Cruise report

AEM-MOSJ and COPOL II 2011

13-23 July 2011

R/V Lance

Kongsfjorden, Rijpfjorden and Ice-edge

Contents

1. General

The 2011 July cruise sampled hydrography, nutrients, phytoplankton and zooplankton according to standard protocols for AEM programme along the KongHAU transect. The Arctic Ecosystem Monitoring program is a part of MOSJ (Environmental monitoring – Svalbard and Jan Mayen, www.mosj.npolar.no/). Additional samples were taken according to the AEM protocol in Rijpfjorden, the ice edge in the Fram Strait and Billefjorden. Samples to study the level of contaminant in biota were taken in Kongsfjorden, Rijpfjorden and at the ice-edge for the COPOL project. At all stations samples was collected for radionuclide studies in water and biota. A research project studying lipids, buoyancy, predator response and vertical position of *Calanus* spp. were carried out in Kongsfjorden, Rijpfjorden and Billefjorden. Data to support of the long term data series collected continuously by the ARCTOS arctic observatories were taken in Rijpfjorden and Billefjorden. Two PolArt artistes joined the cruise.

In memory of the victims in Oslo and Ytøya
A national tragedy and terror attack hit Norway with many dead and injured in Oslo and at Utøya. At 08:00 Saturday 23. July 2011 the flag was lowered at R/V Lance in memory of the victims of the terror attack. At the end of the cruise scientists and crew were gathered for one minute silence in respect for those involved.

2. Study area

The cruise started in Longyearbyen on July 13^{h} and finished on July 23rd in Longyearbyen. The main research areas were the Kongsfjorden-HAUSGARTEN transect (KongHAU), Rijpfjorden and a ice station in the mariginal ice zone in Fram Strait (Figure 1).

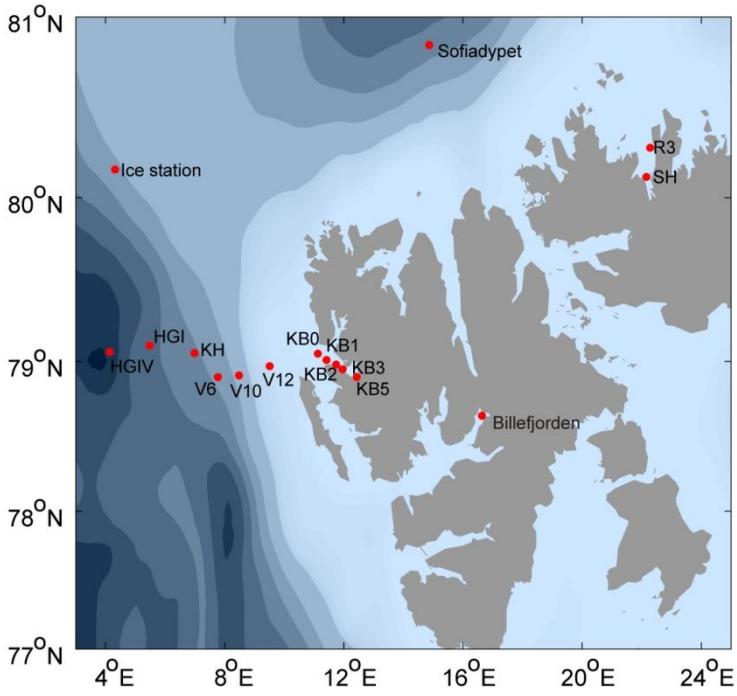

Figure 1: Stations sampled during MOSJ cruise July 2011

Table 1: Overview of stations

Area	Station	Date	Latitude (degrees)	Longitude (degrees)	Activities
Kongsfjorden	Kb5	14.07.2011	78 53.79	12 26.45	MOSJ
Kongsfjorden	Kb3	14-15.07.2011	78 57.24	11 57.38	MOSJ, COPOL, Calanus
Kongsfjorden	Kb2	15.07.2011	78 58.68	11 43.91	MOSJ
Kongsfjorden	Kb1	15.07.2011	79 00.67	11 25.66	MOSJ
Kongsfjorden	Kb0	15.07.2011	79 02.78	11 08.36	MOSJ
Kongsfjorden	V12	16.07.2011	78 58.79	09 29.77	MOSJ
Kongsfjorden	V10	16.07.2011	78 55.96	08 32.82	MOSJ
Kongsfjorden	V6		78 54.39	07 46.24	MOSJ
Hausgarten	KH	22.07.2011	79 03.00	07 00.00	MOSJ
Hausgarten	HG-I	21.07.2011	79 08.00	06 05.54	MOSJ
Hausgarten	HG-IV	21.07.2011	79 03.90	04 10.80	MOSJ
Rjipfjorden	R1 (SH)	18.07.2011	80 07.42	22 09.17	COPOL, Calanus
Rjipfjorden	R3mooring	18.07.2011	80 17.10	22 18.26	MOSJ
Sofiadypet		20.07.2011	80 51.08	14 52.0	Radionucleids
Ice edge	Ice station	20.07.2011	80 9.77	4 19.5	COPOL
Billefjorden		23.07.2011	78 38.59	16 39.14	Fastice, Calanus

3. Participants

Table 2: List of participants

Name	Institution	Project	Task	Email
Stig Falk-Petersen	NPI	MOSJ	Cruise leader /zoopl.	stig@npolar.no
Alexey Pavlov	NPI	MOSJ	Hydrography /Optics	alexey.pavlov@npolar.no
Anna Silyakova	NPI	MOSJ	Hydrography /Optics	anna.silyakova@uni.no
Malin Daase	NPI	MOSJ	Zoopl./phytoplankton	malin.daase@npolar.no
Anette Wold	NPI	MOSJ	Zoopl./phytoplankton	anette.wold@npolar.no
Jordan Grigor	UNIS/NPI	MOSJ	Zoopl./phytoplankton	quik.mercury@msn.com
Stefanie Tofelde	NPI	MOSJ	Zoopl./phytoplankton	Stefanie.tofelde@uni-konstanz.de
Margarita Zarubin	Interuniversity Institute for Marine Sciences	Calanus	*Calanus* lipids & vertical distribution	margaritazarubin@googlemail.com
Karen-Christine Oehninger-Storvoll	NTNU	Calanus	*Calanus* vertical distribution (MS thesis)	oehninge@stud.ntnu.no
Siri Myhren	NTNU	Calanus	Genetics of *Calanus* (MS thesis)	sirimy@stud.ntnu.no
Ingeborg G. Hallanger	NPI	COPOL	Ecotox	ingeborg.hallanger@npolar.no
Ida Beate Øverjord	NTNU	COPOL	Ecotox	overjord@bio.ntnu.no
Daniel Vogedes	NPI	COPOL	Ecotox	daniel.vogedes@npolar.no
Justin Gwynn	NRPA	COPOL	Radionucleids	Justin.Gwynn@nrpa.no
Per Arnberg	NPI	MOSJ		per.arnberg@npolar.no
Magnus Rognhaug	MD	MOSJ		mar@md.dep.no / rognhaug@hotmail.com
Lars Korff Lofthus		PolArt		larslofthus@gmail.com
Linn Halvorsrød		PolArt		lightsuit@gmail.com

4. Arctic Ecosystem Monitoring (MOSJ)

Responsible: Stig Falk-Petersen, Malin Daase & Anette Wold

4.1. Introduction

The 2011 July cruise sampled hydrography, nutrients, phytoplankton and zooplankton according to standard protocols along the KongHAU transect. Additional samples were taken in Rijpfjorden, the ice edge in the Fram strait and Billefjorden. The Arctic Ecosystem Monitoring program (AEM) is a program to monitor changes in the Arctic Ecosystem. It started in 1995 and consists of two parts:

- Long-term transect: the KongHAU transect from Kongsfjorden to Fram Strait, the Hornsund transect and the Rijpfjorden transect. These transects are serviced 1-3 times per year.
- A comprehensive database that covers all phytoplankton and zooplankton data collected by the Norwegian Polar Institute in Arctic waters. All data are analyzed to species level in cooperation with the Institute of Oceanology in Poland.

AEM is a part of MOSJ (Environmental monitoring – Svalbard and Jan Mayen, www.mosj.npolar.no/) and is continuously serviced and used by scientists from the Norwegian Polar Institute and other ARCTOS members (www.arctosresearch.net). AEM covers benthos, zooplankton, ice-fauna, phytoplankton and ice algae and is maintained through joint efforts by Akvaplan-niva (APN), the University of Tromsø (UoT), the University Centre in Svalbard (UNIS), the Norwegian Polar Institute (NPI), the Polish Institute of Oceanology (IOPAS) and the Alfred Wegener Institute of Polar and Marine Science (AWI).

As a part of MOSJ, AEM is used by NPI to monitor long term changes in the Arctic ecosystem, including changes in phytoplankton and zooplankton populations and community structure as well as trophic structure. Data from the AEM program are also in use in a number of international diversity and research programs. The most well known is Arctic Ocean Diversity (ArcOD, www.arcodiv.org), which is a project under the Census of Marine Life (www.coml.org) aimed at coordinating research efforts examining the diversity in each of the major three realms: sea ice, water column, and the sea floor.

4.2. Procedures

4.2.1. Hydrography and Light

Responsible: Alexey Pavlov / AARI

Area

Oceanographic activities were focused on one CTD transect from the inner part of Kongsfjorden (station Kb5) toward the continental shelf break (station V6) and some spot observations in Rijpfjorden (2 stations), ice edge (1 station) and Hausgarten stations (3 stations) (Figure 1). List of CTD stations is presented in Table 3.

Table 3: List of CTD stations during MOSJ 2011 cruise

St number	Date	Time (GMT)	Latitude N	Longitude E	Depth (m)	Location
1	13/07/2011	13:56:00	78.228	14.798	205	Isfjorden
2	14/07/2011	01:20:00	78.953	11.956	339	KB3
3	14/07/2011	12:45:00	78.970	11.895	311	KB3
4	14/07/2011	20:05:00	78.958	11.967	331	KB3
5	15/07/2011	07:33:00	78.898	12.425	68	KB5
6	15/07/2011	08:24:00	78.902	12.430	60	KB5
7	15/07/2011	11:34:00	78.957	11.955	336	KB3
8	15/07/2011	12:21:00	78.958	11.922	350	KB3
9	15/07/2011	15:45:00	78.979	11.742	239	KB2
10	15/07/2011	16:19:00	78.983	11.745	234	KB2
11	15/07/2011	19:40:00	79.010	11.420	358	KB1
12	15/07/2011	20:15:00	79.007	11.429	344	KB1
13	15/07/2011	23:33:00	79.045	11.134	318	KB0
14	16/07/2011	00:19:00	79.050	11.136	322	KB0
15	16/07/2011	03:39:00	78.975	9.509	222	V12
16	16/07/2011	04:25:00	78.962	9.472	220	V12
17	16/07/2011	10:04:00	78.919	8.501	475	V10
18	16/07/2011	10:53:00	78.924	8.512	395	V10
19	16/07/2011	13:49:00	78.910	8.496		V10
20	16/07/2011	23:32:00	78.903	7.775	1124	V6
21	17/07/2011	00:06:00	78.903	7.768	1124	V6
22	18/07/2011	04:20:00	80.12	22.16	193	SH
23	18/07/2011	08:18:00	80.13	22.15	201	SH
24	18/07/2011	17:59:00	80.29	22.28	238	R1
25	18/07/2011	18:47:00	80.29	22.27	275	R1
26	18/07/2011	22:06:00	80.13	22.15	203	SH
27	20/07/2011	03:24:00	80.85	14.87	960	
28	20/07/2011	16:38:00	80.17	4.36	1176	Ice
29	20/07/2011	17:59:00	80.16	4.28	1216	Ice
30	21/07/2011	07:40:00	79.07	4.08	2385	HG IV
31	21/07/2011	08:03:00	79.07	4.18	2412	HG IV
32	21/07/2011	18:10:00	79.11	5.51	1356	HG I
33	21/07/2011	18:34:00	79.10	5.48	1399	HG I
34	22/07/2011	00:50:00	79.05	7.00	1318	KH
35	22/07/2011	01:22:00	79.05	7.00	1320	KH
36	22/07/2011	06:26:00	78.90	7.76	1128	V6
37	22/07/2011	06:59:00	78.90	7.74	1128	V6

Description of instruments/observations

All CTD measurements were fulfilled with standard Seabird Electronics equipment installed onboard R/V Lance: SBE9plus profiler and SBE32 Carousel Water Sampler. The basic measured characteristics are temperature and salinity of seawater, underwater light availability within the PAR range (QCP2300-HP, Biospherical Instruments) and concentration of chlorophyll based on fluorescence measurements (WETLabs ECO-FL).

Description of oceanographic conditions in Kongsfjorden, Shelf, Rijpfjorden and Ice Edge

In general, oceanographic regime in fjords of West Spitsbergen is controlled by the interaction between waters of Atlantic origin from the West Spitsbergen Current, Arctic type waters over the continental shelf, glacial melts, river run-off and sea ice formation during winter (Cottier et al. 2005).

Kongsfjorden. Oceanographic conditions in Kongsfjorden are influenced by waters of Atlantic origin. Transformed Atlantic Water (TAW, $S > 34.65$, $1\ °C < T < 3\ °C$) was found at all stations (KB5-KB1). Chlorophyll concentrations based on fluorescence measurements did not show strong and distinct peaks ($F < 0.2$-0.3 µg/l). PAR availability varied significantly along the Kongsfjorden, with lowest values of euphotic zone (ca. 2-4 m) in the inner part of the fjord close to the glacier and deeper euphotic zone in the outer fjord (ca. 20 m).

Continental Shelf. Oceanographic conditions on the shelf and the shelf break (V6, V10, and V12) were dominated by Atlantic Water (AW, $S > 34.65$, $T > 3\ °C$). It is likely to be that the core of West Spitsbergen Current (WSC) was located in the vicinity of station V6 with observed temperatures in the upper layer of more than 6 °C. Chlorophyll concentrations peaks were higher in comparison with Kongsfjorden, but still did not exceed 1 µg/l. Observations at stations V6 and V12 were done during the nighttime and therefore should be carefully considered with respect to light conditions. At station V10 euphotic zone reached ca. 31-33 m.

Rijpfjorden. Oceanographic conditions in Rijpfjorden represent completely different environment. Large amount of drifting sea ice, apparently from the Arctic Ocean (AO) and its subsequent melt form brakish upper layer with salinities below 28 psu. In the deep layer, Winter Cooled Water (WCW, $34.4 < S < 35.0$, $T < -0.5\ °C$) is dominant. The transition zone represented a sharp salinity and therefore density gradient (pycnocline). Concentrations of chlorophyll in surface layer were generally low, sometimes close to the detection limit of the instrument. However, during two CTD casts stronger peaks were encountered ($F \approx 1$ µg/l) indicating potential high spatial variability in distribution of chlorophyll. Euphotic zone was relatively deep for fjords and ranged from ca. 24 to 27 m, owing mostly to fresh and transparent upper layer.

Ice edge. As in case with Rijpfjorden, an upper layer of fresh and relatively cold water historically called as Polar Water (PW, $S < 34.4$, $T < 0\ °C$) in the Arctic Ocean (Aagaard & Swift 1981) was found. Warm core of the AW underlying PW spans from 50 m down 300 m. Chlorophyll concentrations reaching up to 1 µg/l were similar compare to other sampling areas. Euphotic zone was found to be approx. 27-30 m.

Hausgarten stations. Due to wavy conditions during the sampling period at deep Hausgarten stations (HG IV, HG I and KH) a well-mixed upper layer (down to 20-30 m) was found. TS characteristics of the underlying layer reaching ca. 400 m correspond to AW. Below, denser intermediate and deep water masses were found (see Aagaard & Swift 1981). In general, chlorophyll concentrations were high, with the maximum of 1.7 µg/l measured during one of the CTD casts (HG IV). PAR availability was similar to other sites with the euphotic zone of 25 to 30 meters.

4.2.2. Phytoplankton - taxonomy, chlorophyll-*a* and phaeopigments, nutrients

Water samples were taken from 0, 10, 25, and 50 meter depth, and the depth of chlorophyll maximum (as indicated by fluorescence measurements from the CTD) at each station using Niskin water bottles. Samples were collected for analyses of phytoplankton taxonomy, Chlorophyll *a* and phaeopigments and nutrient concentration. This data will give an indication of the available food concentration for the next trophic level at the time of sampling. The phytoplankton sampling is standardized and has become part of the standard sampling protocol for NP transects in 2009. Since phytoplankton forms the basis of energy for the whole pelagic food web the data on phytoplankton quantity, quality and distribution is an important addition to the long term zooplankton series from this area.

Phytoplankton Taxonomy

250 ml water taken from each depth (Table 3) was stored in dark glass bottles and preserved in 20% hexamine buffered formalin and 1 ml glutaraldehyd.To quantify mircophytoplankton species, 32 liter water were taken from 0 m, chlorophyll maximum and the standard depth below the chlorophyll maximum. This water was poured carefully through a 20 µm net and fixed 20% hexamine buffered formalin and 3 ml Strontiumchlorid. Furthermore, to identify rare species a 20 µm net was taken from 20-0 m at each station. All taxonomy samples will be analysed at IOPAS in Sopot, Poland by Joseph Wictor.

Chlorophyll a and phaeopigments

500-1000 ml water from each depth was filtered through 25 mm GF/F filters by use of a vacuum pump. Three replicates were filtered for each depth. Filters were extracted in Methanol for approximately 24 hours in the fridge and analysed on board using a Turner Design 10-AU-000 fluorometer (Synnyvale, California).

Nutrients

Samples for nutrients were taken immediately after the CTD came onboard, filled right from the Niskin-bottle into an acid-washed nalgene bottle (125 ml) and stored at ≤ 20°C until analysis. Nutrient samples will be analysed at The Norwegian College of Fishery Science in Tromsø.

Table 4: Sampling depth and amount of water for the different phytoplankton samples

Sample type	Depth	Volume
Nutrients	0-10-25-50 plus Chl a max	125 ml
Chl *a*/ Phaeopigments	0-10-25-50 plus Chl a max	500 ml
Phytoplankton taxonomy	0-10-25-50 plus Chl a max	250 ml
Mircoplankton taxonomy	0m, Chl a max, depth below Chl a max	32 l
Phytoplankton taxonomy	25-0m with plankton net	

4.2.3. Zooplankton: Abundance, species composition, vertical distribution & lipids

Zooplankton abundance, species composition, vertical distribution
To investigate distribution and species composition of mesozooplankton (zooplankton in the size range of 200-2000 µm) depth stratified samples were taken at each station with a Multinet (Multiple Plankton Sampler (MPS), mesh size 200µm, opening 0.25m^2). At each station five depth-strata were sampled (Table 5). Zooplankton samples were preserved in 4% borax-buffered formaldehyde immediately after collection.
These data will provide information on the vertical distribution of zooplankton species and developmental stages as well as geographical variations in the species composition and vertical distribution. Special emphasize will be put on the population status and species composition of *Calanus* species at the different locations, as these are the key zooplankton species in the system. Samples will be analysed at IOPAS in Sopot, Poland by Slavek Kwasnieswki.
Since larger, more mobile zooplankton species tend to avoid the Multinet we used a MIK net (1 net, mesh size 1.5 mm and 500 µm at the end, opening 3.14 m^2) at each station to collect macro-zooplankton. Half of the sample was fixed in 4% formalin to be later analysed with regard to abundance and species composition, while the other half was frozen at -20 C for biomass analysis. Samples will be analysed by the Institute of Marine Research in Bergen by Padmini Dalpadado.

Table 5. Sampling depth for the different zooplankton nets

Gear (mesh size)	Purpose	Sampling depth (m)
Multinet (200 µm)	Mesozooplankton abundance, species composition, vertical distribution; lipids	Bottom depth > 600 m: Bottom-600-200-50-20-0 m Bottom depth < 600 m: Bottom-200-100-50-20-0 m
MIK (1.5 mm)	Macrozooplankton abundance, species composition, biomass; stable isotopes	Bottom-0 m

4.3. Preliminary results

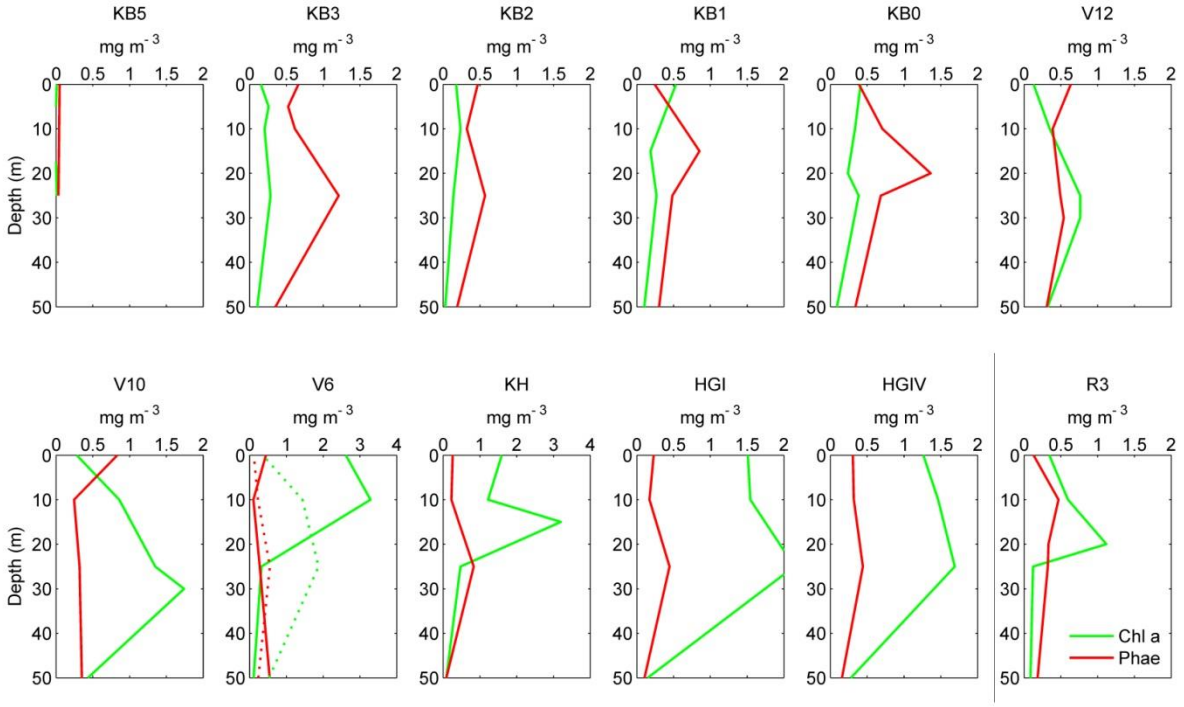

Figure 2: Chlorophyll a and phaeopigment concentration at all stations

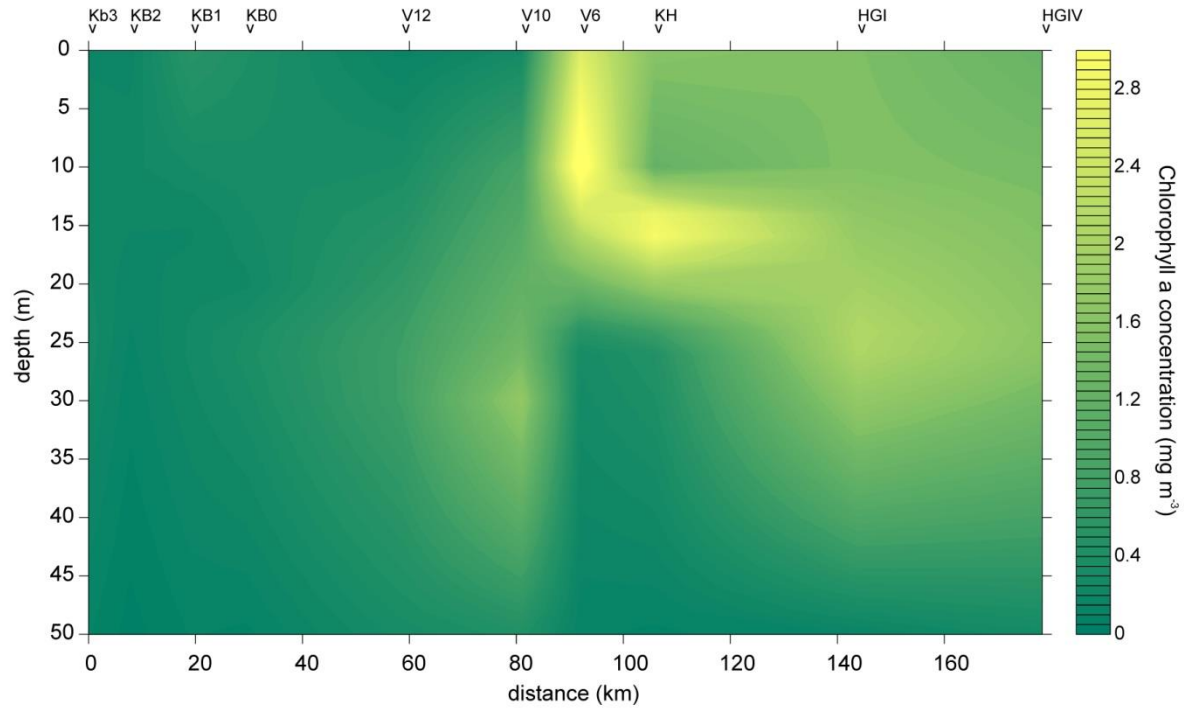

Figure 3: Chlorophyll a concentration along the KongHAU transect

5. Lipids, buoyancy and vertical position of *Calanus* spp.

Responsible: Margarita Zarubin

5.1. Introduction

Lipids influence the overall body density of individual copepods playing a role in their buoyancy. Theoretical models predict that the density difference between the individual copepod and the ambient water should affect the feeding currents generated by the copepod. There might be an optimal density difference for the generation of effective feeding currents, probably species- and life-stage specific. Theoretical calculations of copepod body density at different depths suggest that in order to keep such a "fixed" density difference a copepod with higher lipid content should be found deeper in the water column compared to a copepod with less lipids (both copepods of the same species and life stage). On board Lance I was sampling *Calanus* spp. at three different depths during day and night, sorting for species and life stages, and photographing each individual copepod for later image analysis and determination of the percentage of lipids area. Each individual was deep-frozen in liquid nitrogen after photographing in a separate cryovial and stored at -80 °C for later determination of the fatty acid composition. The alternative hypotheses are that the copepods vertically distribute themselves according to (a) the availability and composition of their food – phytoplankton and/or (b) the distribution of their predators. These hypotheses were examined on the same cruise by Siri Myhren and Karen-Christine Oehninger-Storvoll.

5.2. Procedures

The multinet was towed for 10 minutes at three distinct depths in the upper water (10, 20 and 40m). The 5 nets were programmed at the following depths net1: 40-35m, (net2: 35-20), net 3: 20-15, (net4: 15-10), net5: 10-0m. The multinet was towed at 10 minutes for net 1, 3 and 5 at 40, 20 and 10m. Net 2 and 4 was discarded. An additional multinet was towed at deep. Sampling was carried out approximately at midday and mid night at each station.

Sample log

Kongsfjorden st. Kb3, 14.7.11, day
We tested horizontal towing of multinet at 10, 20-15 and 40 m. The sample from 20-15 m (MOSJ11-423) was used for sorting. The samples from 10 m and 40 m were discarded, since most animals died. Deep towing was done at 270 m (MOSJ11-22) at 17:45.

Kongsfjorden st. Kb3, 14.7.11/15.7.11, night
10, 20 and 40 m (not recorded in the sample log). In the 40 m there were only 8 *C. glacialis* specimens and these were mistakenly frozen before photographing.

Kongsfjorden st. Kb3, 15.7.11, day
10 m tow (to be used together with the data from the day tow on 14.7.11) (MOSJ11-86)

Rijpfjorden st. SH
Day: 8 m (MOSJ11-251), 20 m (MOSJ11-252) and 40 m (MOSJ11-253)
Night: 6 m (MOSJ11-297), 15 m (MOSJ11-298), 40 m (MOSJ11-299) and 150 m (MOSJ11-300)

Billefjorden, 23.7.11
Day: 10 m (MOSJ11-411), 20 m (MOSJ11-410) and 40 m (MOSJ11-409)

Titles of the folders with *Calanus* spp. photos and the respective boxes/plastic bags with cryovials:
Kb3_14.7.11 day 20-15 m
Kb3_14.7.11 day 40 m
Kb3_15.7.11 day 10 m
Kb3_14.7.11 night 10 m (actually sampled on the night of 15.7.11)
Kb3_14.7.11 night 20 m
Kb3_14.7.11 day 270 m (17:45)

R1_18.7.11 day 8 m (The station name "R1" is wrong, it was actually the station SH!)
R1_18.7.11 day 20 m
R1_18.7.11 day 40 m
R1_18.7.11 night 6 m (the night samples were actually taken on 19.7.11)
R1_18.7.11 night 15 m
R1_18.7.11 night 40 m
R1_19.7.11 night 150 m

BF_23.7.11 day 10 m
BF_23.7.11 day 20 m
BF_23.7.11 day 40 m

Each cryovial title contains the station name, the date, the time of the day, and the species name and the stage as the following abbreviations:
gla = *Calanus glacialis*, fin = *C. finnmarchicus*, hyper = *C. hyperboreus*, e.g.
gla IV - *C. glacialis* copepodite IV
gla V – *C. glacialis* copepodite V
gla AF – *C. glacialis* adult female

Sample storage
After photographing each individual was frozen in a separate cryovial and frozen first in liquid N_2 and then transferred to a -80 °C freezer. Note that the copepods from Billefjorden were frozen in glass vials directly in the -80 °C freezer, since the cryovials finished. All samples will be stored in the Norwegian Polar Institute (NP) in Tromsø (for later analysis of fatty acids probably in Germany). The photographs of the individual copepods will be stored on my personal computer and later on the server of the Interuniversity Institute for Marine Sciences in Eilat (IUI), Israel.

Sample analysis – where and how
The photographs will be analysed using ImageG (or ImageTool) software for measurements of the oil sac area and the prosome area, in order to determine the percentage of oil area in the individual copepods. The individual frozen copepods will be analysed for fatty acid composition most probably in Germany in the Alfred Wegener Institute (AWI) using gas chromatography (to be decided and organized by Stig Falk-Petersen).

Analysis of the results at the finals stage – where and how
The final results of the copepod lipid area percentage are going to be analysed and evaluated in the IUI. The fatty acid composition results will be analysed probably in the Norwegian Polar Institute (to be decided by Stig).

Methods deviations
Note that the copepods from Billefjorden were frozen in glass vials directly in the -80 °C freezer (without using liquid nitrogen), since the cryovials finished.

6. Student Project: Vertical distribution in *Calanus*

Responsible: Siri Myhren and Karen-Christine Oehninger-Storvoll

6.2. Introduction

Calanus was collected from Kongsfjorden and Rjipfjorden for two different Master thesis. One of the aims is to find out what affects the vertical distribution; phytoplankton distribution, predator distribution or lipid content of *Calanus*. Another aim is to do genetic analyses of *Calanus* from different areas and compare these results with length measurements.

6.3. Procedures

6.3.1. Phytoplankton

Sampling was conducted at two stations: Kb3 in Kongsfjorden and R1 in Rijpfjorden. Temperature, salinity and fluorescence throughout the water column were measured at each station using a CTD. To assess phytoplankton abundance and phytoplankton species composition water samples were taken from 100,60,40,20 and 0 m with Niskin bottles attached to the CTD rosette. 100 ml were fixed in lugol, 200 ml in 20% hexamine buffered formalin.

6.3.2. Calanus vertical distribution, lipid and stable isotopes

Calanus spp. was sampled using a Multinet. One vertical haul for abundance analyses from the depth layer 100-80-60-40-20 m. These sampled were fixed in formalin and will be analysed to estimate Calanus abundance and stage composition in the different depth layers. The Multinet was also trawled horizontal at three distinct depths (40, 20 and 10 m layer) for 10 m at each depth. These samples were sorted to species and stages (only the largest stages) for lipid and stable isotopes analyses. Digital photos were taken of individuals of Calanus to estimate lipid sack area. These individuals were frozen and will be analysed by Margarita Zarubin.

6.3.3. Predator vertical distribution, lipid and stable isotopes

To assess vertical distribution of potential predators of *Calanus*, samples were collected by trawling the MIK at 40, 20 and 10 m depth for 10 min. Themisto spp., Limacina helicina, chaetognaths and krill were sorted out of these samples and frozen to be analysed for lipid and stable isotope composition. The rest of the MIK samples were fixed in formalin to be analysed for abundance. Both multinet and MIK net samples were collected around noon and around mid- night.

6.3.4. Genetics

At station R1 200 individuals of *Calanus* stage CIV, CV and females were measured individually and fixed in ethanol for genetic analyses.

Table 6: Overview of samples taken for Master student project (SI = stable isotopes

Gear	Purpose	Preservation	Kb3 day	Kb3 night	SH day	SH night	Billefjorden
Water samples	Phytopl. taxonomy	Lugol, formalin		10, 20, 40, 60, 100m	10, 20, 40, 60, 100m		
Multinet vertical	Calanus abundance	Formlain		0-20-40-60-80-100 m	0-20-40-60-80-100m		
Multinet horizontal	Lipids & SI	Frozen	40, 20, 10m	40-35, 20-15, 10-0m	40-35, 20-15, 10-0m	40-35, 20-15, 10-0m	
MIK horizontal	Lipids & SI; abundance; pictures	Frozen; Formalin	40-0m, 20-0m, 10- 0m	40-0m, 20-0m, 10- 0m	40-0m, 20-0m, 10- 0m	40-0m, 20-0m, 10- 0m	40-0m, 20-0m, 10- 0m
Multinet	Genetics	ethanol					

Table 7: List of samples taken for lipids and stable isotopes

						# of individuals		
SampleID	Gear	Depth	Type	Species	stage	repl1	repl2	repl3
Kongsfjorden (Kb3) Day								
MOSJ11-8	MPS	20-15 m	lipids	C. finmarchicus	CV	10	10	10
	MPS	20-15 m	lipids	C. glacialis	CV	10	8	8
	MPS	20-15 m	lipids	C. finmarchicus	CIV	14	14	14
	MPS	20-15 m	lipids	C. glacialis	CIV	10	10	10
	MPS	20-15 m	SI	C. glacialis	CV	25	25	25
MOSJ11-10	MPS	40 m	lipids	C. glacialis	CIV	10	10	10
	MPS	40 m	lipids	C. glacialis	CV	8	no	no
	MPS	40 m	lipids	C. finmarchicus	CIV	14	14	14
	MPS	40 m	lipids	C. finmarchicus	CV	10	no	no
MOSJ11-19	MIK	10 m	lipid	T. libellula		?	?	?
	MIK	10 m	SI	T. libellula		?	?	?
MOSJ11-20	MIK	20 m	lipid	T. libellula		?	?	?
	MIK	20 m	SI	T. libellula		?	?	?
MOSJ11-21	MIK	40 m	lipid	T. libellula		?	?	?
	MIK	40 m	SI	T. libellula		?	?	?
MOSJ11-22	MPS	270 m	lipids	C. finmarchicus	AF	8	8	8
	MPS	270 m	lipids	C. finmarchicus	CV	10	10	10
	MPS	270 m	lipids	C. glacialis	AF	6	6	6
	MPS	270 m	lipids	C. glacialis	CV	8	8	8
	MPS	270 m	lipids	C. glacialis	CIV	10	10	10
	MPS	270 m	lipids	C.hyperboreus	AF	4	4	4
	MPS	270 m	lipids	C.hyperboreus	CV	6	6	6
	MPS	270 m	lipids	C.hyperboreus	CIV	8	8	8
	MPS	270 m	SI	C. finmarchicus	AF	25	25	25
	MPS	270 m	SI	C. finmarchicus	CV	30	30	30
	MPS	270 m	SI	C. glacialis	AF	20	20	20
	MPS	270 m	SI	C. glacialis	CV	25	25	25
	MPS	270 m	SI	C. glacialis	CIV	30	30	30

						# of individuals		
SampleID	**Gear**	**Depth**	**Type**	**Species**	**stage**	**repl1**	**repl2**	**repl3**
Kongsfjorden (Kb3) Night								
MOSJ11-34	MIK	40 m	lipid	T. libellula		5	5	5
	MIK	40 m	SI	T. libellula		5	5	5
	MIK	40 m	lipid	Chaetognaths		5	5	5
	MIK	40 m	SI	Chaetognaths		5	5	5
	MIK	40 m	lipid	T. inermis		5	5	5
	MIK	40 m	SI	T. inermis		5	5	5
MOSJ11-35	MIK	20 m	lipid	T. libellula		5	5	5
	MIK	20 m	SI	T. libellula		5	5	5
	MIK	20 m	lipid	Chaetognaths		5	5	5
	MIK	20 m	SI	Chaetognaths		5	5	5
MOSJ11-36	MIK	10 m	lipid	T. libellula		5	5	5
	MIK	10 m	SI	T. libellula		5	5	5
Rijpfjorden (SH) Day								
MOSJ11-254	MIK	40	lipids	T. libellula	big	2	2	2
	MIK	40	lipids	L. helicina		5	5	5
	MIK	40	lipids	C. limacina		1	1	1
	MIK	40	lipids	T. inermis		3	3	3
	MIK	40	lipids	Chaetognaths		4	5	x
	MIK	40	SI	T. libellula	big	2	2	2
	MIK	40	SI	L. helicina		5	5	5
	MIK	40	SI	C. limacina		1	1	1
	MIK	40	SI	T. inermis		3	3	3
MOSJ11-255	MIK	20	lipids	T. libellula		5	5	5
	MIK	20	lipids	L. helicina		5	5	5
	MIK	20	lipids	C. limacina		1	1	1
	MIK	20	lipids	T. inermis		2	2	2
	MIK	20	SI	T.libellula		5	5	5
	MIK	20	SI	L. helicina		5	5	5
MOSJ11-256	MIK	10	lipids	T. libellula		5	5	5
	MIK	10	lipids	L. helicina		5	5	5
	MIK	10	lipids	C. limacina		1	1	
	MIK	10	SI	T. libellula		5	5	5
	MIK	10	SI	L. helicina		5	5	5
Rijpfjorden (SH) Night								
MOSJ11-288	MIK	40	lipids	T. libellula	big & small	2	5	5
	MIK	40	lipids	L. helicina		5	5	5
	MIK	40	lipids	C. limacina		1	1	1
	MIK	40	lipids	T. inermis		4	4	4
	MIK	40	SI	T. libellula	big	2	2	2
	MIK	40	SI	L. helicina		5	5	5
MOSJ11-289	MIK	20	lipids	T.libellula		5	5	5
	MIK	20	lipids	L. helicina		5	5	5
	MIK	20	lipids	C. limacina		1	1	1
	MIK	20	lipids	T. inermis		3	3	3
	MIK	20	SI	T. libellula		5	5	5
	MIK	20	SI	L. helicina		5	5	5
	MIK	20	SI	C. limacina		3	3	3
	MIK	20	SI	T. inermis		3	3	3
MOSJ11-290	MIK	10	lipids	T. libellula		5	5	5
	MIK	10	lipids	L. helicina		5	5	5
	MIK	10	lipids	C. limacina	big	1	1	1
	MIK	10	SI	T. libellula		5	5	5
	MIK	10	SI	L. helicina		5	5	5
	MIK	10	SI	C. limacina	big & small	2	2	2

Analysis
Frozen samples and samples fixed in formalin will remain on Lance until September and will then be stored at NPI in Tromsø (-80° C freezer). Samples for genetics will be stored at UNIS (Tove Gabrielsen's office). Fatty acids analyses of individual speciemen of *Calanus* will be done at AWI in co-operation with Martin Graeve. Fatty acid composition of pooled samples of *Calanus* and predators (*Themisto libelulla*, *Thyssanoessa* spp. Chaetognates) will be analysed at UNILAB, Tromsø or Trondheim. Stable isotopes will be analysed at IFE, Kjeller. Samples on formalin from each depth will be analysed for species diversity, length and abundance in Tromsø or Trondheim. Water samples will be analysed for community distribution and nutrients at UNIS. Genetic samples will be analysed at UNIS. The matter of how the samples are to be analysed in Tromsø or Trondheim is still to be determined. Results are to be analysed in Trondheim and UNIS. How is yet to be determined.

7. COPOL - Ecotoxicology

Responsible: Ingeborg G. Hallanger & Ida Beate Øverjord

COPOL II is the continuing of the ecotoxicological work with pelagic food webs stared by the IPY financed COPOL. The aim of COPOL was to elucidate differences in accumulation of contaminants that could be linked to climate change. This was done by comparing concentrations and patterns of contaminants in organisms living in Arctic water masses to organisms living in Atlantic water masses, and using these water masses as a proxy for the Arctic of today (Arctic water mass) and the Arctic of the future (Atlantic water mass). However, confounding factors, such as ice cover, seasonal variation, freshwater runoff, and time lag were observed in that study. COPOL II aims to gain more knowledge on how these confounding factors may change the concentration and patterns of contaminants in species of zooplankton and the whole pelagic food web.
The aim of the field sampling is to sample a zooplankton and benthos from Kongsfjorden, Rijpfjorden and the ice edge (only zooplankton). Samples for ecotoxicological investigations were collected using CTD, MIK, triangular scrape and Van veen grabb. These samples will he analysed for stable isotopes, persistent organic pollutants (POPs) and mercury (Hg).

Table 8: Overview of zooplankton and benthic samples for COPOL project

	MOSJ11-04 Kb3 CTD no 2			**MOSJ11-216 V10 CTD no 17**			**MOSJ11-238 + 258 Rijpfjorden CTD no 22**			**MOSJ11-304 Ice station CTD no 29**		
Samples	Si	POP	Hg	Si	POP	Hg	Si	POP	Hg	Si	POP	Hg
Calanus spp.	X	X	X	X	X	X	X	X	X	X	X	X
Metridia longa										X		X
T. abyssorrum				X	X					X	X	
T. libelulla	X	X										
Arrow worms	X	X	X	X			X	X		X		
Krill	X	X										
C. limacina							X		X			
L. helicina	X	X					X	X	X			
Sediment	X	X		X*	X*		X	X				
Benthos	X	X		X*	X*		X	X				

* Deviation from station: Samples taken at N78°57.57 and E009°41.62

There were also filtered water from chlorophyll max for stable isotopes and POM, using GF/F filters.

Table 9: Overview of POM samples for COPOL project

Station	Chlorophyll max (depth in m)	Stable isotopes	POM
Kb3	10	X	X
V10	18	X	X
Rjipfjorden	25	X	X
Ice	20	X	X

All samples are to be stored at -20 °C at the Norwegian Polar Institute.
The POP samples will be analysed at NILU in Tromsø using a gas chromotograph mass specter (GC-MS). Where the stable isotopes, mercury and POM is to be analysed is not yet decided.

8. Radionuclide sampling

Responsible: Justin Gwynn, Norwegian Radiation Protection Authority

7.1. Introduction

The sampling programme was designed to support two ongoing research projects. Firstly seawater and zooplankton samples were collected as part of the COPOL II project to determine levels of the naturally occurring radionuclides Po-210 and Pb-210. Little data is available on levels of these radionuclides in seawater and lower trophic biota in the Svalbard area. Melting of permafrost may result in increased fluxes of Rn-222 to the terrestrial environment which in turn may provide increased fluxes of the decay products Po-210 and Pb-210 to fjord marine systems. Therefore there is a need to document current levels of these important contributors to the natural background dose rate.
Further seawater samples were collected to determine levels of anthropogenic I-129 released into the environment via authorized discharges from nuclear fuel reprocessing facilities at Sellafield (UK) and Cap la Hague (France). I-129 can be used as a tracer of ocean circulation due to its conservative nature in seawater and long half life (16 million years). Previous sampling in the central Arctic in 2008 has shown the return of peak discharges beginning in 1993 from Cap la Hague in the Trans Polar Drift. The speciation of I-129 will also be determined and compared against available chlorophyll *a* data to elucidate the role of biotic conversion of iodate to iodide in the marine environment.
One sample of seawater (100l) was collected from Ny Ålesund (Palm Beach) for analysis for Tc-99 as part of a long term time series for the national monitoring programme (RAME).

7.2. Procedures

Sample log
In total, 1 sample was collected for Tc-99 analysis, 23 seawater samples and 18 samples of zooplankton were collected for Po-210 and Pb-210 analysis whilst 56 seawater samples were collected for I-129 analysis. Details of samples collected are given below

Table 10: Seawater samples

Area	Station	CTD station	Latitude (N)	Longitude (E)	Tc-99	Po-210+ Pb-210*	I-129
Ny Ålesund	Palm Beach	-	78.93	11.93	0m - 100l	-	-
Kongsfjorden	Kb5	5	78.90	12.43	-	0m - 6l 59m - 7l	1l at 0m, 20m, 59m
Kongsfjorden	Kb3	3	74.97	11.89	-	0m - 7l 282m -8l	1l at 0m, 30m, 100m, 200, 282m
Kongsfjorden	Kb0	13	79.04	11.12	-	0m - 6l 306m - 8l	1l at 0m, 20m, 100m, 200m, 306m
Kongsfjorden	V12	15	78.97	9.52	-	5m - 7l 210m - 7l	1l at 5m, 30m, 100m, 210m
Kongsfjorden	V6	21	78.91	7.78	-	0m - 7l 1101m -9l	1l at 0m, 10m, 100m, 200m, 550m, 1101m
Hausgarten	HG-IV	31	79.07	4.18	-	0m - 7l 2375m - 7l	1l at 0m, 25m, 100m, 200m, 500m, 1000m, 2375m
Hausgarten	KH	-	79.05	7.00	-	-	1l at 0m
Rjipfjorden	R1	23	80.13	22.15	-	0m - 6l 194m - 7l	1l at 0m, 25m, 50m, 100m, 194m
Rjipfjorden	R3	24	80.29	22.28	-	0m - 6l 252m - 7l	1l at 0m, 20m, 50m, 100m, 252m
Ice edge	IS1	28	80.17	4.36	-	0m - 6l 20m - 6l 50m - 7l 100m - 7l 200m - 7l 300m - 8l 1164m - 9l	1l at 0m, 20m, 100m, 200m, 400m, 800m, 1164m
	IS2	27	80.85	14.87	-	-	1l at 0m, 15m, 100m, 200m, 380m, 700m, 950m

* Volume of seawater filtered

Table 11: Zooplankton sampled by MIK net

Area	Station	Latitude (N)	Longitude (E)	Species	Sampling depth	Day/ Night
Kongsfjorden	Kb3	78.96	11.94	Calanus spp.	Bottom to surface	d
				T. abyssorum	10	d
				C. limacina	10	d
				T. abyssorum	10	n
				T. libelulla	10	n
				T.abyssorum	20	n
				T. libelulla	20	n
				T. abyssorum	40	n
				T. libelulla	40	n
				S. elegans + E.hamata	40	n
				Thysanoessa spp.	40	d
				S. elegans + E. hamata	40	d
				Calanus spp.	40	d
Kongsfjorden	V10	78.94	8.54	Calanus spp.	Bottom to surface	d
				S. elegans+ E.hamata	Bottom to surface	d
				Thysanoessa spp.	Bottom to surface	d
				L. helicina	Bottom to surface	d
Rjipfjorden	R1	80.12	22.15	C.gracialis	40	d

Storage and analysis of samples

Seawater sample taken for Tc-99 will remain on board Lance and will be analysed in Tromsø by the NRPA by beta counting. Seawater samples collected for Po-210 and Pb-210 analyses will be sent directly from Longyearbyen to the University of Seville (Spain) for analysis by alpha counting. Filters from seawater samples taken for Po-210 and Pb-210 and all zooplankton samples will be returned to Tromsø at the end of the cruise and analysed in Tromsø by the NRPA by alpha counting. Seawater samples taken for I-129 will be sent directly from Longyearbyen to the Risø National Laboratory for Sustainable Energy, Denmark for determination of I-127 by ICPMS and chemical separation of I-129 species. Samples will then be sent to the Institute of Earth Environment, Chinese Academy of Sciences (China) for determination of I-129 by AMS.

Sampling protocols

Water sampling for radionuclides

Po-210/Pb-210

10l of surface and bottom water should be filtered onboard (through pre-weighed <0.2µm membrane filter at 1l/min (max)) into 10l plastic cans and acidified with conc. HCl (1ml/l). Filters should be dried and stored. Cans and filters should be marked with sample date, CTD station and depth.
Initial plan is to take 10l surface and bottom samples at the following stations:
Kb5, Kb3, Kb1, V12, V6, HG-IV, R1, R2/R3, Ice station
Experience from sampling: Actual volume of water sampled was between 6l and 9l. Heavy sediment load in surface water in Kongsfjørden meant filtration was very slow. Surface water sample taken at Ripfjørden station R1 required the use of 2 filters to complete filtration of just 6l of water. No sediment observed in surface water at R1 (euphotic zone to 22m), but possible presence of ice algae may have blocked filter pores. Acidification of samples to pH2 required greater than 1ml/l conc. HCl.

I-129

1l of surface, bottom and mid-depth water should be collected in 1l plastic bottles. Bottles should be rinsed once with a small amount of sample water. Mid-depth samples should be chosen depending on total depth, salinity profile, Chl *a* max. All bottles should be marked with sample date, CTD station and depth.
Experience from sampling: Actual depths sampled for each station are given in table above. Extra stations taken on shelf edge (Ice edge station IS2).

Tc-99

100l of surface water should be taken from Ny Ålesund Palm Beach in 4 x 25 l cans. Cans should be marked with sampling date.
Experience from sampling: Sample taken as planned.

Biota sampling for radionuclides

Zooplankton

2g samples of *Calanus* spp. (more if possible) from the planned 3 ecotox stations (Kb3, R3 and Ice station). Samples should be transferred to pre-weighed filters, dried and stored.
Samples of other biota e.g. krill, arrow worms, amphipods, benthic fauna desired if possible… minimum sample size 2g… more for larger fauna if possible…
All samples should be stored at -20°C.
Experience from sampling: Samples collected from planned stations as well as station V10. Samples stored fresh (i.e. not dried) in collection vials.

9. PolArt

9.1 Lars Korff Lofthus

The cruise is slowly ending and this short report is to document how I have experienced the cruise. I will start by saying that I am thankful for being given the opportunity to take part on this 10-day journey in arctic waters. Together with the other PolArt participants this summer, I will have an exhibition in Tromsø in January 2012.

For my part, the days onboard have been rather open and I am thankful to the other cruise members for giving me all the space I want to go in and out of the different parts of the everyday life on a research cruise.

Here follows an excerpt from my application to Tromsø Kunstforening (Tromsø Art Society), in Norwegian:

"Fleire av arbeida mine har tek utgangspunkt i naturkrefter og katastrofetenking. Eg er særleg oppteken av korleis media framstiller naturkrefter og kor "opphissa" mange kan bli av naturkreftene når dei virkar utanfor vår kontroll, som no i Japan. I USA har ein eigne tornado-entusiastar som køyrer rundt på jakt etter det neste store katastrofe-kicket. Dei er "junkies" på naturfenomen - utan nødvendigvis å vera oppteken av den vitenskaplege delen. Kan forskarar også ha eit subjektivt og sanseleg forhold til naturvitenskap?"

Can scientists also relate to natural science in a sensuous way? I haven't really come any closer to this question, and maybe the question has lost it's relevance during the cruise. I can however confirm that they are very committed to what they are doing, in terms of hours spent on the lab and on deck, taking samples. The presentations given in the after-dinner meetings were a good way to get understand more of what people are working on. Personally, most of the arousal during the cruise came from standing on deck watching the boat force its way through thick ice.

Like Hardanger (where I currently live and work), Svalbard and its surroundings is putting a spectacular scenery on display. Here, the nature has all the extreme elements and is open 24-7. And this is probably what I will remember the most. I have been keeping some kind of diary during the cruise, but words can not describe some of the sceneries I have seen, at least not the notes in my book. Like many contemporary artists, dealing with nature means dealing with several hundred years of art history. This can be difficult to implement in a body of work without turning to banalities and clichés. Making art in Hardanger, for example, forces one to relate to the Norwegian national-romantic period. -You can't compete with nature, a colleague of mine once said. How can one justify to make a landscape painting in 2011? What new does it bring to the table? If making art means generating new meaning and understanding of who we are (and lets assume it does), what will the spectator gain from looking at another painting of the ocean? This chain of thoughts is probably out of place for a report like this, but it also explains why I haven't been standing on deck painting the ocean with my watercolor set.
What I *have* been doing, on the other hand, is to take a lot of photos. My work for this project has only just began when I come home. Hopefully in six months time something will materialize itself in Tromsø Kunstforening.

And I have also made new friends, some of which I will keep in touch with after the cruise and hopefully see more of.

9.2 Linn Halvorsrød

Day 1. 13 july. Wednesday. Worked with waterfall sound and crazy bird sound and sorted pictures from Longyearbyen. Draw 3 drawings of the ocean.
Day 2. 14 july. Thursday. Visited Ny Ålesund. Got more nice pitures and bird sounds. Draw 4 drawings of the ocean.
Day 3. 15 july. Friday. Got nice recordings of the glacier. Draw 2 drawings of the ocean.
Day 4. 16 july. Saturday. Did recordings of the deck, outside. Draw 2 drawings of the ocean.
Day 5. 17 july. Sunday. Did recordings on the boat inside. Draw 4 drawings of the ocean.
Day 6. 18 july. Monday. Read The Coca Hola Company. Draw 2 drawings of the ocean.
Day 7. 19 july. Tuesday. Visited Rjipfjorden. Got more nice pictures. Draw 2 drawings of the ocean.
Day 8. 20 july. Wednesday. The engine was turned of for a a few hours, worked on my composition. Draw 3 drawings of the ocean.
Day 9. 21 july. Thursday. Did recordings of the engine in the machine room. Draw 2 drawings of the ocean.
Day 10. 22 juli. Friday. Made a plan for my exhibition in Tromsø. Draw 3 drawings of the ocean.
Day 11. 23 juli. Saturday. Visited Pyramiden, got loads of very good pictures.

10. Overview of samples and measurements taken

								MOSJ					COPOL		Other projects		
Station	Lat degrees	Lat min	Long degrees	longs min	Bottom depth (m)	Date	CTD	MPS	MIK	Chlorophyll	Nutrients	Phytoplankton Taxonomy	Ecotox Plankton	Ecotox Benthos	Radionucleids	Lipids Photos	Lipids & SI (students)
Isfjorden	78	13.75	14	47.24	206	13072011	x	x									
Kb5	78	53.99	12	25.55	68	15072011	x	x	x	x	x	x					
Kb3	78	57.56	11	56.91	336	15072011	x	x	x	x	x	x	x	x		x	x
Kb2	78	58.74	11	44.45	240	15072011	x	x	x	x	x	x					
Kb1	79	0.62	11	25.17	358	15072011	x	x	x	x	x	x					
Kb0	79	2.72	11	8.03	318	15072011	x	x	x	x	x	x					
V12	78	58.13	9	30.73	225	16072011	x	x	x	x	x	x					
V10	78	54.52	8	28.62	485	16072011	x	x	x	x	x	x	x	x			
V6	78	54.24	7	46.11	1125	16072011	x	x	x	x	x	x					
SH	80	7.42	22	9.4	194	18072011	x	x	x	x	x	x	x	x		x	x
R3	80	17.2	22	17	267	18072011	x	x	x	x	x	x					
Sofiadypet	80	51.08	14	52	960	20072011	x								x		
Ice st.	80	9.77	4	19.05	1185	20072011	x						x	x			
HGIV	79	4.33	4	4.63	2385	21072011	x	x	x	x	x	x					
HG-I	79	6.6	5	30.4	1356	21072011	x	x	x	x	x	x					
KH	79	3.22	6	59.19	1319	22072011	x	x	x	x	x	x					
V6	78	54.24	7	46.11	1125	12072011	x	x	x	x	x	x					
Billefjorden	78	38.57	16	37.14	170	23072011	x	x	x			x				x	