground	79° 24.61' N	4° 41.58' E	2505
0191-3	26.07.12	00:40	BC	on deck	79° 24.79' N	4° 40.91' E	2516
0192-1	26.07.12	04:09	AGT	in the water	79° 39.51' N	4° 47.09' E	2854
0192-1	26.07.12	04:18	AGT	lowering	79° 39.89' N	4° 45.92' E	2771
0192-1	26.07.12	05:26	AGT	profile start	79° 42.99' N	4° 46.44' E	2580
0192-1	26.07.12	05:34	AGT	lowering	79° 43.20' N	4° 46.68' E	2537
0192-1	26.07.12	05:38	AGT	on ground/ max depth	79° 43.35' N	4° 46.34' E	2533
0192-1	26.07.12	05:41	AGT	profile start	79° 43.44' N	4° 46.04' E	2532
0192-1	26.07.12	06:12	AGT	profile end	79° 43.87' N	4° 44.26' E	2547
0192-1	26.07.12	06:59	AGT	off ground	79° 43.82' N	4° 42.94' E	2590
0192-1	26.07.12	08:10	AGT	at surface	79° 43.95' N	4° 41.60' E	2601
0192-1	26.07.12	08:16	AGT	on deck	79° 43.91' N	4° 41.72' E	2608
0193-1	26.07.12	10:00	OFOS	in the water	79° 35.98' N	5° 9.93' E	2749

Station PS80/	Date	Time	Gear Abbr.	Action	Position Latitude	Position Longitude	Water Depth [m]
0193-1	26.07.12	10:55	OFOS	on ground/ max depth	79° 36.04' N	5° 9.89' E	2736
0193-1	26.07.12	10:56	OFOS	profile start	79° 36.04' N	5° 9.88' E	2748
0193-1	26.07.12	14:17	OFOS	profile end	79° 33.53' N	5° 16.99' E	2609
0193-1	26.07.12	14:17	OFOS	hoisting	79° 33.53' N	5° 16.99' E	2609
0193-1	26.07.12	15:07	OFOS	on deck	79° 33.44' N	5° 16.43' E	2623
0194-1	26.07.12	17:27	CTD/RO	in the water	79° 16.99' N	4° 19.77' E	2362
0194-1	26.07.12	18:18	CTD/RO	on ground/ max depth	79° 16.99' N	4° 19.68' E	2364
0194-1	26.07.12	18:18	CTD/RO	hoisting	79° 16.99' N	4° 19.68' E	2364
0194-1	26.07.12	19:00	CTD/RO	at surface	79° 17.02' N	4° 19.49' E	2365
0194-1	26.07.12	19:02	CTD/RO	on deck	79° 17.02' N	4° 19.49' E	2366
0194-2	26.07.12	19:07	MUC	in the water	79° 16.99' N	4° 19.59' E	2363
0194-2	26.07.12	19:45	MUC	on ground/ max depth	79° 17.02' N	4° 19.54' E	2363
0194-2	26.07.12	19:46	MUC	hoisting	79° 17.02' N	4° 19.51' E	2364
0194-2	26.07.12	20:23	MUC	at surface	79° 16.99' N	4° 19.70' E	2360
0194-2	26.07.12	20:26	MUC	on deck	79° 16.98' N	4° 19.71' E	2361
0194-3	26.07.12	20:37	BC	in the water	79° 16.97' N	4° 19.76' E	2361
0194-3	26.07.12	21:06	BC	information	79° 16.98' N	4° 19.67' E	2361
0194-3	26.07.12	21:43	BC	lowering	79° 17.00' N	4° 19.66' E	2363
0194-3	26.07.12	21:53	BC	on ground/ max depth	79° 17.01' N	4° 19.59' E	2364
0194-3	26.07.12	21:53	BC	hoisting	79° 17.01' N	4° 19.59' E	2364
0194-3	26.07.12	21:53	BC	hoisting	79° 17.01' N	4° 19.59' E	2364
0194-3	26.07.12	22:37	BC	on deck	79° 17.08' N	4° 18.77' E	2375
0195-1	27.07.12	00:15	BONGO	in the water	79° 4.87' N	4° 5.71' E	2461
0195-1	27.07.12	01:42	BONGO	on ground/ max depth	79° 4.92' N	4° 5.81' E	2458
0195-1	27.07.12	02:34	BONGO	at surface	79° 4.91' N	4° 5.77' E	2459
0195-1	27.07.12	02:38	BONGO	on deck	79° 4.90' N	4° 5.73' E	2458
0195-2	27.07.12	02:48	LOKI	in the water	79° 4.91' N	4° 5.81' E	2458
0195-2	27.07.12	03:03	LOKI	on ground/ max depth	79° 4.89' N	4° 5.81' E	2458
0195-2	27.07.12	03:05	LOKI	profile start	79° 4.89' N	4° 5.78' E	2458
0195-2	27.07.12	03:05	LOKI	hoisting	79° 4.89' N	4° 5.78' E	2458
0195-2	27.07.12	03:27	LOKI	profile end	79° 4.89' N	4° 5.78' E	2459
0195-2	27.07.12	03:29	LOKI	on deck	79° 4.88' N	4° 5.77' E	2458

Station PS80/	**Date**	**Time**	**Gear Abbr.**	**Action**	**Position Latitude**	**Position Longitude**	**Water Depth [m]**
0195-3	27.07.12	03:39	BC	in the water	79° 4.90' N	4° 5.86' E	2458
0195-3	27.07.12	04:13	BC	on ground/ max depth	79° 4.93' N	4° 5.90' E	2458
0195-3	27.07.12	04:14	BC	hoisting	79° 4.93' N	4° 5.90' E	2458
0195-3	27.07.12	04:48	BC	on deck	79° 4.91' N	4° 5.50' E	2462
0195-4	27.07.12	05:07	BL-LT	in the water	79° 4.66' N	4° 6.46' E	2461
0195-4	27.07.12	05:07	BL-LT	on ground/ max depth	79° 4.66' N	4° 6.46' E	2461
0195-4	27.07.12	05:07	BL-LT	action	79° 4.66' N	4° 6.46' E	2461
0196-1	27.07.12	05:38	OFOS	in the water	79° 5.99' N	4° 22.46' E	2298
0196-1	27.07.12	06:25	OFOS	on ground/ max depth	79° 5.97' N	4° 21.70' E	2295
0196-1	27.07.12	06:46	OFOS	profile start	79° 5.98' N	4° 23.01' E	2297
0196-1	27.07.12	10:46	OFOS	profile end	79° 6.02' N	4° 33.92' E	2042
0196-1	27.07.12	10:46	OFOS	hoisting	79° 6.02' N	4° 33.92' E	2042
0196-1	27.07.12	11:29	OFOS	on deck	79° 6.18' N	4° 32.38' E	1876
0197-1	27.07.12	13:12	BC	in the water	78° 55.03' N	5° 0.55' E	2594
0197-1	27.07.12	13:53	BC	on ground/ max depth	78° 55.08' N	5° 0.10' E	2594
0197-1	27.07.12	13:53	BC	hoisting	78° 55.08' N	5° 0.10' E	2594
0197-1	27.07.12	14:30	BC	on deck	78° 55.23' N	5° 2.44' E	2585

Abbreviation	Gear
AGT	Agassiz-Trawl
AUV	Autonomous Underwater Vehicle
BC	Boxcorer
BL-FT	Bottom-Lander - Fish-Trap
BL-LT	Bottom-Lander - Long-Term
BL-MP	Bottom-Lander - Micro-Profiler
BONGO	Bongo Net
CAL	Calibration - Sound Profile
CTD/RO	CTD/Rosette Water Sampler
FES	Fishery Echosounder Survey
HN	Hand Net
LOKI	Light frame On-sight Key species Investigation
MN	Multi Net
MOR	Mooring
MUC	Multicorer
OFOS	Ocean Floor Observation System

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