the Nansen LEGACY

Seasonal cruise Q4 2019

Cruise Report

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Seasonal cruise Q4 2019

Cruise 2019711

R/V Kronprins Haakon
Longyeabyen-Tromsø
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SUMMARY

This cruise was the second of in total four seasonal cruises with RV Kronprins Haakon in 2019/20 focusing on biology in the project Arven etter Nansen (AeN). This seasonal cruise was named Q4 (Q4= 4th quarter of the year) investigating in total 17 stations of the established AeN transect along 34 E in the Northern Barents Sea and adjacent Arctic Basin from 76 to 82°N (see Fig. 1 below). The cruise addressed objectives of the research foci in RF1 on Physical drivers, RF2 on Human drivers, RF3 on the living Barents Sea and RA-C Technology and method development, and collected a multitude of data along the Nansen Legacy transect which was ice covered except the southernmost station P1. In addition to *in situ* sampling, on board experiments were conducted to quantify biological processes, rates and interactions that will also be important feeds into modeling work and projections in RF4 The future Barents Sea.

The cruise took a variety of continuous ship measurements (Weather station, EK80, EM203, ADCP, thermosalinograph, pCO2 underway) as well as station measurements such as CTD with water samples, biological sampling of the benthos (box corer, benthic trawl), water column (multinet, MIK net, macrozooplankton trawl and many other smaller nets) and sea ice (snow, ice cores, water just underneath sea ice). In addition, experimental work (respiration, grazing and egg production) was conducted in the ship's laboratories. The chemistry team onboard measured oxygen, nutrients and pH from standard depths on most CTD stations and sea ice samples.

The cruise started in Longyearbyen and ended in Tromsø (28.11.-17.12.2019). The sampling began at the deep (>3000 m) northernmost station of the transect, Stn. P7, and continued along the southward transect until station P1, in open water and Atlantic dominated water masses. During the expedition the Barents Sea was characterized by a relatively large sea ice cover with consolidated sea ice all the way from P7 to P2. The Polar Front was located just north of P1. All process stations were sampled (P7-P1) as well as two ice stations: one close to P7 ad one close to P5. At the southernmost station P1, stormy weather challenged sampling, but most tasks were in the end accomplished except of deploying the box corer, sediment trap and the AUV. These operations were considered too challenging due to strong drift and ship movement, and it was not safe to conduct small boat operations. Challenges with the box corer was also experienced at the deep station P7 due to technical issues. In the end, most work was accomplished despite challenging weather, sea ice conditions and some technical issues making this cruise successful in gaining new important knowledge about the Northern Barents Sea in the polar night season which is extremely poorly studied. The overall high biological activity and biomass at this time of the year, November-December, was surprising for most of us.

INTRODUCTION

Scientific goals and achievements

The Nansen Legacy Seasonal Q4 (Q4= 4th quarter of the year) cruise, continued the seasonal investigation of the northern Barents Sea and adjacent Arctic Basin that was initiated in August 2019 with the same ship. The seasonal cruise activities are key milestones for 2019 -2021. The cruise addressed objectives of the research foci in RF1 on Physical drivers, RF2 on Human

drivers, RF3 on the living Barents Sea and RA-C Technology and method development and collected important data along the Nansen Legacy transect within the ice and in open waters. In addition to *in situ* sampling, onboard experiments were an important component to quantify processes, rates and interactions that will also feed modeling work and projections in RF4 The future Barents Sea. Most cruise participants had joined the Q3 August cruise and were familiar with the routines for sampling, data management and data storing.

At the Q4 cruise we did not prioritize to bring on board an artist. We decided to bring two persons from RA-C instead, plus that the instrument personnel also needed to bring one more instrument technician, a new employee, on this cruise. All in all this cruise was very successful with lots of data and samples collected despite challenging weather, sea ice conditions and short cruise time. Data from November-December in the Northern Barents Sea are rare and therefore very important to get to investigate biological adaptation to the strong seasonality in the physical and biological environment.

Brief description of the activities

The Seasonal cruise Q4 (28. November to 17. December 2019) focused on the Nansen legacy transect (Figure 1) and repeated the investigations conducted during the Seasonal cruise Q3 from 5th to 27th August the same year, except that no deployment of moorings and gliders were conducted during this polar night November-December cruise. Q4 cruise was a joint physical, chemical and biological cruise, including experimental biology work and testing of new technology addressing the aims of RF1, RF2, RF3 and RA-C. All seven process stations (P7-P1) were sampled in addition to ten of the in total 24 NLEG stations. In addition, some extra CTD stations were taken across the Polar front: four CTD stations and one mini process station named P1-X where CTD with water, one phytoplankton net and one Bongonet 64 µm and 180 µm were collected (Appendix 1.1). The entire Nansen Legacy transect was covered by ~1 m thick sea ice except P1 south of the Polar front (Figure 1).

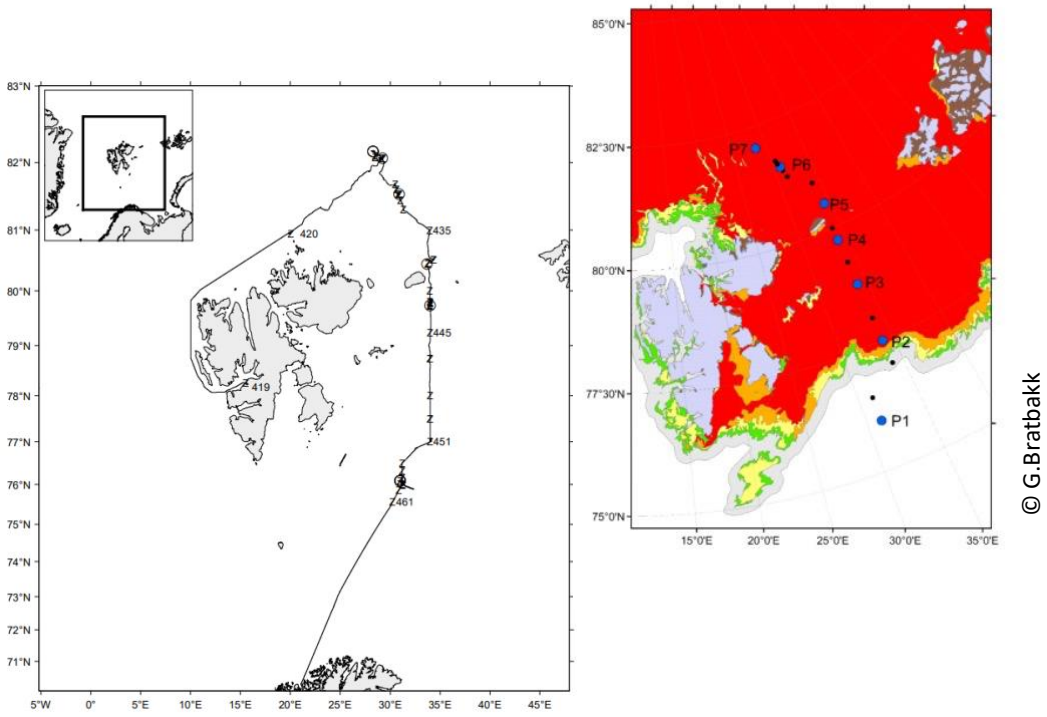

Figure 1. *Sailing route with CTD (z) and Bongo net stations (o) shown during the Q4 cruise in November-December 2019 from Longyearbyen to Tromsø. Focus was the Nansen Legacy transect and the Process (P) stations P7 to P1 (left). Consolidated sea ice up to 1 m thickness dominated with only open water at P1.*

The Nansen Legacy transect represent an environmental gradient from Atlantic water in the south to Arctic water dominance over the Northern Barents Sea shelf before Atlantic water again influence North at the shelf break to the deep Arctic Ocean. At the Q4 cruise we started to sample furthest North at Process station 7 (P7) for so to work our way south to P1 and ending the cruise in Tromsø. The thick (~1 m) and extensive sea ice cover in the Northern Barents Sea made us decide to sail to P7 along the ice-free West Spitsbergen (Figure 1) to save time. Before the ship entered the pack ice NE of Svalbard, two pelagic trawls were taken since next opportunity for trawling was first in open water close to P1. The standard water and plankton community sampling was fulfilled at all seven process stations which lasted from 12-48 hrs, with the exception of P7 which due to great depths (3500 m) and some challenges with box core sampling was extended to 56 hrs. To sample in ice went well and two ice stations were also successfully accomplished (in association to P7 and P4) despite very cold weather combined with some wind. Stormy weather at P1 in open sea prevented deployments of the sediment trap and Autonomous Underwater Vehicle (AUV), and also made it also impossible to safely use the big box corer to collect sediments. Otherwise, most activities were run as planned. Two successful ice stations in association with stations P7 and P5 was also accomplished. Hydrography and water were in addition to the process stations collected on most of the 24 N-leg stations plus that a few extra was taken across the Polar front (see Appendix A1.1). In addition, a handheld CTD (SAIV model 208, Bergen) were used at most stations fixed at the phytoplankton net and lowered down to 50 m, since the large CTD rosette was deployed from the moonpool and thus the water properties it measured in the upper 10 m were questionable.

ALONG TRACK MEASUREMENTS CARRIED OUT DURING THE CRUISE

RV Kronprins Haakon is equipped with several underway measurement systems to provide data along the cruise track. Below an overview of data collected during the polar night Q4 cruise.

Meteorological measurements from Vaisala AWS430 weather station

Air and sea temperature (8 m depth), air pressure, wind speed and direction, relative humidity and solar radiation was measured continuously by a Vaisala AWS430 weather station.

Weather balloons with radiosenders attached were released daily around 10:30-11:00 UTC to record atmospheric properties (e.g. temperature and moisture vs. height). The data from the system was logged locally on the vessel and is included in the dataset from the cruise but is also reported to Norwegian meterological institute/ Deutscher Wetterdienst.

Thermosalinograph

Temperature, salinity, density and fluorescence was measured from the clean water intake at 4 m depth and continuously logged from departure Longyearbyen to arrival Tromsø.

The clean water intake is very sensitive to ice (filter get clogged) or water at freezing temperature (-1.7°C), so pumps were shut down in shorter periods (station NLEG 12, P5) for ice removal. The alternative inlet at 9 m depth is located in the sinking keel which cannot be used in ice covered waters.

pCO2 measurements

Using the 4 m sea water inlet, a pCO2 underway system for autonomous high frequency surface water measurements provides data on pCO2 in sea water and air, dissolved O2 and O2 saturation and sea water temperature during the entire cruise. The seawater intake at 4 m was sampled by the chemistry team onboard (see below) at 17 occasions for DIC, pH, TA, salinity and nutrient measurements to evaluate the underway instrumentation for autonomous high-frequency surface water measurements of partial pressure of CO_2, pCO_2 (General Oceanics). The water-intake for pCO2 and the thermosalinograph is the same and when low temperatures it was always some problems with ice in the water intake (see above).

Ocean current measurements from ADCP 150 kHz

Currents in the upper ~500 m of the water column were continuously measured during the cruise using a 150 kHz ADCP (RDI Instruments) mounted on the drop keel. The setup followed the setup in the test cruise. The instrument was synchronized with the EK80 using K-sync. The 38 kHz ADCP was not used due to interference with the 38 kHz of the EK80. The ADCP data was not processed during the cruise due to time constraints.

Acoustic measurements of zooplankton and fish with the vessel's EK80

Acoustic surveying of fish and zooplankton was conducted using the six scientific Simrad EK80 echo sounder. The flush mounted echosounders were used from the start of the survey until after P2 due to the risk of damaging the drop keel when going in sea ice. The drop keel was used at P1 until finalizing P1. The drop keel was again raised, and the flush mounted system was used while steaming from P1 to Tromsø (for more details see page 23 below).

Sea ice observations (T1-1.2)

Ship-based sea ice observations were done following the ASSIST protocol (https://icewatch.met.no/assist). A roster system established to conduct observations every few hours during daylight (which we did not have, but we also tested this out in darkness with help of the ship lights) while in se aice (paused while stationary at sea ice stations). Observations of ice concentrations, type, thickness, topography and meteorology were entered directly in a web browser-based form (own computer on the observational deck). Sea ice was assessed from the observation deck, and photos were taken pointing port, ahead and starboard. This was the first time we tried out this regular way of sea ice observations on the seasonal Q1-Q4 cruises. Rolf Gradinger (UiT) was leading this work onboard.

STATION-BASED WORK

The Nansen Legacy transect (Figure 1) provides a climatic gradient from the southern Atlantic influenced region of the Barents Sea (P1) across the more Arctic influenced northern shelf (P2-P5), and into the Arctic Basin (P7). The northern branch of the Atlantic Water current into the Arctic Basin along the shelf break, is covered by the shelf break station (P6). This transect may also represent a space-for-time gradient. On a seasonal time-scale, ice-free waters in the south can reflect a later seasonal stage compared to the ice-covered regions in the north were sea-ice cover may delay the productive onset in the water column. At the same time, this may be compensated by an early ice algal production. On a longer timescale, the climatic conditions in the Barents Sea is strongly impacted by the warm and saline Atlantic Water inflow. With increased and extended Atlantic impact further north, an "Atlantification", characteristics of the southern end of the transect may represent elements of future conditions in the north.

To increase the observational resolution along the transect, 18 additional CTD stations (NLEG1-25) reduce the gaps between the process stations (P1-P7). The overview of NLEG and P-station is given in Appendix A2. A reduced biogeochemical sampling program was carried out on the NLEG stations.

NLEG STATIONS

Ten of in total 24 NLEG stations (Stns. and 5 extra stations across the Polar Front, were covered with CTD casts, with T, S, O2, fluorescence and LADCP. CTD data can be found here CTD data from Nansen Legacy Cruise - Seasonal cruise Q4 https://doi.org/10.21335/NMDC-301551919
At CTD station 438 the oxygen sensor froze (so no oxygen data here). The oxygen sensor was replaced, but **comparison with data from the Winkler titration showed that both these oxygen sensors mounted on the CTD had drifted much more than acceptable (+2 ml/l) and the data from these two sensors should, therefore, not be used.**

RESEARCH FOCUS 1 (RF1): NATURAL DRIVERS

The Barents Sea is characterized by competing influences between cold Arctic Water, and warm Atlantic Water, modulated by variability in sea-ice and atmospheric forcing. The Q4 seasonal cruise primarily focused on the biology, but since biology is closely connected to the physical environment we also collected valuable information for RF1 by a variety of along track measurements during the cruise (see above) and CTD casts on all Process stations (P1-P7) and selected NLEG stations (see Table 1 below). In addition, we did a higher resolution CTD transect between NLEG 2 and P1 (3 instead of 1 station) and additional 2 stations south of P1 (10 and 30 nm S of P1) to better capture the variability over the Polar front region.

RESEARCH FOCUS 2 (RF2): HUMAN IMPACTS

With the retreating sea ice, the direct human impacts on the ecosystem change in the northern Barents Sea increases. In AeN, we focus on three key anthropogenic pressures on the ecosystem
1) increase in atmospheric CO2
2) pollution
3) commercial fishing.

Three interrelated research questions are addressed:

Q2.1 What are the current drivers of ocean acidification and how is ocean acidification affecting marine organisms and ecological interactions in the Arctic Ocean?

Q2.2 How are changes in species distribution, trophic interactions and energy allocation affecting toxic potency and generational transfer of contaminants?

Q2.3 How may climate-driven changes in ecosystem structure and functioning lead to unanticipated effects of fishing?

RF2 T2-1.1 Current variability and drivers of ocean acidification

Helene Hodal Lødemel (IMR), Elizabeth Jones (IMR) and Ylva Ericson (NPI)

Our focus was to investigate carbonate and nutrient chemistry for the study of ocean acidification and the carbon cycle in the surface water, water column and sea ice environment (snow, ice, brine, under-ice water) in different regimes/gradients. We sampled the water column and sea ice for nutrients and oxygen isotopes ($\delta^{18}O$) and performed instrument analyses on board for the determination of the carbonate chemistry (total alkalinity (AT), total inorganic carbon (DIC), pH) and dissolved oxygen (DO).

During Q4, we sampled seawater from Niskin bottles mounted onto a 24 bottle CTD-Rosette from a total of 17 stations (total 210 samples) for analyses of carbonate chemistry onboard and nutrients and $\delta^{18}O$ for storage and post-cruise analysis. Sampling and analysis followed the protocol described in *Nansen Legacy Sampling Protocol version 5 and Dickson et al., 2007*. The samples for carbonate chemistry were sampled first or directly after dissolved oxygen (DO) samples and analysed within 24-hours directly onboard for the determination of total alkalinity (AT), total inorganic carbon (DIC), and pH. Samples for inorganic nutrients (nitrate+nitrite, nitrite, phosphate, silicic acid) were preserved with chloroform and stored in the cool and dark for post-cruise analyses at IMR in Bergen.

DO was sampled from 11 CTD stations. On 2 CTD stations duplicate sampling was preformed to ensure that the analytical performance was acceptable. **The data from the Winkler titration**

showed that the 2 oxygen sensors mounted on the CTD had drifted much more than acceptable (+2 ml/l) and the data from these two sensors should, therefore, not be used. The last calibration for both sensors was about one year old.

At sea ice stations (P7 and P5), ice cores, brine, snow and under-ice water were sampled. A total of 6 sea ice cores with a length from 30 cm to 90 cm of first year ice were sampled. At all stations ice thickness, freeboard and snow thickness was collected for each ice core. Under ice water was sampled with a tube from a GO-FLO bottle at P7 but at P5 the sample had to be collected through the bottom opening of the GO-FLO bottle due to freezing. Ice cores were sampled and processed as described in protocol v5. Ice cores were sliced into 10-cm pieces from the sea-ice top (snow-air interface) to the base (ice-seawater interface). Sea ice samples were melted in airtight bags at laboratory temperature and analysed for AT, DIC, pH and salinity onboard. Samples for $\delta^{18}O$ and nutrients were preserved and stored cool and dark similar as for seawater samples.

Underway surface water CO_2 data.

The seawater intake at 4 m was sampled at 17 occasions for DIC, pH, TA, salinity and nutrient measurements to evaluate the underway instrumentation for autonomous high-frequency surface water measurements of partial pressure of CO_2, pCO_2 (General Oceanics). Table 1 summarizes the sampling from water column using the CTD-Rosette.

Table 1. *Seawater samples from the CTD-Niskin Rosette system.*

Station Name	CTD #	# of AT/DIC/pH	# of Nutrients	# of $\delta^{18}O$	# $DO_{Winkler}$
P7	425	18	18	18	36
NLeg24	427	13	13	13	
NLeg23	428	16	16	16	16
P6	431	13	13	13	
NLeg19	433	11	11	11	
NLeg15	434	11	11	11	
NLeg14	435	10	10	10	10
P5	437	9	9	9	9
NLeg12	439	10	10	10	20
P4	444	11	11	11	11
NLeg9	445	9	9	9	9
P3	447	11	11	11	11
NLeg5	448	10	10	10	
P2	450	10	10	10	13
NLeg3	451	10	10	10	
NLeg2	452	11	11	11	11
P1	454	11	11	11	11

Preliminary results of physical and chemical properties from the water column

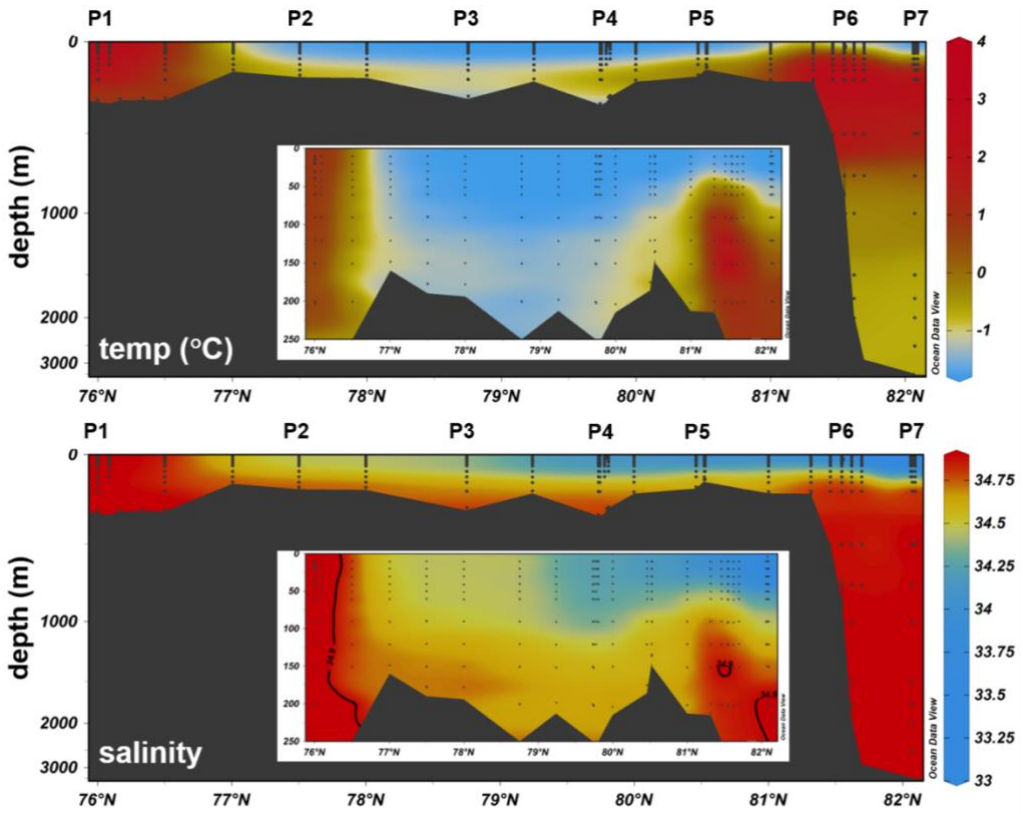

Figure 2. *Temperature (upper panel) and salinity (lower panel) of the water column from north (P7) to south (P1), including several NLEG CTD stations along the transect and additional CTD stations around the Polar Front near P1. Inserts show the upper 250 m of the water column with the 34.9 salinity contour marked in black to indicate the transition to Atlantic Water.*

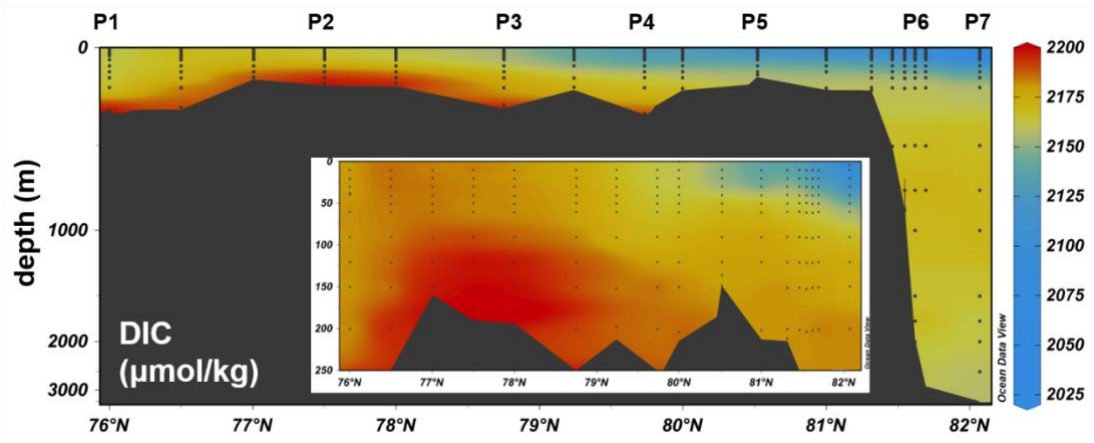

Figure 3. *Dissolved inorganic carbon (DIC) in the water column from north (P7) to south (P1), including several NLEG CTD stations along the whole transect and some additional CTD stations around the Polar Front near P1. Inserts show the upper 250 m of the water column.*

Further, a handheld CTD from UNIS (SAIV model 208, Bergen) was used on selected stations (see Figure 4 below) to measure the surface 100 m since we lost the upper 10 m of the water column when sampling with the big CTD on the rosette when deploying it in the ship moonpool.

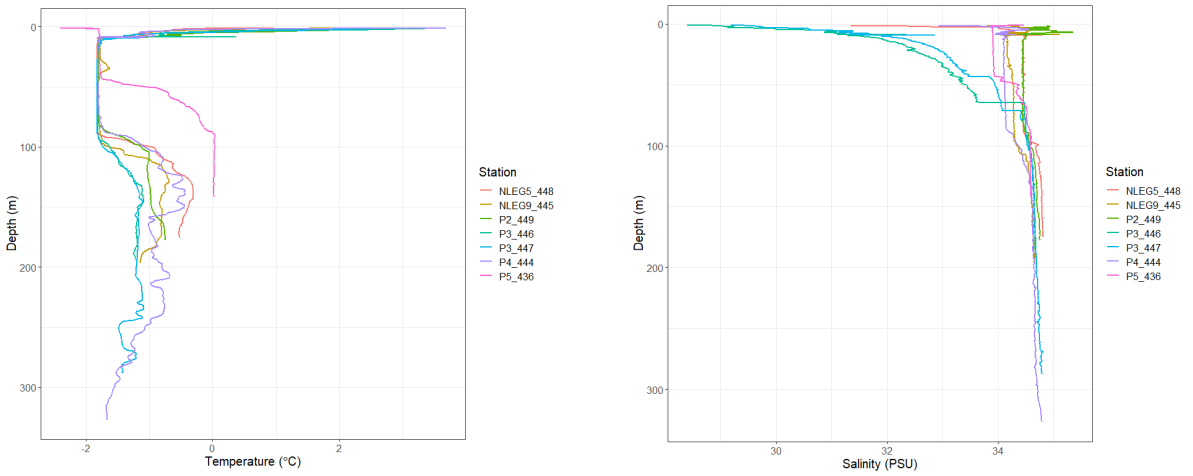

Figure 4. *Temperature (left) and salinity (right) profiles from the handheld CTD (SAIV 208) in the upper water column during the Q4 cruise.*

RF2 T2-1.2. Ocean acidification effects on the mobility of particulate and dissolved organic carbon (POC, DOC), essential trace elements (micro-nutrients) and heavy metals

Stephen Kohler and Maria Digernes (NTNU)

The purpose of this task is to understand the impact of ocean acidification on the biogeochemistry (cycling and mobility) of dissolved organic carbon (DOC) and trace elements in the water column of the Northern Barents Sea. To best explore this topic, a complete survey of trace elements and heavy metals needs to be sampled along the entire transect and at various depths under clean sampling and handling conditions. In addition, the characterization of dissolved organic matter (DOM, DOC), at each station at select depths will aid in understanding the different forms and distributions of DOM and how they may interact with trace elements. As the solubility of trace metals, both essential and toxic, are dependent on its interaction with DOM, the distribution and type of both trace metals and DOM was surveyed.

Trace elements (micronutrients)

Both total (n= 56) and dissolved (n= 56) trace elements, were successfully sampled at all process stations (P1-P7) at eight depths up to 15 m above the seabed or up to 500m with GO FLO bottles with clean sampling and handling techniques. Replicate samples were collected at certain stations

Heavy metals (Hg)

Separately, samples for both total mercury (n=56) and methylmercury (n=56) were also collected at all process stations (P1-P7) at eight sampling depths up to 500m with GO FLO bottles using clean sampling and handling techniques. At stations P6 and P7, samples for total mercury and methylmercury were also collected from the deeper depths (>500m) from the CTD rosette with bottles to complete the profile. Replicate samples were collected at P1, P4, and P7. To compare the clean sampling technique to the CTD, samples were collected from the CTD at P7 at the same depth as one of the GO FLO depths. We hope to share mercury data with RF2, T2-2, and RF3, T3-4.1.

At P7 (Deep Ice) and NLEG24, four depths were selected for a stable isotope mercury methylation experiment. Briefly, stable isotopes of inorganic ^{199}Hg and ^{201}MeHg were spiked to filtered and unfiltered seawater incubations in triplicate and preserved at four time periods over the course of 24 hours. This data will aid in understanding both methylation and demethylation rates throughout the water column in the Arctic basin.

Dissolved organic matter (DOM) characterization, Total organic carbon (TOC), Dissolved organic carbon (DOC) and Total dissolved nitrogen (TDN)

Samples were collected for 6 depths *(10m, 20m, 30m, 40m, intermediate and bottom depth) the intermediate and bottom depth was based* on local station and hydrography. Process stations (P1, P2, P4, P5, P6, P7) were sampled and collected from CTD bottles. All samples were subsequently collected, filtered, and extracted for DOM to be analyzed using UPLC MS at NTNU gløshaugen. In addition, samples including replicates were collected for TOC, TDN and DOC analysis for aforementioned stations at all 6 stations and 6 depths at each station to complement DOM characterization analysis. DOC and TOC analysis will be performed using high temperature combustion TOC instrument.

Aggregation experiments (collaboration with Yasemin V. Bodur, UiT)

Samples were filtered and extracted for DOM characterization and DOC quantification for an aggregation experiment with a 24h incubation time using a rolling tank at 4C temperature. Samples for DOC/Q and DOM characterization were collected at station P1, P2 and P7 at 30m depth. POC samples were also collected and to be analyzed by Yasemin V. Bodur.

Ice work

Two ice cores were collected for trace elements at P5 ICE and P7 ICE. Cores were collected whole, and then cut and processed onboard according to AeN protocol.

Two ice cores were collected for Hg at P5 ICE and P7 DEEP ICE. Cores were collected whole, and then cut and processed onboard.

2 ice cores were collected for DOM at P7 DEEP ICE and P5 Ice. Cores were cut in the field, then filtered and extracted onboard for DOM using only the 0-20cm section of each core.

Sediment sampling

At select stations, samples of surface sediments were collected by the benthos group (UiT – Nord) for trace element analysis by sequential sediment extraction.

RF2 T2-1.4. Ocean acidification effects on planktonic calcifiers and biological pump efficiency

Kasia Zamelczyk (UiT)

To better understand the effects of ocean acidification in the Barents Sea, the abundance, carbonate contribution and the condition of shells of planktic marine calcifiers (foraminifera and pteropods) will be studied from microzooplankton net samples from all P stations (P7 to P1).
The samples have been collected using the 64 µm multinet at the standard depths: bottom - 200m, 200-100m, 100-50m, 50-20m and 20-0m. Samples from P6, P4 and P2 have been sorted into four size fractions (>500µm, 500-250µm, 250-100µm and 100-63µm) and quantitatively analyzed on board. The preliminary results have been presented during a scientific seminar during the cruise. During analyses, 238 specimens (38 foraminifera and 200 pteropods) have been picked and freezed individually at -80° C for protein extraction analysis. If available, 10 to 50 specimens of each group of organisms have been picked and placed slides for estimation of the shell conditions on shore. The remained analyzed samples have been stored in plastic bags at -80° C for further analysis on shore. Samples from station P7, P5, P3 and P1 have been put into plastic bags and stored at -80° C for analysis on shore. Samples from P7, P5, P3 and P1 have not been analyzed on board.
Three phytoplankton nets (ø 10 µm) have been collected through ice hole at ice stations (P7 at 0-5m and 0-30m water depth; at P6 at 0-5 m water depth). These samples have been filtered through 0,8 µm Polycarbonate filter, dried at room temperature and stored in plastic ampoules for SEM analyses on shore. In addition, at station P7, a 93 cm long ice core have been recovered for planktic foraminiferal and pteropods analyses. This ice core was put into a plastic bag and stored in -20° C. Abundances and shell condition will be compared to the ocean carbonate chemistry parameters measured from water samples collected just prior or after the multi net samples retrieval.

RF2 T2-2.1. Effects of changes in species composition and distribution on contaminant in food web accumulation

Julia Giebichenstein (UiO), Rita Amundsen (UiO), Øystein Varpe (UNIS), Robynne Nowicki (UNIS), PI: Katrine Borgå (UiO)

As changes in temperature and sea ice distribution and thickness are expected in the Barents Sea, the energy transfer processes in the food web are expected to change. The present study aims at identifying and comparing bioaccumulation and biomagnification processes of legacy and emerging contaminants (e.g. persistent organic pollutants and mercury) related to energy

use and availability between an Atlantic-influenced and an Arctic marine pelagic food web in the Barents Sea throughout the year. Zooplankton and fish samples will be collected during the process study cruises. From these, chemicals representing lipid-soluble and protein associated contaminants will be analyzed, in addition to dietary descriptors to trace energy source (stable isotopes and lipid analyses). Model predictions of climate change effect on food web accumulation of contaminants include reduced accumulation due to predicted reduction in lipid storage. Bioaccumulation changes due to altered dietary composition is predicted to have less influence than the predicted lower lipid content. These predictions will be tested in the present task.

Sampling approach

During this cruise we have collected water, zooplankton and fish samples for legacy and emerging contaminants, mercury, stable isotope and fatty acid analyses. Doreen Kohlbach (NPI) will analyze the fatty acid samples and the stable isotope and mercury samples will be analyzed at UiO, contaminant samples will be analyzed at NILU in Tromsø. We hope to share mercury data with T2-1.2 and zooplankton community data with Tom from IMR.

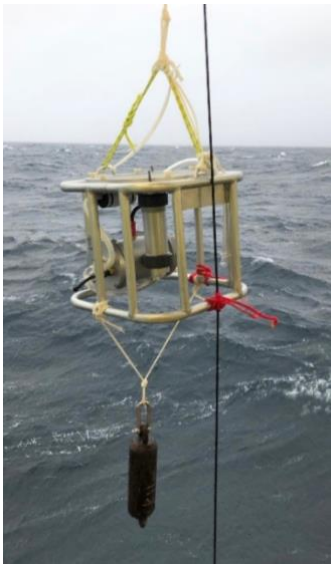

Figure 5. *In-situ filtration pump*

Water samples for legacy persistent organic pollutant (POP) analyses were collected with an in-situ filtration pump (see Figure 5) at the process stations P7, P4, P3 and P1. The sampling at P6 failed due to freezing of the gear. To compare the influence of warmer, more saline Atlantic water on contaminant levels with the cold, fresher Arctic water we tried to target both water masses, if applicable. Due to harsh weather conditions and limited time, it was not always possible to deploy both pumps at the same time. Sampling at P6 failed due to freezing of the gear. In addition, we took water samples from the CTD rosette in triplicates for PFAS analyses at P1, 5 and 7.

Meso- and macrozooplankton samples of key food web species were collected at each process station. Mesozooplankton (primarily Copepod stages CIV and CV) were sampled with either WP3 or Bongo.

Figure 6. *Zooplankton sample from P5. Photo credit: Øystein Varpe*

Macrozooplankton (mainly euphasiids, amphipods and juvenile fishes) samples were collected from the MIK net or from the macrozooplankton trawl (see Figure 6 for an example from the MIK net). All zooplankton samples were sorted and grouped by family and by species, if possible. Samples for contaminants were handled as little as possible and frozen as quickly as

possible to avoid cross-contamination. We sampled for POPs, mercury, stable isotope and fatty acid analyses.

Fish tissue and whole fish were sampled via bottom trawl for POPs, mercury, stable isotope and fatty acid analyses at P1 and between P2/P1. We attempted a trawl at the Ntrawl station north of Svalbard, but it was cancelled due to inappropriate bottom condition. Sea ice prevented us from trawling earlier than P2/P1. The of sampled fishes stomach was frozen for microplastic analyses and otoliths for age determination were dissected. The target species relevant to the pelagic Barents Sea food web included Polar cod (*Boreogadus saida*), Atlantic cod (*Gadus morhua*) and Capelin (*Mallotus villosus*) and were below 25 cm in total length (see Table 2). Other dominant fish species (like *Leptoclinus spp*. at P2/P1) were sampled opportunistically and frozen whole. (see part T2-3-1 in this report for detailed information on the trawls).

Table 2. *Overview of the number of dissected fishes at the process stations.*

Process station	**P1**	**P2/P1**
Atlantic cod (*Gadus morhua*)	1	3
Polar cod (*Boreogadus saida*)	7	3
Capelin (*Mallotus villosus*)	6	4

Part of the sampled fishes were shared with subtasks T2-3.1 for further ecotoxicological analyses.

RF2 T2-2.5. Critical seasonal windows of responses to multiple stressors on key organisms in a pelagic food chain

Robynne Nowicki (UNIS/UiO), Supervisors: Øystein Varpe (UNIS), Geir Wing Gabrielsen (NPI), Katrine Borgå (UiO)

Purpose

The samples taken on this cruise will be used in T2-2.5 "Critical seasonal windows of responses to multiple stressors on key organisms in a pelagic food chain". Macrozooplankton and fish samples will be taken on all four seasonal cruises (Q1-4) for bioenergetics, protein, lipid and pollutant remobilization analysis. The samples taken will be used to assess seasonal fluctuations in energy content of key organisms in the pelagic food web of the Barents Sea. This data will be used to expose annual critical windows in which organisms may be of weakened body condition and predators may have a low-quality food supply. Thus these organisms may be more susceptible to stressors such as persistent organic pollutants and climate change parameters, during this critical period. I also took samples of macrozooplankton to assess sexual maturity and life history stages, in order to allow for a more trait-based approach to seasonal

energy variation. As well as this, polar cod brains were collected (to be used in conjunction with brains collected from kittiwakes from Svalbard in future) for organ specific analysis of seasonal pollutant remobilization. Samples were taken at each process station (excluding P3), allowing for additional comparison of southern (Atlantic) and northern (Arctic) species, as well as regional differences in individuals of the same species.

Sampling approach

Macrozooplankton: Due to ice conditions, with stations P7- P2 being ice covered, macrozooplankton were predominantly sampled using MIK-net 1500um vertical hauls. Macrozooplankton trawls were taken at an additional "N. Trawl" station and at P2 and P1. The multiple MIK nets were taken at some stations to provide substantial biomass. The bulk samples were sorted into major zooplankton groups, with this work focusing on krill, amphipods and pteropods, with 2-3 species selected for each. Individuals were selected and measured, with an aim to collect a range of size classes, in order to assess the relationship between body size and energy content. This cruise also saw *Themisto libellula* in a range of life history stages with males, and females with and without eggs present. For each sample, organisms were wrapped in aluminium foil, placed in a labelled Ziploc bag and frozen at -20°C. Large organisms were stored individually, whilst smaller organisms were pooled per sample, with the aim of each sample weighing between 1-2g. Samples were taken opportunistically, with not all species being collected from each station.

Fish: Fish were collected using campelen trawl at stations P2/1 (an opportunistic station between P2 and P1) and P1. Atlantic cod (*Gadus morhua)*, capelin (*Mallotus villosus)* and polar cod (*Boreogadus saida)* were the target species collected. Some small polar cod were also caught in the macrozooplankton trawl at station N. trawl. However Atlantic cod were only available from P1 and capelin from P2/1 and P1, whilst polar cod were taken from all sampled stations. The fish were taken whole from the trawl (roughly 10-25 individuals per species per station where abundance allowed), weighed and measured for total length. Individuals were then wrapped in aluminium foil and frozen at -20°C. Polar cod that were dissected for other simultaneous sampling onboard had their brains removed for remobilization studies, with weight and total length of the sample fish being noted.

RF2 - T2-3.1. Climate change and fisheries: Spatial environmental variables and genomics

Siv Hoff (UiO), Julie Bitz-Thorsen (UiT) and PI Leif Christian Stige (UiO)

The aim of this task is to investigate the roles of spatiotemporal population structure and possible local adaptations in three key fish species in the northern Barents Sea ecosystem: The Northeast Arctic population of the Atlantic cod (*Gadus morhua*), capelin (*Mallotus villosus*) and polar cod (*Boreogadus saida*). If local adaptations are important for population dynamics and responses to climate change, it may be necessary to revisit the management of fisheries in order to maintain intact spatial and genetic structure. For this purpose, individual samples of these

species will be collected at transect cruises in summer (2 years) and winter (1 year) for whole-genome sequencing. We will also include samples of the same species collected in associated projects at other locations, such as at their spawning grounds. From these data we aim to characterize the population sub-structure(s) for each of the species, as well as identify signatures of directional selection, for instance as a result of temperature adaptations. In addition to spatial structure, we will assess possible temporal structure, linked to seasonal partitioning of habitat use.

During this winter cruise we have collected tissue samples of the Northeast Arctic cod, polar cod and capelin from process station P1x, and multiple trawl locations which was not part of specific process stations. These trawl locations include one on the northwest of Svalbard, named N_trawl, and one located between NLEG2 and NLEG3. This sums up to three trawling locations in all (Table 3). Trawling was generally limited during this cruise, due to ice and weather conditions.
At the location between NLEG2 and NLEG3, and at P1x demersal (Campelen) fish trawl was taken. In addition, macrozooplankton trawl was taken at N_trawl, the location between NLEG2 and NLEG3, and P1x.

Table 3. *Number of fish sampled at each of the stations where trawling was conducted during SSQ4*

Station/ Species	**N_trawl**	**between NLEG2 & NLEG3**	**P1x**
Northeast Arctic cod	-	14	21
capelin	4	35	30
0group capelin	27	20	10
Polar cod	29	47	30

In concordance to last year sampling (JC1/2: 6-23 Aug. 2018) and SSQ3 August cruise 2019, the Northeast Arctic cod was observed at the two most southern stations P1 and between NLEG2 & NLEG3.

The Atlantic cod caught during this cruise were generally small to medium in size (range between < 20 and 2240 grams), and < 4 in maturation (the range is 1-7, where 6 is ready to spawn). Adult capelin was mainly caught in bottom trawls, and 0group capelin caught in macrozooplankton trawls at three locations. Polar cod were caught in all trawls taken. Polar cod caught in the macrozooplankton trawls were generally of a small size, between 5 and 7cm, and are likely 0 yearlings.

For all sampled fish, a total of three tissue samples were taken, two for whole-genome DNA sequencing (aprox. 20x coverage), and one for RNA sequencing. Additionally, otoliths were collected for all fish sampled, in order to determine age.

Metadata was recorded for all fishes sampled, and includes the following parameters: fork length, total length, total weight, sex, maturation stage and presence of ecto/endoparasites. In addition, for the Northeast Arctic cod and a subset of the sampled polar cod at each station liver, gonad and somatic weight was also recorded.

RESEARCH FOCUS 3 (RF3): THE LIVING BARENTS SEA

The ecosystems of the northern (Arctic-influenced) Barents Sea and adjacent slope and basin areas function fundamentally differently from the southern (Atlantic-influenced) region. In RF3 we focus on quantifying the structure and function of the poorly described ecosystems of the northern Barents Sea and adjacent slope and basin and compare them with the much better-known ecosystems of the central and southern Barents Sea and contrast them with the historic baseline data. Unique to this effort and unprecedented for the region is the synoptic study of microbes to mammals, and the all-seasons approach. The main research questions are:

Q3.1 What are unique characteristics of the marine life in the marginal ice zone of the northern Barents Sea and adjacent basin, compared to the much better understood southern Barents Sea?

Q3.2 How do environmental conditions impact the timing of biological processes across marine ecosystem realms?

Q3.3 What is the magnitude, range, and variability of production across trophic levels?

Q3.4 How and at what rate do carbon and nutrients cycle through the food web, and what is determining the rate of the processes involved?

RF3 - T3-1.1. Characterize biological phytoplankton/ protist communities and seasonality in terms of biodiversity, abundance, biomass and distribution patterns

Anna Vader (UNIS), Miriam Marquardt (UiT), Rita Amundsen (UiO)

The main aim of our sampling during the AeN2018711 cruise was to collect material which will be used to study diversity, distribution and ecology of microalgae and other protists along the Barents Sea to Arctic Ocean transect. Our sampling also focused on Sea ice communities, and we collected material from ice cores and under-ice.

For the **molecular analysis** of diversity (metabarcoding) and function (metatranscriptomics) of phytoplankton and protist communities along the transect we collected samples together with

Anna Vader (UNIS). We took part in collection and filtration of the molecular samples as well as sampling and processing of ice-cores and sea water on ice. A complete list of which microbial parameters were collected at which depth and stations is presented elsewhere in the report.

For the **analysis of phytoplankton** abundance we collected the samples. These samples were collected from CTD Niskin bottles at all planned depths at station P1-P7. All stations were taken in the moonpool. Sample depth 5m was changed to 10m, due to sampling through the moonpool. Samples where fixed in Glutaraldehyde and formalin solution for further light microscopy analysis in the lab. They will provide quantitative and qualitative information about phytoplankton abundance and diversity along the transect.

Morphological analysis of phytoplankton diversity and isolation of cultures of Arctic microalgae. We also collected samples for the scanning electron microscopy (SEM) analysis of small phytoplankton and groups which are not well preserved in quantitative samples fixed in Lugol's solution. This includes primarily calcifying microalgae (coccolithophores) which are an important part of the Barents Sea phytoplankton. The samples for quantitative and qualitative SEM analysis were taken at each station at four depths which corresponded to depths sampled for molecular metabarcoding and metatranscriptomics.

A plankton net (mesh size 10µm) was deployed at each station to obtain a concentrated phytoplankton vertical sample. The collected material was divided in five parts. To part was fixed in 2% formalin and one in 1% Lugol's for light microscopy to be used together with the quantitative samples above. Another part was fixed in 1% glutaraldehyde and these will be used for studying diversity of protists using scanning and transmission electron microscopy at UiO.
At sea ice stations, we sampled water from 0.5m below ice and 5m, 50m below ice and concentrated it using 10µm bottle-net. Part of material was fixed for SEM, TEM and LM for later analysis. The ice-cores were divided in to 0-3 cm, 3-10cm, 10-20cm, 20-30cm. One part for meiofauna and one part was fixed for microscopy.

RF3. T3-1.1 & 2.1 Mesozooplankton taxonomy, abundance, biomass and genomics

Anette Wold (NPI) and Amalia Keck (NPI)

The main objective was to describe the mesozooplankton taxonomic composition, abundance and biomass along the transect going from open Atlantic water (P1) to ice covered Arctic water (P7). We expect to see a gradient in the presence of Atlantic and Arctic species.
The data obtained during this cruise (Q4) are part of the seasonal investigation of zooplankton communities with data collected in Aug 2019 (Q3) as well as in March (Q1) and April/May (Q2).

Description of work

We have sampled with Multinets Midi (HydroBios, opening: 0.25m^2, net length: 250 cm) and Bongonets (HydroBios, opening: 2 x 0.2827m^2, net lengths: 250 cm): For both nets we have been using both 180 µm and 64 µm mesh nets in order to cover all size groups. We refer to the

samples from the two mesh sizes as “mesozooplankton” and “small mesozooplankton” respectively.

Taxonomy and abundance were sampled at 5 standard depth intervals using the Multinet. The depths were from the bottom-200, 200-100, 100-50, 50-20 and 20-0 m. At the deep stations, the sampling depths were from 1000-600, 600-200, 200-50, 50-20 and 20-0 m. All samples were preserved in 4 % formaldehyde free from acid.

Total biomass (dry weight) and metabarcoding were sampled using Bongonets from the bottom-surface and from 1000 m to the surface at the deep stations. Each Bongonet were split in two, net 1 was used for metabarcoding and taxonomy with ½ of the sample for each. Net 2 was used for biomass and fatty acid, or experimental work if needed, with ½ of the sample for each. The biomass samples were dried and measured onboard. Genetic samples for metabarcoding were preserved in ice cold 96 % ethanol. Taxonomy samples were stained with Neutral red and preserved in 4 % buffered formaldehyde in order to distinguish between dead and alive specimens. The taxonomy samples will be used to support the metabarcoding samples.

Gelatinous zooplankton were picked out from MIK net at all stations as well as from Bongonet 180 µm at P1 and Macroplankton trawl at NLEG3. One picture was taken of each taxa including all individuals. Individuals in good conditions were stored individually with ice cold 96 % ethanol. It would improve the sampling of gelatinous zooplankton to use a light-board or external light sources and have a dedicated camera.

Table 4. *Overview of mesozooplankton sampling*

Purpose	**Gear**	**Station**	**N samples**	**Task**
Mesozooplankton taxonomy	Multinet 180 µm	P1, P2, P3, P4, P5, P6, P7	35	T3-1.1 & 1.2 T3-2.1 & 2.2
Small mesozooplankton taxonomy	Multinet 64 µm	P1, P2, P3, P4, P5, P6, P7	35	T3-1.1 & 1.2 T3-2.1 & 2.2
Mesozooplankton biomass	Bongonet 180 µm	P1, P2, P3, P4, P5, P6, P7	7	T3-1.1 & 1.2 T3-2.1 & 2.2
Small mesozooplankton biomass	Bongonet 64 µm	P1, P2, P4, P5, P6, P7	7	T3-1.1 & 1.2 T3-2.1 & 2.2
Mesozooplankton metabarcoding	Bongonet 180 µm	P1, P2, P3, P4, P5, P6, P7	12*	T3-1.1
Small mesozooplankton metabarcoding	Bongonet 64 µm	P1, P2, P3, P4, P5, P6, P7	7	T3-1.1
Mesozooplankton taxonomy (alive/dead)	Bongonet 180 µm	P1, P2, P3, P4, P5, P6, P7	7	T3-1.1 & 1.2 T3-2.1 & 2.2
Small	Bongonet 64 µm	P1, P2, P3, P4, P5, P6, P7	7	T3-1.1 & 1.2

mesozooplankton taxonomy (alive/dead)				T3-2.1 & 2.2
Mesozooplankton fatty acid (total community)	Bongonet 180 µm	P1, P2, P3, P4, P5, P6, P7	7	T3-1.1 & 1.2 T3-2.1 & 2.2
Gelatinous zooplankton	MIK net 1500 µm, Bongonet 180 µm, Macroplankton trawl	P1, P2, P3, P4, P5, P6, P7	149 ind.	T3-1.1 & 1.2 T3-2.1 & 2.2

*We took one Multinet sample for metabarcoding at DEEP-ICE station (5 extra samples)

Table 5. *Overview of gear deployment*

Gear	**Sampling depth**		**Hauling speed (m/s)**	
	Shallow	Deep	lowering	heaving
Multinet 180 µm	Bot-200-100-50-20-0m	Bot-600-50-20-0m	0.5	0.5
Multinet 64 µm	Bot-200-100-50-20-0m	Bot-600-50-20-0m	0.5	0.3
Bongonet 180 µm	Bottom-0m	1000-0m	0.5	0.5
Bongonet 64 µm	Bottom-0m	1000-0m	0.5	0.3
MIK 1500 µm	Bottom-0m	Bottom-0m	0.3*	1.5

*If lowering to fast the net-bucket might flip into the net since the ring is much heavier than the bucket even when added weight to the bucket. The net bucket should be improved in order to attach heavier weights.

Table 6. *Overview of gelatinous zooplankton samples*

Gear type	**Station**	**Depth**	**Taxon**
MIK 1500 µm	Deep-ice/P7	1000-0m	*Aglanta digitale* *Mertensia ovum* *Beroe* sp. *Atolla* sp. Unknown 1 Unknown 2
MIK 1500 µm	P6	800-0m	*Aglanta digitale* *Mertensia ovum* *Beroe* sp. Unknown 1
MIK 1500 µm	P5	120-0m	*Aglanta digitale* *Euphysa flammea* *Sarsia (*with *Thermisto* inside) *Catablema vesicarium/Halitholus cirratus* Unknown
MIK 1500 µm	P4	300-0m	*Beroe* sp.

			Euphysa flammea Unknown
MIK 1500 µm	P3	280-0m	*Aglanta digitale* *Mertensia ovum* *Beroe* sp.
MIK 1500 µm Bongonet 180 µm	P2	170-0m 180-0m	*Mertensia ovum* *Beroe* sp. *Ptychogena lacteal* *Euphysa flammea* *Beroe* sp. *Dryodora glandiformis*
Macrozooplankton trawl	NLEG3	100-0 0m	*Cyanea capilata*
MIK 1500 µm	P1	300-0m	*Aglanta digitale* *Beroe* sp.

RF3 - T3-1.1; 2.1. Macrozooplankton

Tom van Engeland (IMR) and Nils Olav Hanegard (IMR), (PI Randi Ingvaldsen, IMR)

Macrozooplankton consists mainly of larger planktonic organisms such as krill, amphipods, arrowworms, jellyfish, fish larvae and shrimps. This document reports on the macrozooplankton sampling activities, that were performed on the Nansen Legacy seasonal cruise Q4 (cruise number 2019711). The aim of this sampling was two-fold: (1) assessment of the community composition in terms of size distributions and relative abundance, and (2) obtaining ground-truthing data for comparison with signals from the ship's echosounders and the TS (target strength) probe. For the latter, the focus was mainly put on the euphausiids and amphipods, which are key prey species for many economically and ecologically important fish species in the Barents Sea.

The cruise started in Longyearbyen on November 28 and ended in Tromsø on 17 December 2019. Most of this macrozooplankton sampling was done with the MIK net (midwater ring-trawl; d=2m; mesh = 1.5mm). On all process stations, a vertical haul was taken from a depth of 1000m, or from 30m above the bottom at shallower stations.

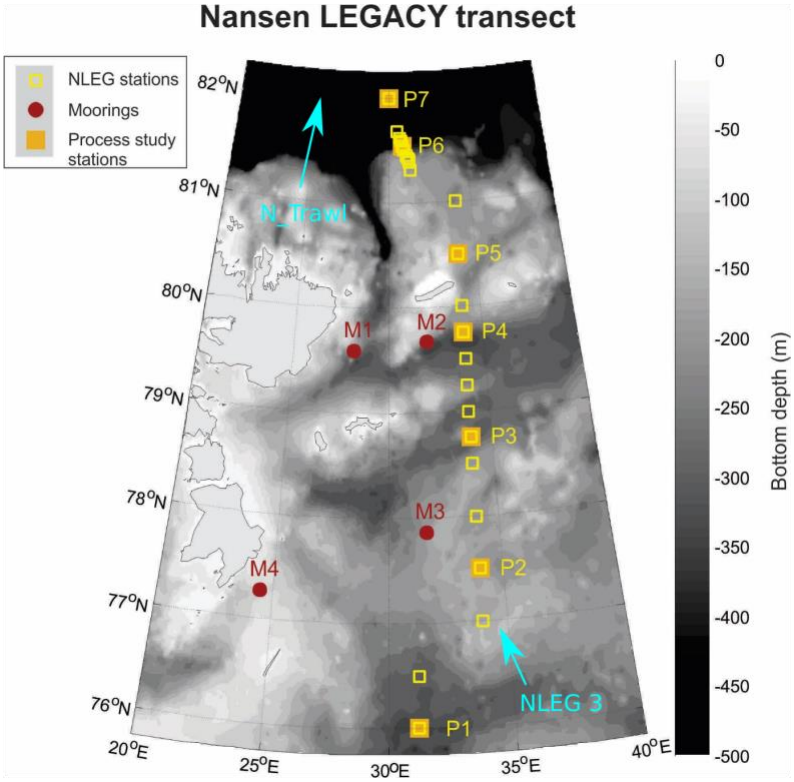

Figure 7. *Overview of the transect that was sampled from north to south. Process stations are indicated with 'P'. Open squares in between are stations where CTD casts and TS Probe casts were performed. At NLEG 3, P1, and N_Trawl, a macroplankton trawl was taken.*

Acoustics measurements of zooplankton and fish with EK80

The objective is to get a measure of acoustic backscatter associated to each process station and NLEG station. This will be combined in later analysis to the sample data and the TS probe data, providing a vertical resolution of the main scatterers in the area (Figure 8).

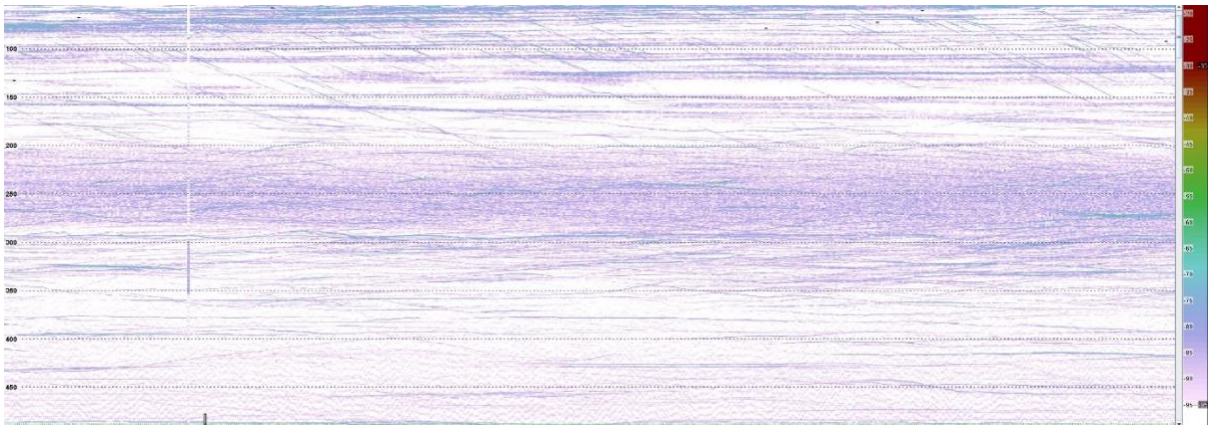

Figure 8. *Example echogram from the ship based echosounder for the P7 station. The echogram show the 70kHz echosounder. The vertical range is depth from surface to 500 m. The horizontal axis is time.*

The standard IMR settings were used for the echosounder. The flush mounted echosounders were used from the start of the survey until after P2 due to the risk of damaging the drop keel. The drop keel was used at P1 until finalizing P1. The drop keel was raised, and the flush mounted system was used while steaming to Tromsø.

The data were preprocessed using the LSSS system (Marec, Norway). Since we are mainly using the acoustics on or near stations, we cannot use the normal distance-based interpretation. The data is interpreted time based and the portion of the data where the transducers are covered with ice or when moving in ice are excluded. On station, there are also several cases where the data is corrupted due to CTD casts or TS probe casts etc. These data are removed using the LSSS exclude region or delete functions. The delete and exclude functions are typically applied to all frequencies, but in some cases, e.g. when where there is noise on one frequency only, the deletion is applied to that frequency only.

It is not possible to trawl under the ice, and the categorization is therefore uncertain. A very simplified approach is taken where all "clean" backscatter is allocated to the "PLANKTON" class for all frequencies. An integration threshold of -90 dB is used to capture the weak targets under the ice. In some cases, this leads to elevated noise levels, but, at least on the lower frequencies, the sensitivity to the threshold is relatively low.

The standard grid for IMR surveys is 10 m channels and 0.1 nm. Assuming standard survey speed of 10 knots, this would correspond to 1/100th hour or 36 s. The grid in the LSSS data base and in subsequent reports are 10 m and 36 s in depth and time, respectively. The standard reports are exported from LSSS and are available on request.

Data availability

The raw EK80 data are stored in the (internal) IMR survey folder. These can be accessed from within IMR under "" and the sub folders "Drop Keel" and "Flush Mount", respectively.

The interpreted data are placed under
"\\ces.imr.no\cruise\2019\2019 Tokt Kronprins Haakon\S2019711_PKRONPRINSHAAKON_9566\ACOUSTIC\LSSS\",

where the LSSS project and reports are found under "LSSS_FILES" and "REPORTS" folders, respectively.

The TS probe

The probe system consists of a steel frame that is equipped with an echo sounder system (EK80) with four split-beam transducers: (38, 70, 120, 200 kHz), that are mounted to "look" horizontally (Figure 9). The system also has a 333 kHz, but the 38kHz was used instead as there are only 4 transceivers. The TS probe deployments covers station P7 to P1 (in descending order) including a subset of the NLEG (CTD) stations. A probe cast consisted of a down- and up-cast at each station.

Different settings were used for the “downcast” and “upcast” probing. For the downcast we used the echosounders in continuous wave mode (CW) and 512 ms pulse length for all transducers. For the upcast, the FM mode with sequential pinging was used, except for the 38kHz transducer that use the same configuration as for the downcast. Range was set to 50 m. All the settings are found in the files “AeN_CW_downcast.set” and “AeN_FM_upcast.set” files (see the “Data availability” section for location).

Figure 9. *Tom Van Engeland with the TS probe.*

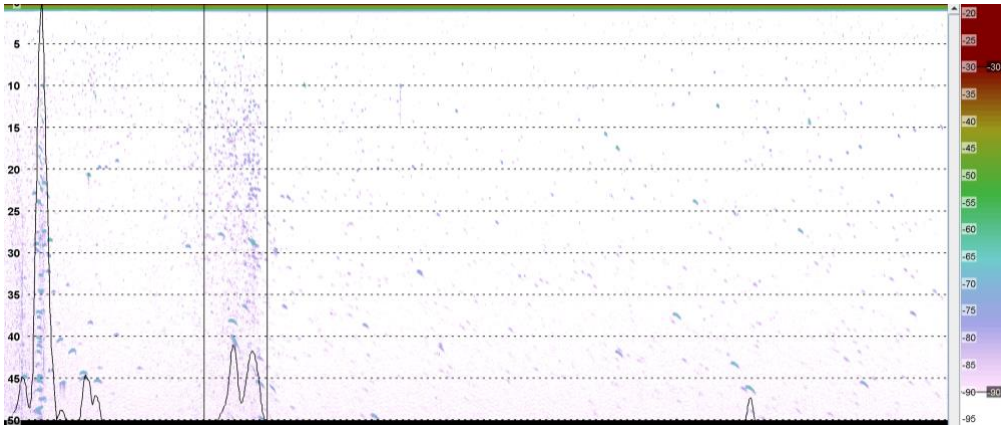

Figure 10. *The 70 kHz data from the probe at P7. The horizontal axis is the depth ranging from 5 to 1000 m. The vertical axis is the range in meters horizontally.*

There are one LSSS project for each downcast and upcast, see Table 1. The integration interval is set to 10 m to 50 m, and the first noisy part close to the vessel is excluded. All frequencies are stored and the grid is set to 2 pings by 1 m. All energy is allocated to “PLANKTON” with a lower integration threshold of -90dB. The side lobes near the surface and bottom is removed for all frequencies using the LSSS erase function.

Table 7. *A list of probe casts. A complete list of metadata is found in the "TSprobeMetadata.xlsx" (see the section "Data availability" for location).*

Cast	Type	LSSSproject	Station Name	Parent event UUID
1	downcast	NA	N_Trawl	1fed2e92-1351-11ea-a5f2-000c29fb4a96
2	downcast	NA	N_Trawl	b57af9de-138e-11ea-a5f2-000c29fb4a96
3	downcast	S7111_PKronprins Haakon[9566]	DEEP-ICE	8cce0102-14bc-11ea-a5f2-000c29fb4a96
3	upcast	NA	DEEP-ICE	8cce0102-14bc-11ea-a5f2-000c29fb4a96
4	downcast	S7113_PKronprins Haakon[9566]	NLEG24	da0ffe41-161d-11ea-a5f2-000c29fb4a96
4	upcast	NA	NLEG24	da0ffe41-161d-11ea-a5f2-000c29fb4a96
5	downcast	S7115_PKronprins Haakon[9566]	P6	c9fb4f21-16c8-11ea-a5f2-000c29fb4a96
5	upcast	NA	P6	c9fb4f21-16c8-11ea-a5f2-000c29fb4a96
6	downcast	S7117_PKronprins Haakon[9566]	NLEG15	9feaee09-17d0-11ea-a5f2-000c29fb4a96
6	upcast	NA	NLEG15	9feaee09-17d0-11ea-a5f2-000c29fb4a96
7	downcast	S7119_PKronprins Haakon[9566]	NLEG14	9feaee0b-17d0-11ea-a5f2-000c29fb4a96
7	upcast	NA	NLEG14	9feaee0b-17d0-11ea-a5f2-000c29fb4a96
8	downcast	S7121_PKronprins Haakon[9566]	P5	e04512f2-1885-11ea-a5f2-000c29fb4a96
8	upcast	NA	P5	e04512f2-1885-11ea-a5f2-000c29fb4a96
9	downcast	S7123_PKronprins Haakon[9566]	NLEG12	bacce506-1923-11ea-a5f2-000c29fb4a96
9	upcast	NA	NLEG12	bacce506-1923-11ea-a5f2-000c29fb4a96
10	downcast	S7125_PKronprins Haakon[9566]	P4	bacce508-1923-11ea-a5f2-000c29fb4a96
10	upcast	NA	P4	bacce508-1923-11ea-a5f2-000c29fb4a96
11	downcast	S7127_PKronprins Haakon[9566]	NLEG9	84d4f25d-1a33-11ea-a5f2-000c29fb4a96
11	upcast	NA	NLEG9	84d4f25d-1a33-11ea-a5f2-000c29fb4a96
12	downcast	S7129_PKronprins Haakon[9566]	P3	e9e79ee2-1aab-11ea-a5f2-000c29fb4a96

12	upcast	NA	P3	e9e79ee2-1aab-11ea-a5f2-000c29fb4a96
13	downcast	S7131_PKronprins Haakon[9566]	NLEG5	23ea582d-1af8-11ea-a5f2-000c29fb4a96
13	upcast	NA	NLEG5	23ea582d-1af8-11ea-a5f2-000c29fb4a96
14	downcast	S7133_PKronprins Haakon[9566]	P2	23ea582f-1af8-11ea-a5f2-000c29fb4a96
14	upcast	NA	P2	23ea582f-1af8-11ea-a5f2-000c29fb4a96
15	downcast	S7135_PKronprins Haakon[9566]	NLEG3	32ce3c7c-1bfd-11ea-a5f2-000c29fb4a96
15	upcast	NA	NLEG3	32ce3c7c-1bfd-11ea-a5f2-000c29fb4a96
16	downcast	S7137_PKronprins Haakon[9566]	NLEG2	66fd2a8c-1c4b-11ea-a5f2-000c29fb4a96
16	upcast	NA	NLEG2	66fd2a8c-1c4b-11ea-a5f2-000c29fb4a96
17	downcast	S7139_PKronprins Haakon[9566]	P1	e259cde6-1d35-11ea-a5f2-000c29fb4a96
17	upcast	NA	P1	e259cde6-1d35-11ea-a5f2-000c29fb4a96

Data availability

- The data are stored in the (internal) IMR survey folder. These can be accessed via "\\ces.imr.no\cruise\2019\2019 Tokt Kronprins Haakon\S2019711_PKRONPRINSHAAKON_9566\"
- The EK80 raw data are placed in
  "\OBSERVATION_PLATFORMS\TS_PROBE\TS_PROBE_EK80_RAWDATA\"+ Cast+"_"+GUID+"downcast"
  and
  "\OBSERVATION_PLATFORMS\TS_PROBE\TS_PROBE_EK80_RAWDATA\"+ Cast+"_"+GUID+"upcast"
  for the downcast and upcast, respectively, where *Cast* and *GUID* are strings as defined in table 1.
- The metadata and EK80 settings files are located under *"\OBSERVATION_PLATFORMS\TS_PROBE\"*.
- The processed data are organized in LSSS projects under *"\OBSERVATION_PLATFORMS\TS_PROBE\LSSS\"+LSSSproject*
  where "LSSSproject" is the the lsss subdirectory used for the .lsss project files (c.f. Table 1). The LSSS db is placed in
  "\OBSERVATION_PLATFORMS\TS_PROBE\LSSS\LSSS_DB\lsss_DB"

Macroplankton trawling was limited to areas with open water because of safety reasons. Three trawls were eventually taken (Tab. 8). One initial trawl was taken at the beginning of the cruise

before entering the ice-covered part of the arctic ocean. Two additional trawls were taken in the southern part of the transect at stations NLEG 3 (CTD/TS probe station) and at station P1.

Table 8. *Overview of the sampling efforts with the MIK net and the macroplankton trawl.*

Station	Sampling date	Latitude (ºN)	Longitude (ºE)	Sampling gear
N_Trawl	2019-11-30	80.9880	20.0090	Macroplanktontrawl
P7	2019-12-02	82.0494	28.5958	MIK
P6	2019-12-05	81.5342	30.9438	MIK
P5	2019-12-06	80.5317	34.3821	MIK
P4	2019-12-08	79.8370	34.2088	MIK
P3	2019-12-09	78.7490	33.9987	MIK
P2	2019-12-10	77.5000	34.0019	MIK
NLEG3	2019-12-11	77.0094	34.0649	Macroplanktontrawl
P1	2019-12-13	75.9996	31.2190	MIK
		76.0014	31.2028	Macroplanktontrawl

During this cruise, version 5 of the Nansen legacy protocol was followed for sampling and processing the trawl and MIK catches. This protocol differs from the previous version in that the MIK net is the preferred sampling gear and that vertical hauls were taken with it instead of V-hauls. This change was made in an attempt to standardize the results and make them more comparable between stations (both within and outside the ice). The disadvantage of the MIK net is that it tends to under-sample larger, more mobile, species. To overcome this problem, the heaving speed was kept high (1.5 m/s instead of 0.7 in earlier versions of the protocol). In addition, the macrozooplankton trawl was used when possible, to assess the potential for under-sampling by the MIK and to get a more complete overview of the species present. Although the protocol also prescribes that all larger and rare (only a few in the sample) specimens should be removed from the sample and stored separately for later analysis, it was decided to share the fish specimens with colleagues for genetic studies (this is a deviation from protocol version 5). Subsamples of the community and the gelatinous fraction were taken for collaboration with colleagues at UiT.

Figure 11. *Deployment of the MIK net (midwater ring-trawl) at the A-frame of RV Kronprins Haakon.*

Observed general trends

No clear north-to-south gradient was found for the total biomass caught by the MIK net (Fig. 12 A). This is not surprising since the sampling effort (depth of the haul) differed per station. Figure 12B shows that after normalizing for the volume filtered by the net, the biomass concentration in the relevant volume was much lower at P7 (arctic ocean) and P6 (continental slope) than on the continental shelf. However, again these data do not reveal the entire picture. Observations of the echosounder signals during the survey showed that most of the biomass was found in the shallow layer above and around the thermocline. If most of the biomass was concentrated in the upper layer of the water column, increasing the depth of the MIK hauls dilutes this signal. This illustrates the added value of acoustic data to characterize zooplankton abundance. The MIK and trawl sample from P1 had unexpectedly low biomass (based on indications from the TS probe and ship's echosounder). However, a substantial part of the backscatter in the ship's echosounder may have been caused by fish, which may under-sampled by the MIK net. Still, this does not explain the low yield in the macroplankton trawl.

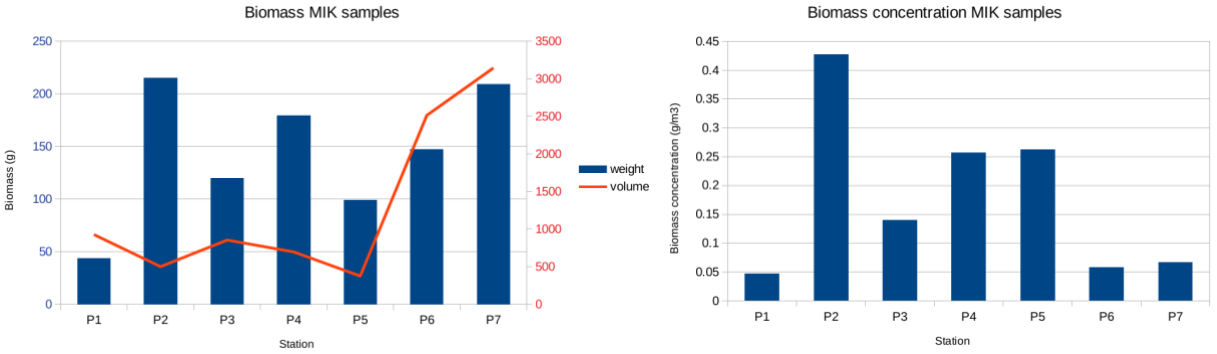

Figure 12. *A: Total mass of the biomass caught and the corresponding depth of the vertical haul with the MIK net per station. B: The biomass concentration per sampling event with the MIK net. Volumes were calculated from the surface area of the ring of the net and the sampling depth as indicated by the red line in panel A.*

Chaetognaths (arrow worms) were abundantly present at all station. At station P7, they were particularly large and were identified as *Sagitta maxima*. Krill was found at all stations, but their relative abundance in the MIK samples varied considerably throughout the transect. The most northern and most southern stations were influenced by Atlantic water and contained *Meganyctiphanes norvegica*. *Thyssanoessa sp.* were found in all samples and were the most dominant krill taxa at the stations on the continental shelf, apart from P1. Regarding amphipods, the samples were dominated by *Themisto libellula in Arctic waters, whereas Themisto abyssorum* seemed more dominant in waters with an Atlantic influence. Another species that was found at most stations was *Clione limacina*.

Chronological overview per station

The N_Trawl station

An initial macrozooplankton trawl was taken north of Svalbard as far to the east as sea ice conditions permitted (no sea ice). This means that a strong Atlantic signal was to be expected in the trawl catch, since this region is strongly influenced by a branch of the Atlantic current turns East around Svalbard at its northern continental slope north. The ad hoc trawl station was called N_trawl.

Fish was collected from the trawl following the methodology as stipulated in the Nansen Legacy protocols v.5.0. No gelatinous zooplankton was found. Larger Cnidaria were not present, and smaller taxa, such as Ctenophora are often heavily damaged and pushed through the meshes of the macroplankton trawl. No particularly rare species were found, and a large fraction of the recovered biomass consisted of krill, chaetognaths and small fish larvae, especially capelin (*Mallotus villosus*). The larger juvenile fish were separated from the bulk, weighed and length measured. Three species of juveniles were identified as *Sebastes sp.*, *Mallotus villosus* (Figure 13), and *Boreogadus saida*. The *Sebastes* specimens were frozen, while the other two species were shared with a colleague for genetic analyses.

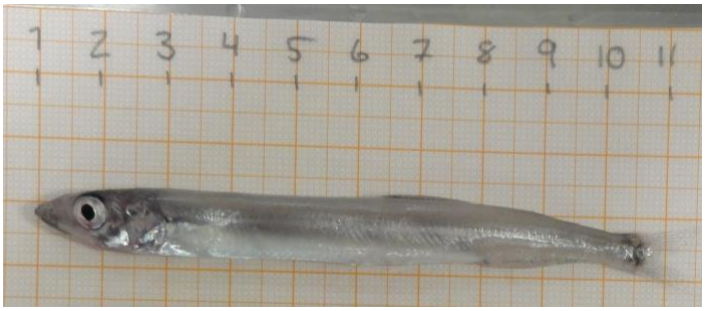

Figure 13. *Juvenile capelin (*Mallotus villosus*) from N_trawl station.*

As can be expected from Atlantic waters, *Meganyctiphanes norvegica* was fond in the sample. The exact species composition will be determined from a subsample that was fixed with buffered formalin 4%.

Process station P7 (Arctic Ocean)

Process station P7 had sea ice with thickness varying between 95 and 120 cm. The MIK net was deployed from the A-frame just after the deployment of the TS probe for acoustic measurements. It was lowered to 1000m depth at a descent speed of 0.3 m/s to avoid that the net would turn inside out or coil up. To reduce the effects of net avoidance behaviour the net was pulled up at a speed of 1.5 m/s. Considering that a heavy weight (~15-20 kg; shackle) was

attached to the cod-end, the ascent was initiated at a lower speed which built up to the final 1.5 m/s in 1-2 minutes. Filtered volumes were calculated based on the wire length.

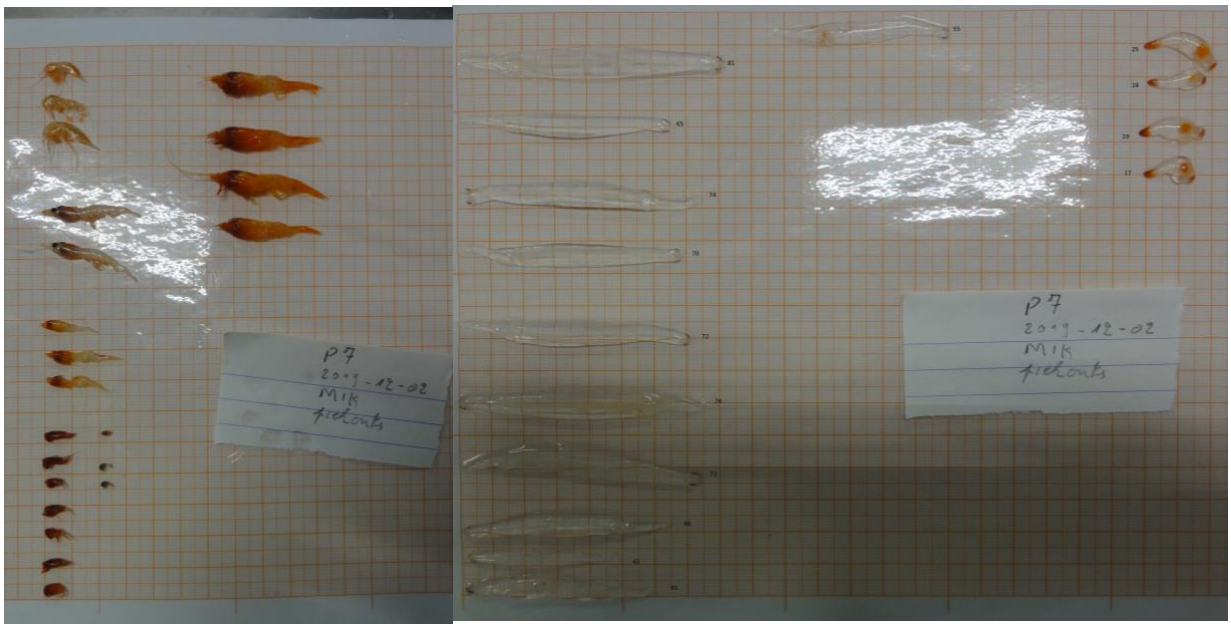

Figure 14. *Size determination of specimens picked out from the MIK sample at P6.*

The biomass that was retrieved from the net consisted for a considerable part of chaetognaths, krill, amphipods (*Themisto sp.* and deep sea species that will be identified later), and gelatinous zooplankton. The gelatinous zooplankton, and rare and large specimens were picked out from the sample to be weighed and measured separately. Among the pickouts were *Sagitta maxima* (large chaetognath), *Himenodora sp.*, isopods that need further identification, and a few specimens of *Clione limacina* (Figure 14). Apart from a surprised *Sebastes* of ~700g, no fish or fish larvae were found in the sample. The *Sebastes* specimen was shared with a colleague. The total biomass without the fish amounted to ~200g. Apart from the gelatinous zooplankton, all pickouts were frozen. The reason that the gelatinous zooplankton was not preserved, is that it was too much damaged by handeling it. For the other stations the net content was put in water after collection, to avoid this damage and to facilitate isolation of the gelatinous fraction.

Process station P6 (slope)

The MIK sample from P6 (800-0 meters sampling depth) contained *Thysanoessa* species as dominant krill taxa, although some *Meganyctiphanes norvegica* specimens were picked out as well. *Themisto abyssorum* was the dominant amphipod. Among the isolated specimens were *Hymenodora sp.*, *Aucerius holmii*, *Clione limacina*, *Cyclocaris guilemi*, *Euchaeta barbata* (to be confirmed), and one *Sebastes* specimen. Gelatinous zooplankton was isolated from this MIK as well. Among the identified species were *Aglantha digitale* and *Mertensia ovum*. Species identification of the gelatinous fraction was done by Anette Wold and Amalie Keck.

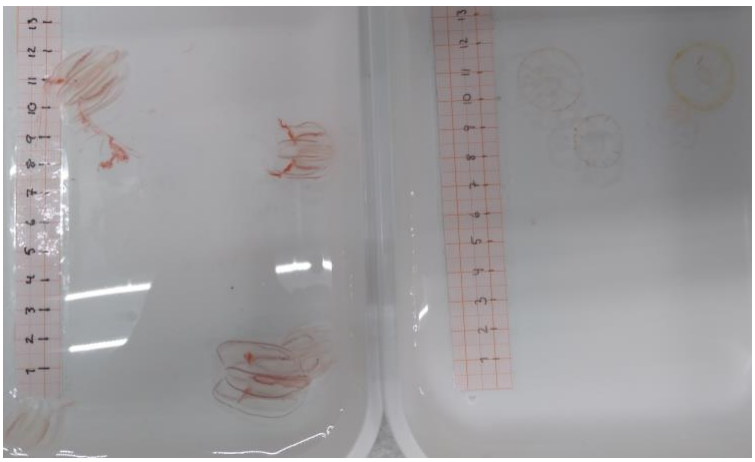

Figure 15. *Selection of Ctenophora from the MIK sample at station P6.*

Process station P5 (continental edge)

At station P5, krill consisted largely of *Thysanoessa inermis*. Presence and contribution of *Thysanoessa longicaudata* (and potentially *Thysanoessa raschii*) will be investigated later on a subsample fixed with buffered formalin. A few Themisto abyssorum specimens were isolated from the sample. The bulk of the amphipods in this sample was *Themisto libellula*. Among the isolates were also two fish larvae that need further identification, *Calanus hyperboreus*, one *Apherusa glacialis* individual, *Euchaeta barbata*, *Paraeuchaeta sp.*, an ostracod, and a number of Ctenophora among which *Aglantha digitale* and *Sarsia* sp. *(Wold and Keck, pers. comm.)*.

Process station P4

The MIK sample of this station showed a high biomass fraction of *Calanus hyperboreus*, *Themisto libellula*, and *Thysanoessa inermis*. It also contained a number of *Clione limacina* specimens. Apart from the gelatinous zooplankton, that is isolated for genetic analyses, no specimens were isolated from this sample, given that all were in sufficient quantities present to take representative subsamples for metabarcoding and fixation in buffered formalin (later species identification). The gelatinous zooplankton represented 8% of the biomass at station 4, and consisted of *Euphysa sp.*, *Beroe sp.* and species that need further identification.

Figure 16*. The complete MIK sample from station P4. The dominant pink colour is caused by Calanus hyperboreus and to a lesser extent by Thysanoessa inermis. The larger amphipods are all Themisto libellula.*

Process station P3

Themisto libellula was by far the largest biomass fraction at this station. Quite some individuals were carrying eggs. A smaller biomass fraction consisted of different species of copepods, *Thysanoessa inermis* and *Clione limacina*.

Process station P2

Process station P2 was similar to P3 in the sense that *Themisto libellula* represented the bulk of the biomass. Within the krill fraction *Thysanoessa inermis* and *T. longicaudata* were identified. In addition, *T. raschii* may have been present, since the typical spine on the tail of *T. inermis* and the longer final tail segment of *T. longicaudata* were not visible in these individuals. Further identification is necessary.

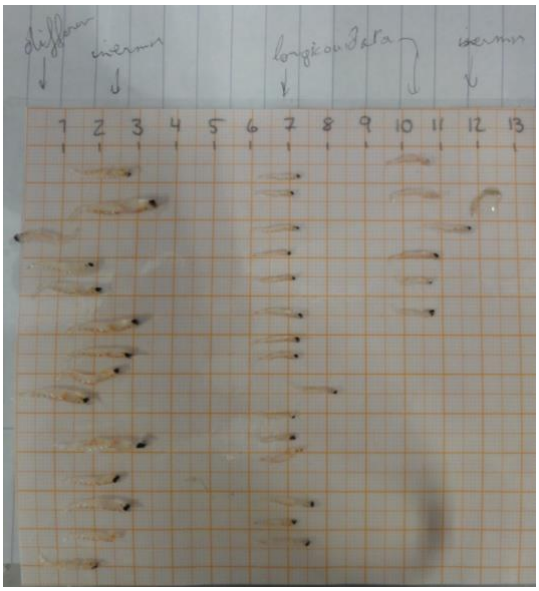

Figure 17. *Thysanoessa spp. isolated from the P2 MIK sample*.

Macroplankton trawl at NLEG 3

At CTD / TS probe station NLEG 3 a macroplankton trawl was taken in the scattering layer at ~100 m. The sample weighed ~5.3 kg and contained among others *Cyanea capillata*, capelin larvae, a number of amphipods that need further identification, and a large fraction of krill (mainly *Thysanoessa sp.*), *Themisto libellula*, *Clione limacina* etc. Gelatinous zooplankton was also isolated from this sample but considering the amount, it was difficult to obtain a qualitative estimate of the weight (difficult to remove all the water).

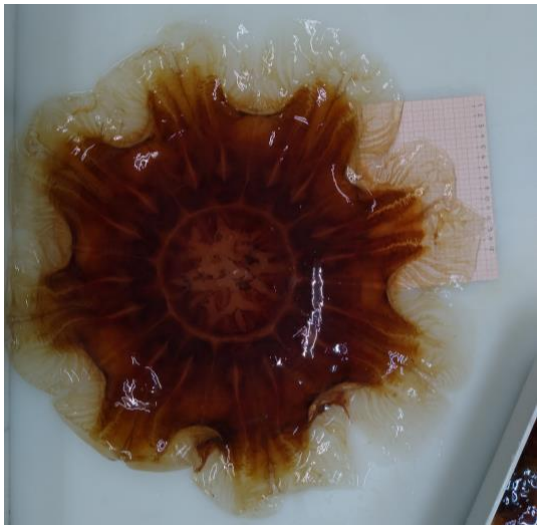

Figure 18*. Largest Cyanea capillata specimen from the macroplankton trawl at NLEG 3.*

Process station P1 (trawl and MIK)

Station P1 was in Atlantic water masses. In contrast to what the echosounder signals suggested, the MIK and trawl catches were modest. *Themisto abyssorum* dominated over *T. libellula*. Both *Meganyctiphanes* and *Thysanoessa* species were present but in low abundance. Among the isolated specimens were two *Pasiphaea* individuals. One of them carried eggs but seemed to be in a bad shape. This will be verified later in the lab. From the trawl, small jellies were isolated which represented 4% of the total weight.

Figure 19. *Pasiphaea sp. with eggs. The eggs seem to suffer from a fungal infection.*

RF3 T3-1.3 Stable isotopes, fatty acids & HBIs of POM, zooplankton & fish

Anette Wold (NPI), Amalia Keck (NPI), Julia Giebichenstein (UiO) and Robynne Nowicki (UNIS)

Purpose

Stable isotopes, fatty acids, and HBIs of POM and main zooplankton taxa will be used to study coupling/de-coupling of sympagic and pelagic primary and secondary producers. In addition, fatty acids (together with C/N ratios) will be used as a measure of food quality for the planktonic grazer communities and will be linked to on board grazing experiment.

Description of work

POM

Stable isotopes, fatty acid, and HBI samples have been taken for POM from the Chl max from stations P1, P2, P4, P5, P6 & P7 and from the bottom 10 cm of the ice core at two ice stations (DEEP ICE & P5 ICE). We filtered between 2-3L from Chl max in order to get enough material, three replicates were taken for each sample type. For the ice core we were restricted to one replicate due to very little biological material.

Zooplankton

Samples for all three parameters were also sampled from the main macro- and mesozooplankton taxa using MIK net 1500 µm and Bongonet 180 µm. This work was done in collaboration with the Ecotox group (Julia Giebichenstein and Robynne Nowicki). Stable isotopes will be analysed by Julia Giebichenstein, UiO while fatty acids and HBI will be analysed by Doreen Kohlbach, NPI. The water mass was quite homogenous at all stations and samples were taken from the bottom to the surface. At some stations additional samples were taken from surface waters if time permitted.

Table 9. *Overview of fatty acid & HBI samples (overview of the stable isotope samples is in the Ecotox section).*

Gear Type	Station	Depth	Taxon
Macroplankton trawl		95m	*Thyssanoessa* spp. *Themisto libellula* *Sagitta elegans*
MIK-net 1500 µm Bongonet 180 µm	DEEP-ICE / P7	1000-0m 500-0m 100-0m	*Calanus finmarchicus* *Calanus hyperboreus* *Paraeuchaeta glacialis* *Cyclocaris guilelmi* *Themisto abyssorum* *Themisto libellula* *Thysanoessa spp.* *Clione limacina* *Sagitta elegans* *Aglanta digitale*
MIK-net 1500 µm	P6	800-0m	*Calanus finmarchicus* *Calanus glacialis* *Calanus hyperboreus* *Paraeuchaeta norvegica*

			Hymenodora glacialis *Themisto abyssorum* *Themisto libellula* *Thysanoessa spp.* *Clione limacina* *Sagitta elegans* *Mertensia ovum* Ostracodes *Eusirius holmii*
MIK-net 1500 µm	P5	120-0m	*Calanus glacialis* *Calanus hyperboreus* *Themisto libellula* *Clione limacina* *Sagitta elegans*
MIK-net 1500 µm	P4	236-0m	*Calanus glacialis* *Calanus hyperboreus* *Themisto libellula* *Thysanoessa spp.* *Clione limacina* *Sagitta elegans*
MIK-net 1500 µm	P2	160-0m	*Themisto libellula*
Macroplankton trawl	NLEG3	100-0m	*Themisto libellula* *Clione limacina*
MIK-net 1500 µm Bongonet 180 µm	P1	300-0m 300-0m	*Aglanta digitale* *Paraeuchaeta glacialis* *Thyssanoessa spp.* *Sagitta elegans* *Meganyotiphanus norvegia* *Themisto abyssorum* *Calanus finmarchicus* *Metridia longa*

RF3 - T3-2.2. Measure how current environmental settings drive the phenology of primary and secondary production, and test how changing conditions may affect these seasonal patterns

Christine Gawinski (UiT) (PI Camilla Svensen, UiT)

The goal of this task is to characterize how current environmental settings drive the seasonality of copepod production. To meet this goal mesozooplankton productivity will be determined experimentally for selected key-species through egg-production/egg-hatching incubations in different seasons, representing species with contrasting life-history traits and reproductive strategies in open and ice-covered waters. Assuming that female copepods allocate their

ingested carbon into egg production rather than into growth, the specific egg production rate can be used as an estimate of the production of the population. The focus during the cruise in November/December 2019 was on *Calanus hyperboreus*, *Calanus glacialis*, *Oithona similis*, *Oncea borealis* and *Metridia longa*. To assess how population dynamics vary across space, egg incubation experiments were set up at three stations, namely P7, representing Arctic conditions (for *C. hyperboreus* and *C. glacialis*) , P4, based on the shelf (for *Oithona similis and Oncea borealis*) and P7, representing Atlantic conditions (for *Metridia longa*).

30 female *Calanus hyperboreus* were collected with a Bongo 64 µm net at station P7 and were incubated separately in 15 ml sterile filtered sea water in small petri dishes at -1.5 °C in situ water temperature. The animals were incubated for a total of 288 hours. Every 24 h the produced eggs were counted and transferred to a new petri dish to check for hatching success. In addition, 20 *C. hyperboreus* and 18 *C. glacialis* of Konrad Karlson's respiration experiment were incubated over 77 hours for egg production. *C. glacialis* was incubated in 70 ml 64 µm screened sea water in spawning chambers equipped with a screened partition that allows the eggs to sink away from the female. After the incubation time, the produced eggs were counted.

30 female *Oithona similis* were collected with a Bongo 64 µm net at P4 and were incubated in 12-well culture plates at -1.5 °C in situ water temperature. At P7 and P1 no females with eggs were found. The experimental animals were photographed in the first 48 h, to determine the prosome length and clutch size of each female. The incubation chambers were checked every 12 h for newly hatched nauplii. In case of a hatching event the exact hatching time and number of hatchlings was noted and the nauplii were removed from the incubation chambers. The duration of the experiment was 156 h. Station P4 was the only station were 16 female *Oncea borealis* with egg sacks were found. These individuals were incubated following the protocol for egg-carrying copepods for 156 h. At station P1 30 *Metridia longa* were collected and incubated at 2 °C in situ water temperature for 72 h following the protocol for free-spawning copepods.
In addition, community samples were taken with a Bongo 64 µm net at station P7, P6, P5, P4 and P1 and fixed in Ethanol to later analyse female-egg ratio. At station P6 numerous nauplii and "sphere"-shaped green balls were found in the water. Samples for DNA analyses were taken and stored in Ethanol.

Preliminary results

At station P7 a total of 70 nauplii hatched from 12 of the 30 female *Oithona* (40 % hatching rate). The maximum number of nauplii per hatching event was 16 nauplii. The earliest hatching event occurred after 12 h and the last hatching event after 156 h.

Calanus hyperboreus showed a hatching success between 33 – 99 %, the average hatching success was 53.5 %. The minimum number produced per female were 84, the maximum 334, with an average of 190 eggs per female. Overall,20 of the 30 females produced 3450 eggs, with one of the copepods producing twice after a period of 10 days. Every day of the 12 days incubation at least one copepod produced eggs. The average hatching time was 8 days, in total 913 nauplii hatched.

All *Oncea borealis* had all their eggs intact after the incubation period of 156 h, without any hatching event occurring.
Metridia longa and *Calanus glacialis* did not reproduce.

The *Oithona similis* and *Oncea borealis* incubations will be transferred to UiT to continue the experiment over Christmas.
The timing of the reproductive cycle will be determined across the annual cycle based on the set of four seasonal cruises, one already conducted in August and two more to come.

Food web interactions

To investigate *Oithona*'s position in the food web, samples for stable isotope and fatty acid analyses were taken at each of the three process stations. At station P7, P4 and P1 three times 50 *Oithona* were picked for stable isotopes and fatty acid analyses and frozen at -80 °C. To investigate a possible top down control of *Oithona* on the microbial food web, a grazing experiment was conducted in collaboration with Lise and Hilde from the University Bergen. In addition to their incubations of 0.8 µm, 3 µm and 90 µm filtered sea water, 20 *Oithona* were added in three replicates to 1 l of 90 µm filtered sea water. To compare the feeding strategies of *Oithona* with that of larger copepods, a treatment with three *Calanus sp.* was added in three replicates. All *Calanus* at station P4 were males. Samples were incubated for 6 days, after which each copepod was removed from the sample to be photographed (size and developmental stage determination, dead/alive). The grazing experiment was performed at two stations, namely P7 and P4, at the same temperatures as the egg incubation experiments (-1.5 °C).

Due to troubles with the incubator that froze half of the samples at station P7, the first grazing experiment failed. Furthermore, the door of another incubator broke off during the cruise but was repaired by the crew. It is to note that the door of the third incubator opens by itself easily and should be secured with tape.

At stations P7 and P6 a grazing experiment on nauplii was set up. In total the grazing impact of 7 potential predators, namely *Metridia longa*, *Oithona similis*, *C. hyperboreus*, *C. glacialis*, *Themisto sp.,* arrow worms and *Paraeuchaeta sp.* on copepod nauplii were evaluated. To do so 3 times 50 nauplii were picked, transferred into 100 ml sterile FSW and one predator (exception 5 *Oithona*) was added. The grazing experiment was run for 48 h and fixed in formaldehyde.
A trial to measure *Oithona similis* respiration was performed together with Konrad, but the animals were too small to see any difference from the control, even when adding 7 animals.

RF3 - T3-3.1; 4.2. Estimate ranges of annual production along environmental and latitudinal gradients (3.1) and Trophic ecology of key zooplankton (4.2)

Angela Stippkugel (NTNU)

Experiments for selective grazing of micro- and mesozooplankton were conducted on board RV Kronsprins Haakon along a south-north gradient in the Barents Sea at three process stations

(P1, P4 and P7) that were assigned as experimental stations. Contrary to the cruise in August 2019 (AeN2019706, SSQ3), the transect was processed from the most northern station P7 to the most southern station P1 due to the final destination Tromsø.

To set up experiments one to two CTD casts were taken from 20 meter depth that was assigned as deep chlorophyll maximum (DCM) alternative: i) 20 liters of seawater were collected for the dilution treatment either from a first CTD cast to prepare 0.2 µm filtered seawater or from seawater that wsa processed by Anna Vader through 0.2 µm filters for metabarcoding and ii) up to 50 liters of seawater were collected from a second CTD cast for four seawater treatments. To prevent delicate organisms from damages seawater was sampled from the CTD by means of the funnel-transfer technique (Loeder et al., 2010) and meanwhile pre-screened through a 180 µm sieve to exclude mesozooplankton. Filtered and unfiltered seawater was stored in ambient temperature until use. In addition, a Bongo net with two times 64 µm mesh sized nets was taken to sample mesozooplankton from the integrated water body (0-100 m) at P7 as well as P4. Due to bad weather conditions, organisms were sampled with a Multinet through the moon pool of KH at P1. The water was sampled for organisms from the bottom to the surface. Due to low catch densities, all depth were pooled except for the upper 50 m, because of contaminations from the vessel. Cyclopoid copepods *Oithona* spp. (mixture of *O. similis* and *O. atlantica*) and calanoid copepods *Calanus* spp. (mixture of *C. glacialis* and *C. finmarchicus*) were selected using a dissecting microscope (Leica M205C) in the chilled room 301 and stored in filtered seawater of ambient temperature thereafter.

Two-point dilution experiments (Morison and Menden-Deuer, 2017) modified after Landry and Hassett (1982) were set-up using the collected seawater from the CTD casts. By means of dilution experiments, the phytoplankton net growth rate μ and the instantaneous growth rate μ_0 excluding the grazing impact of micro- and mesozooplankton can be calculated. As microzooplankton grazing pressure can have a strong influence on the phytoplankton standing stocks (Irigoien et al., 2005), effects obscured by grazing pressure are likely to become visible in μ_0.

Dilutions of 20% were set-up in 2.5 liter carboys that contained a mixture of unfiltered to sterile filtered seawater in a 2:10 ratio. 100% treatments contained undiluted seawater with natural phyto- and microzooplankton communities. In addition, two treatments using 100% unfiltered seawater with i) around 50 *Oithona* spp. and ii) 4 *Calanus* spp. were added as mesozooplankton grazer treatments. The 20% dilution served as a control for phytoplankton growth since the number of grazers is considered as neglectable. A control treatment was added with extra nutrients (f2 medium) to account for nutrient depletion in natural seawater in different seasons.

Incubation bottles were set up in triplicates and placed in a dark cold room adjusted to *in-situ* light and temperatures conditions (between -1.5 to 2 °C). Squared and transparent 2.5 litre plastic bottles were used for the incubations and placed horizontally in a shelve at all stations. Manual rotations from time to time prevented the cells from settling to the bottom. Bottles were incubated for up to 56 hours to account for slow metabolic processes during the polar night season.

Growth rates of phytoplankton will be obtained using pigment measurements and phytoplankton counts. The phytoplankton net growth rate μ will be calculated using an

exponential growth model (Landry and Hassett, 1982). To account for total grazing and selective grazing patterns of micro- and mesozooplankton, pigment samples before and after the incubations will be compared and phytoplankton and microzooplankton cell counts obtained using Uthermöhl sedimentation and inverted microscope techniques. Nutrient concentrations before and after incubations will be measured. In addition to the quantification of prey items and biomass, stoichiometry (C:N:P) will be measured.

T3-1; T3-2 Timing of critical biological processes and phenology of life cycles (3-1), Estimate ranges of annual production along environmental and latitudinal gradients (3.1)

Konrad Karlsson (UNIS) and Janne E. Søreide (PI, UNIS)

Respiration is an important estimate of biological activity and closely connected to the organisms' life history. This experiment is aimed to measure respiration and the main factors that affect respiration on an individual level.
Copepods were sampled from different depths, and with different nets in an unstructured manner (bongo, MIK, multinet, and WP3) to get sufficient number of zooplankton in good health to measure their respiration to estimate their metabolism (activity) and carbon need in winter. Measurements were taken on individual level of five different species of three different life stages: *Calanus finmarchicus*, *C. glacialis*, *C. hyperboreus*, *Metridia longa*, *Paraeuchaeta* spp., and C4, C5 and C6. The copepods were sampled at stations P1, P3, P4, P5, P6, and P7, but most of the measurements were based on individuals from P7. A picture was taken of each individual used for single-individual respiration. From the pictures morphological measurements of prosome length, prosome area, and lipid sac area, will be taken later on. The majority of the individuals were, after the photography, placed in tin cups for later measurements on dry weight and C/N ratio. In addition, individuals were incubated to measure their fecal pellet production, by putting one individual in a flask with seawater. Initially it was planned to measure pellet production on all the individuals that had their respiration measured. However, this experiment was excluded after a while, because, of the 60 first incubated individuals, none of them produced any pellets.
The data analysis will take place during December and January. Here, the aim is to see which covariate that best explains respiration, out of prosome length, prosome area, lipid sac area, species, life stage, station, depth, C/N ratio and dry weight.

RF3, T4-4.1, Molecular characterization of diets of small invertebrates

Snorre Flo (UNIS) with supervisors Anna Vader (UNIS), Bodil Bluhm (UiT), Camilla Svensen (UiT) and Kim Præbel (UiT)

The main objective of the PhD-project is to describe the diets of small meiofauna and mesozooplankton by use of metabarcoding. Since most of the work will be conducted in a laboratory, this report covers only the sampling procedures and some of the rationale behind.

Summary

Sediment samples with benthic meiofauna were obtained from P6, P4 and P2. Sea ice meiofauna were obtained from P7 and P5. Mesozooplankton were obtained from all process stations (P1-P7). Sampled animals were fixed in ethanol and kept cold (-20°C). In contrast to sampling during SSQ3, the pelagic mesozooplankton sample was split in two halves. One half was fixed immediately, and the other was exposed to a 48 h incubation in filtered sea-water to provide a subsample of animals without gut-content. The starved animals are to be used as a control for DNA molecules that are derived from the environment (eDNA) and symbiotic parasites and mutualists.

Targeted organisms

Small copepods such as the cyclopoid *Oithona similis*, harpacticoid *Microsetella norvegica* and calanoid *Microcalanus pusillus* have been identified as candidate species. They occur frequently and abundantly in relevant literature, have different feeding strategies (herbivory, carnivory, detritivory), feeding modes (filter feeding, ambush predatory, particle attachment), yet their diets remain undescribed by means of metabarcoding. Species selection from sea-ice meiofauna are less certain but nematodes (ex. *Cryonema spp.*), rotifers (ex. *Synchaeta spp.*) and harpacticoids (ex. *Tisbe furcata* and *Harpacticus superflexus*) seem likely candidates at the time of writing. From the sediment, nematodes seem the most viable candidates, much due to their dominance in deeper waters, but these species/genera will be chosen at the time of analysis. The full list of preliminary identified candidate species is found in Version 5 of the Sampling protocol. A more comprehensive overview of previous literature on their feeding modes, prey, and gene accession IDs (18S, CO1) can be requested from Snorre.

Sampling of meiofauna

Sympagic meiofauna were isolated from ice-cores at process stations P7 (deep-ice) and P5 (shallow-ice). Ice-cores indended for “Meiofauna” were thawed and meiofauna were handpicked under a microscope by Miriam Marquardt. The samples are to be further analysed at UiT, and shared with the writer at a later date to conduct diet analyses. For benthic samples, three replicates with two scoops of surface sediment (~20 mL) were obtained from stations P6, P4, P2 (only two replicates). Samples were fixed in ethanol (96%) and stored at -20°C. Benthic meiofauna will be identified and analysed at a later stage.

Sampling of small mesozooplankton

Small mesozooplankton samples were obtained by vertical hauls using a Bongo-net (64 µm). The hauls were started as deep as possible, but at 1000 m at the P7 deep station. Approximately half of the sample was immediately sieved on a 64 µm mesh, and large zooplankters were picked from the sieve and discarded. The sample was fixed in ethanol and stored cold (-20°C). The other half was transferred to a sorting tray, in which all large zooplankton were handpicked and discarded. The remaining solution was transferred to an acid-

washed glass bottle, filled with sterile filtered seawater (FSW, 0.22 µm) and incubated for 48 hours in darkness and approximately *in situ* temperature (~0.1-1.0°C). After incubation, the sample was filtered across a 64 µm mesh, fixed in ethanol (96%) and stored at -20°C.

C. finmarchicus spinoff-project

A spinoff-project was initiated after observations by ROV and shallow net-hauls indicated that the under-ice meseozooplankton community of P7 were highly active, and possibly feeding. The principal component of this community appeared to be *C. finmarchicus*. Thus, *C. finmarchicus* were sampled from the upper 50 m surface layer at P7. 100 individuals were isolated for gut-content (GC) analysis in pools of 5 individuals per replicate (20 replicates). An additional 30 individuals (6 replicates) were transferred to small glass vials (25 mL) with sterile FSW (0.22 µm) for a gut evacuation incubation (48 h, 0°C, darkness). After 48 h, starved individuals were isolated in ethanol (96%) and stored at -20°C. Incubation-water from each replicate was filtered over Sterivex filters (0.22 µm) to capture evacuated organic matter (i.e. gut content DNA). Sterivex filters were sealed and stored at -80°C. A separate protocol has been prepared and may be requested from Snorre.

RF3 - T3-2.2; 4.4. Measure how current environmental settings drive the phenology of primary and secondary production, and test how changing conditions may affect these seasonal patterns (2.2) and Sympagic-pelagic-benthic coupling (4.4)

Yasemin V Bodur and Martí Arumi-Amargant (UiT)

Tasks T3-2.2 Measure how current environmental settings drive the phenology of primary and secondary production, and test how changing conditions may affect these seasonal patterns and T3-4.4 Sympagic-pelagic-benthic coupling

Sediment trap deployment and sampling

To assess the vertical flux at the P-stations along the cruise transect, short-term sediment traps (KC-Denmark) were deployed 48 h (Table 10). Due to the bad weather conditions and limited station time, only 3 deployments could be accomplished. At P7, 4 trap cylinders (1.8l volume) were deployed at 30, 60 and 200m and 2 cylinders at 40, 90 and 120m, respectively (Figure 1). At P7 and P4, bottles for the assessment of primary production were deployed at 5, 20, 40, 60, 90m and Chl a max (see report from M. Amargant-Arumi). Due to the shallow depth of P4, no cylinders were deployed at 200m and 4 traps were deployed at 120m. Prior to the deployment, the cylinders were filled with filtered deep water (below 200m) from the corresponding station or from a prior station to make sure that the water within the cylinders had a higher density than at the sampling depths. An anchor of 35kg was fixed to the bottom of the mooring to keep it upright in the water column. To keep the traps neutrally buoyant in the water, 3 large buoys were attached at 10 and 5m (Figure 20). A flagged pole equipped with an AIS beacon was used to mark the location of the mooring and to relocate its position for recovery. A small buoy with a long rope was attached to the pole for the recovery of the mooring. At all stations a chain was

added between 10 and 5m to protect the rig from sea ice, while at P7 and P5 the mooring was deployed on an ice floe where it was attached by an additional chain on two metal poles that were hammered into the ice (Figure 21). On P5, the sediment trap was deployed by hand with a tripod in a pre-drilled hole in the ice.

Table 10. *overview of sediment trap stations during AeN SSQ3 with deployment and recovery time, and the total time of deployment. * the cylinders from 90 and 120m depth got mixed up during the sediment trap retrieval, therefore one sample is a 50:50 mixture between 90m and 120m depth, and the other sample was reduced to half of the original volume.*

Station	Deployment time	Recovery time	Total time of deployment	Deployment conditions	Deployment depths (m)
P7	01.12.2019 23:45	03.12.2019 17:30	41 h 45 min	On an ice floe	2 cylinders: 40, 90, 120 4 cylinders: 30, 60, 200
P5	07.12.2019 00:30	07.12.2019 12:45	12 h 15 min	Underneath the ice	2 cylinders: 20m 4 cylinders: 5, 10, 30
P4	08.12.2019 03:44	09.12.2019 07:30	27 h 46 min	Under ice conditions, in the water	2 cylinders: 40, 90* 4 cylinders: 30, 60, 120*

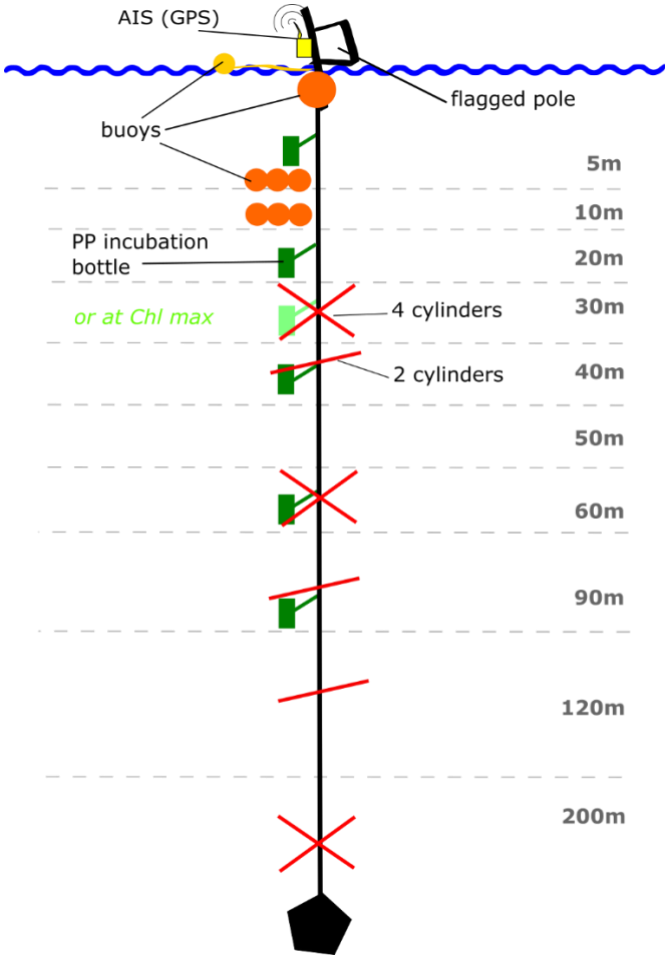

Figure 20. *Scheme illustrating the structure of the mooring and the sampling depths of the sediment traps at open water conditions. At 30m, incubation bottles for primary production were deployed when the Chl a max was already covered at another depth.*

Figure 21. *Deployed sediment trap under ice conditions (left) and on an ice floe (right) during SSQ3 in August 2019.*

Sampling largely followed the Nansen Legacy sampling protocol version 5, chapter 8. Upon recovery of the sediment traps, the cylinder content of each depth was pooled and partitioned (unfortunately, at P4 the cylinders from 90m and 120m got mixed up). From each depth, water was filtered for triplicate POC/PON analyses on pre-combusted GF/F filters and for size

fractionated algal pigments (total Chl a (in triplicates on GF/F filters) and Chl a >10µm; on Polycarbonate filters) and water samples were taken for microscopic counts of fecal pellets and phytoplankton communities. Filters for algal pigments were immediately stored in Ethanol at 4C and measured with a fluorometer on board ideally after 12-24 h. Fecal pellets were preserved in a hexamine-buffered 4% Formaldehyde solution and phytoplankton communtities in GA-Lugol. At 30, 60 and 200m depth additional triplicate samples were filtered for stable isotopes (pre-combusted GF/F) and single samples were filtered for particulate biogenic silica (bSi; on 0,8µm polycarbonate filters), HPLC and IP25 analyses (GF/F). Approx. 500ml was filtered for DNA analyses through sterivex filters. DNA, IP25, HPLC and stable isotopes samples were stored at -80C. POC/PON and bSi were stored at -20C.

RF3 - T3-1.1; 1.2; 4.3; 4.4. Characterize and quantify biota in the seasonal ice zone (1.1), relate environmental conditions to biological communities (1.2), and explore the sympagic-pelagic-benthic coupling and trophic ecology of benthos (4.4)

Arunima Sen (Nord University), Eric Jorda Molina (Nord University), Thaise Ricardo de Freitas (UiO) and Silvia Hess (UiO)

During Q4, our team contributed primarily to the Nansen Legacy RF3 tasks T3-1 and T3-4, specifically T3-1-1, T3-1-2, T3-4-3 and T3-4-4. The gear used to collect samples included a demersal Campelen trawl and a box corer (50 x 50 cm).

Aims

The aims of the group were to:

1. ***T3-1-1: Characterize and quantify biota in the seasonal ice zone*** of the northern Barents Sea and adjacent Arctic Basin by sampling sediment communities for biodiversity and abundance/biomass assessments; specifically microbes (PI Lise Øverås, UiB), benthic foraminifera (PIs Elisabeth Alve, and Silvia Hess UiO, with PhD student Thaise Freitas), multicellular meiofauna (PI Bodil Bluhm) and macro-infauna (PIs Paul Renaud, APN and Henning Reiss via PhD student Eric Jorda Molina, Nord University).
2. ***T3-1-1: Characterize biota in the seasonal ice zone*** by collecting voucher material of benthic macro- and megafauna to be archived at the UiT Museum for a legacy of physical material of the project (PIs Bodil Bluhm, Andreas Altenburger UiT)
3. ***T3-1-2: Relate environmental conditions to biological communities*** by sampling for sediment properties (grain size), indicators of food availability (total organic carbon and nitrogen, sediment pigment amount) and food sources (▪^{13}C/▪▪^{15}N, pigment composition) (PIs Elisabeth Alve and Silvia Hess, UiO and Paul Renauld, Akvaplan-niva)
4. ***T3-4-4: Sympagic-pelagic-benthic coupling*** by sampling representative benthic invertebrate taxa and demersal fishes for stable carbon and nitrogen stable isotope analysis (PIs Bodil Bluhm, UiT and Lis Jørgensen, IMR, for shared PD to be hired)

5. ***T3-4-4: Sympagic-pelagic-benthic coupling*** by conducting sediment community respiration incubation experiments onboard (PI Paul Renaud, APN, with PD Arunima Sen and PhD student Eric Jorda, Nord Univ.)
6. ***T3-4-4: Sympagic-pelagic-benthic coupling*** by sampling sediment for IP_{25} analysis and biogenic silica as indicators of ice algal food available to the sediment communities (PI Marit Reigstad with PhD student Yasemin Bodur, UiT).
7. ***T3-4-4: Trophic ecology of benthos*** by sampling benthic meiofauna for molecular characterization of diets of small benthic invertebrates (PI Anna Vader, with PhD student Snorre Flo, UNIS/ UiT).
8. ***RF1 T1-3: To help to interpret changes in sea-ice distribution, paleoproductivity, and related environmental conditions during the past 2 kyrs*** by using results gained by living benthic foraminiferal assemblage and associated parameter analyses of surface and sub-surface sediments (Elisabeth Alve with Thaise Ricardo de Freitas and Silvia Hess)
9. ***RF2 - T2-1.2 Ocean acidification effects on the mobility of particulate and dissolved organic carbon (POC, DOC), essential trace elements (micro nutrients) and heavy metals*** by sampling sediment sub-samples for trace element analysis by sequential
   sediment extraction (PI Murat Ardelan with PhD Stephen Kohler).

Sampling sites and strategy

Sampling largely followed the Nansen Legacy sampling protocol version 5. We sampled demersal fish and epibenthos at a site south of P2 and P1 from a single ~15 min Campelen 1800 trawl haul. Bottom trawl sampling at P7, P6, P5, P4, P3, and P2 was not possible due to sea ice appearance. Details on the trawling procedure are described in the fish section of protocol version 5. Benthic organisms were picked from the trawl haul both on deck and in the fish lab, identified to the highest practical taxonomic resolution, and either frozen (for later stable isotope analysis and wet weight-to-carbon analysis), or fixed in formalin or 70% ethanol (for the museum collection, depending on taxon), or 96% ethanol (to allow later molecular analysis of museum archived specimens).

Sampling for sediment parameters, organismal abundance and diversity was done at stations P2, P4, and P6 using a 50 x 50 x 50 cm giant box core (owned by APN). At all these sites three box core replicates were taken for further sub-sampling; except for P2 where only 2 successful box corer deployments were recovered. Sediment cores for respiration experiments were collected at P4 and P6.

Station P7 (3.-4. December 2019)

Four box core deployments failed at P7 due to technical problems (unclosed box corer) and sediment conditions. In approx. 15 cm sediment depth a coarse and compact gravel layer prevented a deeper box corer penetration and longer sediment recovery (Fig. 22). Due to the coarse sediment at the box core base, the core was not properly closed/sealed and the surface water and sediment was washed out. No quantitative sediment samples were taken; the entire disturbed surface area was scooped off, washed and preserved for stable isotope analysis of

specific macrofauna (>1 mm) taxa. The location for box coring for P7 was not exactly the same as in the cruise Q3 and some patchiness in the sediment structure in the deep basin around P7 might be the responsible for having had failure of good samples during Q4. For the next cruises Q1 and Q2 we suggest trying to sample at the same exact location as during Q3 for P7.

Figure 22. *Gravel layer at the base of the box core at site P7. The surface water drained off and the sediment surface layer was disturbed. No quantitative sampling was done.*

Station P6 (5.-6. December 2019)

Three box core replicates were successfully recovered. While bringing the corer of the first deployment on board, it was banging against the boat back. This resulted in turbid surface water. Sediment surfaces of deployment 2 and 3 were perfectly preserved had clear surface water on top and some macrofauna was visible (Fig. 23). Sediments were light brownish, soft and fine grained.

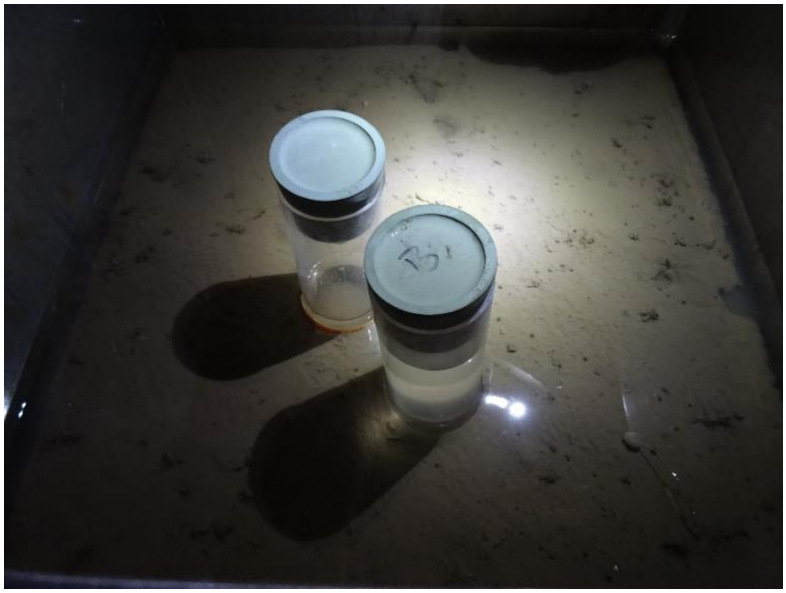

Figure 23. *Sediment surface of box core 2 at site P6.*

Microbes were sampled in replicates of three (one per box core) with a 4.7 cm diameter core and sectioned into 1 cm layers up to 6 cm. The center of each section was taken out with a 60 ml syringe and the sediment placed into a sterile whirl pack bag and frozen at -80°C. The rest sediment of each section and the lower part of the sub-core (>6 cm core depth) were stored in separate sterile whirl pack bags and kept in a fridge for on-board single cell extraction by Lise Øverås (UiB).

Benthic foraminifera and multicellular meiofauna were sampled in replicates of three with a 5.5 cm diameter core, sectioned into 1cm-layers down to 6 cm core depth, placed into Joni containers and preserved with rose Bengal stained 70% ethanol (2g rB per liter) and stored at room temperature.
Four sediment cores (11.7 cm inner diameter) were taken from each replicate core for incubation and measurement of bulk respiration rates. After the incubation experiment these cores were washed for macrofauna analyses through a 0.5 mm sieve and preserved in 4% formaldehyde seawater solution.

Sediment grain size, TOC, TN and $\delta^{13}C/\delta^{15}N$ samples were sampled in bulk using a 5.5 cm diameter core sectioned into 1cm-layers down to 6 cm in each of the three replicate cores. Samples were immediately stored at -20°C.

Sediment pigment (chlorophyll a, phaeopigments) samples were taken from a 4.7cm sub-core sliced down to 6cm in 1cm-slices and from there on in 2cm-slices down to 10cm core depth. Samples were wrapped in aluminum foil and stored in a -20°C freezer.
To assess pigment composition using HPLC analysis, a single sample from each box core was taken from the 0-2 cm layer using a 60 ml syringe and stored wrapped with aluminum foil at -80°C as part of a collaboration with the CHAOS project in the UK's Changing Arctic Ocean program.

A surface sediment sample (0-1cm) was taken for IP25 analysis with a 60 ml syringe and stored at -80°C.

One surface scrape each was taken for molecular analysis of diets of selected meiofauna taxa (stored in 96% ethanol at -20°C), and for trace metal analysis from each box core.
Three samples from a single box core were taken from the 0-2 cm layer using a 60 ml syringe and stored wrapped with aluminum foil for incubation of diatom spores (Marti Amargant).
Two spoonful of the sediment surface was scraped off and placed into 15ml falcon tubes and stored at -20°C for measuring trace metals from each replicate box core.
A single sample from each box core replicate was taken from the 0-3 cm layer using a 60 ml syringe. One-centimeter sections were made and placed into Ziploc bags and stored at -20°C for analysis of biogenic silica.

The remaining surface area was sieved through 1 mm mesh and organisms retrieved (mostly polychaetes) were identified to family level where possible and frozen at -20°C for later stable isotope analysis.

Station P4 (9. December 2019)
Three box core replicates were successfully recovered after four deployments. Sediment surfaces of all replicate cores were well preserved, had clear surface water on top and some visible macrofauna (Fig. 24). Sediments were light brownish down to 3 cm core depth. Sediments below were gray and stiff. Many long polychaete tubes from Spiochaetopterus were present in all replicate cores.
Replicate cores were sub-sampled in the same way as at site P6. A new incubation experiment was set up.

Figure 24. *Sediment surface of box core 2 at site P4.*

Station P2 (11. – 12. December 2019)

Two box core replicates were successfully recovered after five deployments. Sediment surfaces of both replicate cores were well preserved, had clear surface water on top and some visible macrofauna (Fig. 25). Sediments were light brownish down to 4-5 cm core depth. Sediments below were gray and stiff and slightly sandy.

Replicate cores were sub-sampled in the same way as at site P6. No cores were taken for incubation experiments. Instead macrofauna cores were directly sieved (>500 µm) and fixed in 4% formaldehyde seawater solution.

Figure 25. *Sediment surface of box core 1 at site P2.*

Station P1 (13. December 2019)

Three box core deployments were conducted at P1. Due to rough sea conditions and high waves the box corer penetrated the sediment at an angle instead of perpendicular to the sediment surface. This resulted in tilted and disturbed sediment surfaces. Surface water was turbid and rocks and grey clay from the underlying glacial sediments were visible on the surface. Additional attempts to collect sediment material were cancelled due to inappropirate weather conditions (Fig. 26). No quantitative sediment samples were taken; the entire disturbed surface area was scooped off, washed and preserved for macrofauna analysis (>1 mm) taxa.

Figure 26. *Disturbed sediment surface of box core 1 at site P1.*

Respiration incubation experiments

Sediment incubations for measuring bulk respiration rates were conducted with sediment retrieved from stations P4 (330 m depth), and P6 (900 m depth). Both stations had sea ice at the water surface.

At each station where incubations were conducted, about 100L of CTD water was collected early during activities at the station from the bottom and kept in the cold rooms in the dark to keep them at the temperature at which the incubations were conducted. The CTD data from both this year and the year prior were used for determining the temperatures at which incubations would be conducted. Negative temperatures were not possible to achieve in the designated cold rooms, therefore experimental temperatures did not completely match in situ conditions, however, we attempted to mimic seafloor conditions as much as possible while also maintaining observed inter-station variability. One treatment was maintained at ambient water conditions: Treatment 1 (T1). At P6, this treatment was maintained at about 0°C and at P4 temperature was maintained at about 0.5°C. Additionally, one treatment (named treatment 3 or T3) was maintained at higher than ambient temperatures: at P6, temperature was maintained at about 2°C above ambient conditions and at P4, this treatment was maintained at about 4°C above ambient conditions, to simulate expected warming conditions. For each treatment, 6 replicate cores were maintained.

At P6 and P4, 6 sub-cores (sub-cores were 11.7 cm in inner diameter) were inserted into the sediment of the three box cores, filled with bottom water from the CTD and kept in the appropriate cold rooms. Cores were bubbled for 6 hours to saturate with oxygen following which 15-20 ml of overlying water was taken for quantifying nutrients. Core tops with magnetic stir bars were fixed on, removing air bubbles and connected to electric transformers to keep the bars stirring in order to avoid stratification of the water in the cores. Oxygen measurements were taken every 6 hours via the PreSens Fibox 4 optical sensor system. Experiments were terminated about 66 hours later when oxygen concentrations had decreased. Upon termination,

nutrient samples were taken once more from the overlying water. Cores were sieved on a 0.5 mm sieve and all macrofauna retained were fixed in 4% formaldehyde and rose Bengal. Sediment cores for respiration incubations were given a UUID through the system, but no labels were generated since these cores did not have a physical form after incubations were terminated. However, macrofauna samples, nutrient samples and meiofauna samples (post-incubations) were taken from these cores and all these samples had UUIDs and appropriate labels, with the parent UUID being the generated, but label-less UUIDs for the incubation cores.

Macrofauna observations

Epifauna

Trawls were not quantitatively analyzed during Q4. However, we noticed some differences in the epifauna collected by the trawls at P1 and P2. *Pandalus borealis* and *Sabinea septemcarinata* shrimp were highly abundant at both stations. The sea cucumber *Molpadia borealis*, soft corals from the family Nephtheidae (*Gersemia* sp. likely), *Ctenodiscus crispatus,* sea urchins and pycnogonids were more abundant at P1. Polychaetas from the family *Flabelligeridae* (*Brada* sp.) and gastropods (mostly Buccinids) were more abundant at P2.

At the two shelf sites (P2 and P4), polychaete tubes of *Spiochaetopterus sp*. were visible on the surface and extended into the clay layer. At shelf stations (P2 and P4) representatives of the polychaete families Lumbrineridae, Maldanidae, Nepthydae and Spiochaetopteridae were quite abundant. Different types of Bryozoans were also present at some cores along the shelf. At P4, a nudibranch and a large brittle star were even recovered in the box cores and used in the respiration experiments.

At the slope at P6, the sediment surface contained clumps of sponge spicules similar as it was found during the cruise Q3 in August 2019. Spionidae polychaetes were also present together with Maldanidae, Ampharetidae and Trichobranchidae individuals. At station P7 the macrofauna observed after sieving with 1 mm sieve was much less abundant than in all other stations, as it was the case during cruise Q3. In this station some representatives of the family Ampharetidae and Terebellidae were present in the samples, as well as 1 individual of the family Opheliidae.

Table 11. *Overview of stations sampled for each of the different activities. Numbers in parentheses indicate number of sediment layers.*

				Station / number of replicates / treatments for incubation						
Sample type	Task	PI/responsible	Institution	P1	P2	P3	P4	P5	P6	P7/Deep Ice
Sediment microbes	T3-1-1	L. Øvreås	UiB	-	2 (6)	-	3 (6)	-	3 (6)	-
Meiofauna	T3-1-1	E. Alve	UiO	1 (1)	2 (6)	-	3 (6)	-	3 (6)	1 (1)
Macrofauna	T3-1-1	P. Renaud/H. Reiss, E. Jorda	APN / Nord	2 (top 5 cm of whole box core)	8	-	12	-	12	1 (top 5 cm of whole box core)
Museum vouchers	T3-1-1	B. Bluhm	UiT	11	11	-	-	-	-	-
Grain size, TOC/TON, d13C/d15N	T3-1-2	E. Alve	UiO	-	2 (6)	-	3 (6)	-	3 (6)	-
Sediment Chl / phaeopigments	T3-1-2	P. Renaud	APN	-	2 (8)	-	3 (8)	-	3 (7, 6, 8)	-
Sediment pigment compositon	T3-1-2	P. Renaud / UK CHAOS	APN	-	2 (1)	-	3(1)	-	3 (1)	-
Organisms ☒^{13}C/☒^{15}N	T3-4-4	B. Bluhm / L. Jørgensen	UiT / IMR	-	16 taxa	-	21 taxa	-	7 taxa	-
Incubation experiments	T3-4-4	P. Renaud / A. Sen	APN / Nord	-	-	-	2 T/6 R	-	2 T/6 R	-
Nutrients pre-incubations	T3-4-4	P. Renaud / A. Sen	APN / Nord	-	-	-	2 T/6 R	-	2 T/6 R	-
Nutrients post-	T3-4-	P. Renaud / A.	APN / Nord	-	-	-	2 T/6 R	-	2 T/6 R	-

incubations	4	Sen									
Sediment IP_{25}	T3-4-4	M. Reigstad / Y. Bodur	UiT	-	2 (1)	-	3 (1)	-	3 (1)	-	
Meiofauna molecular diet	T3-4-4	A. Vader	UNIS	-	2 (1)	-	3 (1)	-	3 (1)	-	
Trace metals	RF2	M. Adelan / N. Sanchez	NTNU	-	2 (1)	-	3 (1)	-	3 (1)	-	
Biogenic silica	T3-4-4	Y. Bodur/ M. Reigstad	UiT	-	2 (3)	-	3 (3)	-	3 (3)	-	

RA-C

AUV operations and risk in the Arctic

Tore Mo Bjørklund (NTNU), Ruochen Yong (NTNU)

Autonomous Underwater Vehicle (AUV)

The objective is to develop and test adaptive algorithms for marine robots in the arctic. The goal of the algorithm is to search for and map temperature gradients, here the polar front was the ideal testing ground. Due to heavy weather and ice conditions in the polar night, there was not a chance to deploy the AUV near the polar front. There was however, a chance to deploy the AUV in Ullsfjorden, near Tromsø (69N 58.679 20E 06.141) on the 16th of December at 13:12 UTC. The mission failed after 31 minutes and two dives due to an unrejected outlier in the Doppler Velocity Logs (DVL) measurement of the vehicles altitude above the seabed. The adaptive planner on board behaved as expected. The work boat on board KPH was used for deployment, and the MOB boat was used for recovery due to overheating of the workboat engine. It was found that neither of the boats were well suited for AUV operations, as their deck space is limited. In addition, they are located on the 4th deck, while the vehicle was kept at 3rd deck. This led to the need for a crane operation in order to get the AUV on board. After recovery, the AUV was carried by hand throught the interior of KPH, this proved unpractical.

Risk analysis of AUV operation

Another objective is to get experience of operating AUV in the Arctic area (harsh environment) and analyze the risk issue that may occur during the AUV operation in this environment.
It is planned that the AUV mission is conducted in the station P1/P2; however, due to the big wave and other bad weather factors (strong wind and low visibility), the task is canceled. The AUV mission is finally conducted in Ullsfjorden, which is close to Tromsø. The LAUV Harold is not equipped with the recovery device on board, and there is no diver platform on the R/V Kronprins Haakon, so the release and recovery of the AUV has to be deployed with the help of small boat. The main risk issues considered in the station P1/P2 is the weather condition. The wave in the P1/P2 was 3-4m, and the swell was also unacceptable for the deployment of the small boat. In addition, since the cruise is in December, there is no daylight during the deployment, which is challenging for the small boat deployment. The low visibility during operating small boat can lead to inappropriate path selection, which can also increase the risk of mission.

The AUV mission in Ullsfjorden starts from around 13:10, December 16, 2019. The R/V was stopped and stayed still against the wind and wave, providing relatively good environment. Two researchers together with two crews were on the small boat, and the whole mission was around 1 hour including test and real operation. The mission fails due to the mistakes when measuring the altitude of AUV above the bed. The fault log will be recorded for the further risk analysis. In addition, due to the high temperature of the engine of the work boat, the deployment met some problems during the release of the AUV, this may pose risk on the AVU mission.

In general, the issues considered in this AUV operation include weather condition, the interaction between R/V and work boat, the AUV itself and also the operator's control.

Eyeball Remotely Operated Vehicle (ROV)

An eyeball ROV was deployed under the ice at P7, on the 2nd of December, approximately 15:00 UTC. Video footage was captured down to 50m depth.

Acoustic Zooplankton and Fish Profiler (AZFP)

An AZFP was deployed from the ice along with a sediment trap near P7(82N03.79 29E04.35) on the 1st of December at 22:30 UTC. It was left drifting with the ice until the 3rd of December 16:00UTC, the time of recovery. In the acoustic data the sediment trap is clearly visible, see Figure 29.

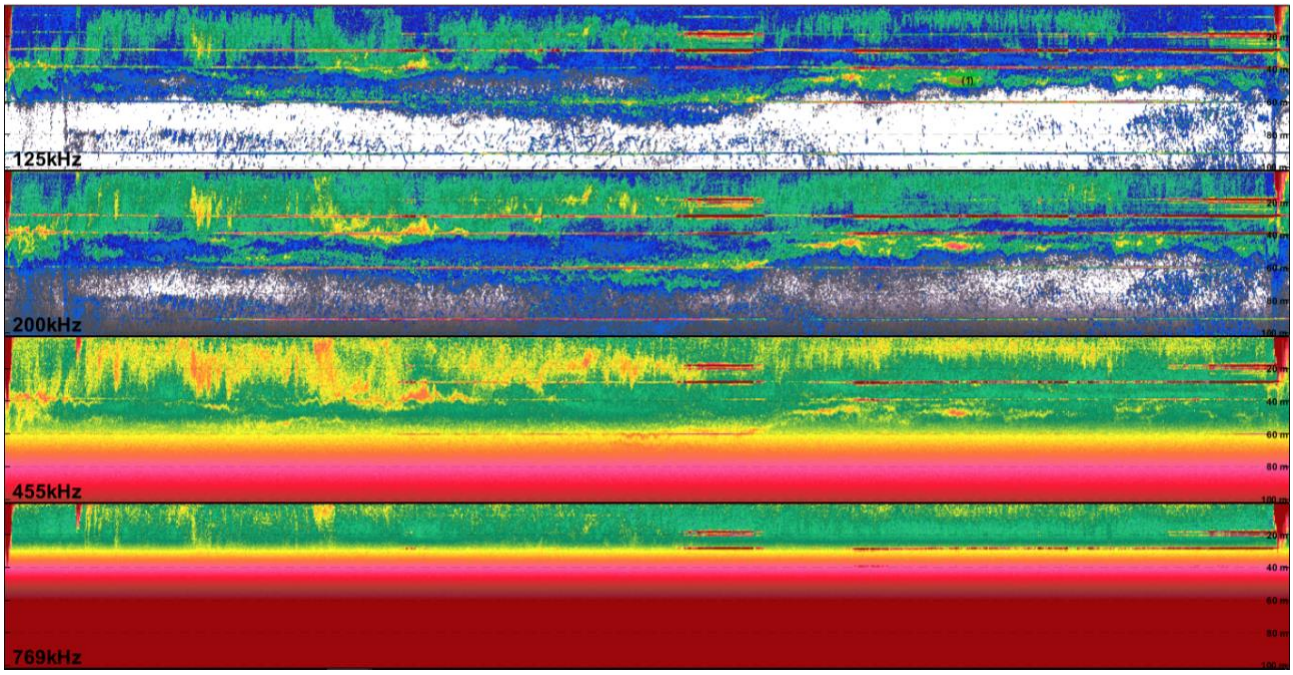

Figure 27. *AZFP acoustic data from all four channels (125, 200, 455, 769 kHz). Deployed for 41 hours in the arctic ice between the 1st and 3rd of December 2019.*

LOGISTICS

Transport of equipment and samples

The logistic team of the Nansen Legacy project, Håvard Hansen and Simon Bjørvig, provided a guideline well ahead of the first cruise with information and deadlines for sending equipment to cruises, and for return of equipment, cooled samples and frozen samples (-20°C and -80°C). Prearranged transportation helps on both efficiency and costs prior to and after each cruise.

Equipment was shipped to Longyearbyen with Bring, and loading the ship in Longyearbyen went smooth and efficient resulting from well-planned work, and good collaboration between the logistics team, the crew and the scientists in Longyearbyen. The Nansen Legacy seasonal Q4

team leaders helped on deck to direct the pallets to the right deck, and cruise participants carried the boxes to the designated labs.
Shipping of samples that required cooled or frozen transport was ordered in advance, including dry ice for transport of frozen samples (-80°C). To be picked up at arrival in Tromsø.
Pallets belonging to UNIS and NPI in Longyearbyen were shipped back with Bring Cargo.

On board communication

Based on the experience from last year cruises, a key task was to address challenges in keeping people updated on ongoing and planned activities, and to keep the station activity plan updated with respect to timing and progress. The vessel is large and the distance from the instrument room at Deck 7 to Deck 3 is long. At Q4 we copied the onboard communication done successfully during the Q3 cruise. Unfortunately, we only had one ship radio available during the Q4 cruise and not two as during the Q3 cruise due to radios being broken.

- Cruise leader and co-lead had 6 hrs shifts to always be present, and to meet often enough to discuss program and respond to any issues regarding practical or overarching character. They planned the overall timing of cruise activities, station work, posted programs and adjusted activities when needed, and had close communication with the bridge, instrument personnel, crew and scientists.
- Station programs were posted and available on all screens in due time, updated continuously, and facilitated good preparations from crew and scientists, and efficient sampling on each station.
- Daily meetings were held after dinner for short science presentations of ongoing work from scientists and cruise leaders, and to share practical information regarding science work, social life and routines onboard.

Station programs

A station program was prepared in Excel, published as a web page on the khfelles-server and updated continuously. This program was available on HDMI13 on the TV screens in all common rooms, on the bridge, labs and cabins. Each screen had to be updated manually (remote control). Adjustments to the program were done in Excel and published as a web page which was updated every 30 sec. Activities were marked green when finished, or red if cancelled or postponed to a later time slot in the program due to technical problems. The availability of plans ~24 hrs ahead and regular updates, resulted in efficient sampling and work during the cruise, as both crew and scientists could plan and prepare for sampling activities, handling of sampling and rest. Helping hands were also provided from those knowing they had some available time in the program. The ability to plan the work was well received on the bridge, among the crew and the scientists. A very handy tool since the program could quickly change due to technical problems with sampling equipment or problems with sea ice in the moonpool etc switching to another task to not lose valuable wire time.

Water budgets

Water budgets were planned in advance to optimize the utilization of the bottles on the rosette. Parameters were distributed on the different CTD casts to optimize co-sampling for related parameters, and early sampling for water needed for experiments. On deep water stations (>3000 m), all deep-water requests were given priority on one CTD cast to avoid repeated CTD to the sea floor.

Sea ice work

Sea ice work were organized to optimize sampling efficiency, and the entire group helped out to support the sea ice team through handling samplings in lab, assisting on the sea ice and as polar bear guards on ice or watches on bridge. Most participants during the Q4 cruise was familiar with sea ice work which was important since at this cruise it was pitch dark 24 hrs.

Sample and data management for legacy

Routines for labelling and logging of samples and metadata for Nansen Legacy were established in 2018 and was well tried out at the previous seasonal Q3 in August 2019. The essential part of this system is that all samples and datasets are labelled with a UUID, and all information about each sample is logged in an excel sheet containing all relevant metadata and standardized parameters. The UUIDs are printed on stickers that can be attached to the samples. The stickers are available in different sizes. Two label printers were set up with a virtual server on the network onboard, so that they could be accessed from both stationary and personal computers. The excel sheet used for logging of sample information is generated using an excel template generator which was made available on the same virtual server along with an excel file checker, UUID generator and relevant documentation (the labelling manual, sampling protocol v4, and lists over the gear and sample types used in the project).

Universally unique IDs (UUIDs) for the individual gear used was assigned by one scientist. Metadata about the gear cast was copied from the cruise logger (Toktlogger v.1.1.2; download function did not work), UUIDs were generated and given, and additional relevant metadata was added (e.g. sample depths, data file names, serial number of instruments). This information was combined in an Excel file and shared in the cruise folder so that the scientists could grab the Parent IDs for their samples and thus did not need to individually acquire metadata about the gear casts. Around 200 gear casts were registered (Appendix A1.1), and around 90 datasets with several samples per dataset were collected and logged during the cruise (Appendix A3.1). Sample and metadata information are added to the Nansen Legacy database which is accessible and searchable through the SIOS webpage. In general, the system for labelling and logging of samples worked well, although several scientists had problems accessing the ship network. This may be related to the fact that the ship computer system is divided into different networks, and that although we should have all relevant access through the network assigned to scientists, this is not always the case. Since our labelling system is placed on a virtual server on the ship network, it is essential that all scientists have easy access. The download function of the cruise logger (v1.2.2) does not work, so information has to be copied into our gear cast log sheet. Until relevant metadata are included in the cruise logger (including generation of UUIDs for each

gear cast) and the download function works, it is necessary to assign one scientist to gather the relevant metadata for each gear cast, assign parent ID and to distribute this information to cruise participants during the cruise.

COMMUNICATION AND OUTREACH

The locations and activities during research cruises are well suited to visualize the Arctic environment as well as the research activities in the project. However, in this polar night cruise space was prioritized for scientists and artist(s) was not invited.
Blog reports from the cruise activities were produced during the cruise, and by the end of the cruise, 6 blog texts were submitted to the project office, and 6 were published on Forskning.no/ Sciencenorway.no (see Appendix 2.1). In addition, a popular scientific report from the cruise was written to the local newspaper Svalbardposten.no in Longyearbyen.

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APPENDIX

Appendix A1.1 Full Q4 station list with station locations and gear sampled

Date	Time (UTC) start	Time (UTC) stop	Gear Type	Station Name	Local Station ID	Latitude	Longitude	Bottom Depth (m)	Sample Depth (m)	Max depth (m)	Min depth (m)	Start Date	End Date	Event Remarks
2019-11-28			EK80	continuous								2019-11-28	2019-12-16	EK80
2019-11-28			EM302	continuous								2019-11-28	2019-12-16	EM302
2019-11-28			Weather station	continuous								2019-11-28	2019-12-16	Weather station
2019-11-28			ADCP	continuous								2019-11-28	2019-12-16	ADCP
2019-11-28				continuous								2019-11-28	2019-12-16	Thermosalinograph
2019-11-28				continuous								2019-11-28	2019-12-16	pCO2 underway
2019-11-28	19:52	20:08	CTD w/bottles	IsA	419	78,265	15,527	92	81	92		2019-11-28	2019-11-28	for IMR
2019-11-30	13:51	14:04	Macroplankton trawl	N_Trawl	4628	80,9500	19,9900	114	94			2019-11-30	2019-11-30	speed 2.5 knot; stop pos. 81.31N; 20.25E
2019-11-30	14:22	14:38	CTD w/bottles	N_Trawl	420	80,9460	20,0555	125				2019-11-30	2019-11-30	Niskin: bottom x2; 20m x 5 (for sea ice core ++)
2019-11-30	14:52		TS probe	N_Trawl	84							2019-11-30	2019-11-30	Failed - no signal
2019-11-30	15:56	16:11	Macroplankton trawl	N_Trawl	111	80,9500	19,8590	132	90			2019-11-30	2019-11-30	Door distance: 32.1-36m
2019-11-30	16:28		TS probe	N_Trawl	85							2019-11-30	2019-11-30	Failed - no signal
2019-11-30	19:11					81,2433	21,6283					2019-11-30	2019-11-30	ice observation
2019-11-30	19:42					81,2433	21,9317					2019-11-30	2019-11-30	ice observation
2019-11-30	23:09					81,3256	23,8771					2019-11-30	2019-11-30	ice observation
2019-12-01	04:46					81,7389	26,5339					2019-12-01	2019-12-01	ice observation
2019-12-01	10:15											2019-12-01	2019-12-01	ice observation
2019-12-01	10:52		CTD w/bottles	P7 (DEEP-ICE)	421	82,0578	29,2830	3425	120			2019-12-01	2019-12-01	10,20,30,40,50,60,90,120m NOON CTD
2019-12-01	12:16		Bongonet 64 um	P7 (DEEP-ICE)	126	82,0600	29,2830	3425	100	100	0	2019-12-01	2019-12-01	For expm.
2019-12-01	12:36		CTD w/bottles	P7 (DEEP-ICE)	422	82,0610	29,2190	3433	1600			2019-12-01	2019-12-01	failure CTD signal -only to 1600m! Up cast file sta9998.cnv
2019-12-01	15:08	15:29	CTD w/bottles	P7 (DEEP-ICE)	423	82,0614	29,1360	3436	90	90	10	2019-12-01	2019-12-01	SHALLOW CTD EXPM
2019-12-01	16:22	19:18	CTD w/bottles	P7 (DEEP-ICE)	424	82,0612	29,1126	3436				2019-12-01	2019-12-01	First CTD expm; Virus; Arunima, Lise/Hilde
2019-12-01	21:17	22:16	Sediment trap (short term)	P7 (DEEP-ICE)	256	82,0634	29,0373	3443	200			2019-12-01	2019-12-01	sediment trap deployment with PP bottles, drift ca 0.1-0.2kn west south west
2019-12-01	21:38			P7 (DEEP-ICE)								2019-12-01	2019-12-01	ice observation
2019-12-01	22:55			P7 (DEEP-ICE)		82,0664	28,9846					2019-12-01	2019-12-01	ice observation at site of sediment trap
2019-12-01	22:16	00:35	GO-FLO	P7 (DEEP-ICE)	257	82,0644	29,0075		500			2019-12-01	2019-12-02	Trace metals
2019-12-02	05:02	07:15	Multinet 180 um	P7 (DEEP-ICE)	127	82,0634	28,8563	3263	2500	2500	0	2019-12-02	2019-12-02	deep multi

2019-12-02	09:00	16:15		P7 (DEEP-ICE)	ICE WORK	82,0428	28,7516					2019-12-02	2019-12-03	ICE WORK ice cores, CTD, net and water
2019-12-02	10:00	12:00	Active water sampler	P7 (DEEP-ICE)	258	82,0428	28,7516		200			2019-12-02	2019-12-02	200m, the surface pump did not work (air trapped)
2019-12-02	12:41	14:01	TS probe	P7 (DEEP-ICE)	86	82,0467	28,6616		1000			2019-12-02	2019-12-02	Nils Olav/Tom
2019-12-02		16:05	MIK-net 1500 um	P7 (DEEP-ICE)	128	82,0494	28,5958		1000	1000	0	2019-12-02	2019-12-02	Community; jellies; Tom, Anette
2019-12-02	16:11	17:45	MIK-net 1500 um	P7 (DEEP-ICE)	129	82,0495	28,5938		1000	1000	0	2019-12-02	2019-12-02	Ecotox Julia; SI/FA Anette
2019-12-02	17:49	20:28	Multinet 180 um	P7 (DEEP-ICE)	130	82,0501	28,5713		2500	2500	0	2019-12-02	2019-12-02	Comunity; no depth because of ice under ship at some events
2019-12-02	21:21	22:52	Multinet 64 um	P7 (DEEP-ICE)	131	82,0548	28,5224	3549	1000	1000	0	2019-12-02	2019-12-02	Community; Amalia, Anette
2019-12-02	23:18	23:54	Multinet 64 um	P7 (DEEP-ICE)	132	82,0639	28,5016	3517	1000	300	0	2019-12-02	2019-12-02	Kasia: forams
2019-12-03	00:23	03:53	CTD w/bottles	P7 (DEEP-ICE)	425	82,0698	28,4973	3525	3515	3515	0	2019-12-03	2019-12-03	deep standard CTD
2019-12-03	05:43	06:30	CTD w/bottles	P7 (DEEP-ICE)	426	82,0918	28,5042	3572	500	500	10	2019-12-03	2019-12-03	shallowstandard CTD
2019-12-03	06:34	09:23	Box core	P7 (DEEP-ICE)	65	82,0947	28,5030	3573				2019-12-03	2019-12-03	did not close properly-sample partly lost
2019-12-03	10:13	12:32	Box core	P7 (DEEP-ICE)	66	82,1060	28,4910	3602				2019-12-03	2019-12-03	did not release - no sample
2019-12-03	13:54	14:03	MIK-net 1500 um	P7 (DEEP-ICE)	133	82,1200	28,4520	3602	500	500	0	2019-12-03	2019-12-03	Ecotox Julia; time from bottom and up
2019-12-03	13:40	14:10		P7 (DEEP-ICE)	ICE WORK	82,1200	28,4520	3602				2019-12-03	2019-12-03	retrieve ice primary productivity incubations, phytopl. net
2019-12-03	16:37		Sediment trap (short term)	P7 (DEEP-ICE)	ICE WORK	82,1522	28,3152	3634				2019-12-03	2019-12-03	recover sediment traps
2019-12-03	17:26	17:38	Phytoplankton net 20 um	P7 (DEEP-ICE)	134	82,1529	28,3031	3635	100	100	0	2019-12-03	2019-12-03	Community
2019-12-03	17:40	18:00	WP2 64 um	P7 (DEEP-ICE)	135	82,1529	28,3030	3636	100	100	0	2019-12-03	2019-12-03	WP2 50um net Oithona F
2019-12-03	18:09	18:16	Niskin	P7 (DEEP-ICE)	260	82,1532	28,2975	3637	20			2019-12-03	2019-12-03	Marti P/I curve
2019-12-03	18:25	18:31	Bongonet 180 um	P7 (DEEP-ICE)	136	82,1534	28,2936	3637	50	50	0	2019-12-03	2019-12-03	Prey for Snorre
2019-12-03	18:46	19:03	GO-FLO	P7 (DEEP-ICE)	261	82,1535	28,2911	3637	90	90		2019-12-03	2019-12-03	Expm. - one bottle spilled so will redo at NLEG 24
2019-12-03	22:29	23:38	Bongonet 180 um	P7 (DEEP-ICE)	262	82,1561	28,2397	3648	1000	1000	0	2019-12-03	2019-12-03	Metabarcoding, biomass, comm, FA
2019-12-03	23:55	02:37	Box core	P7 (DEEP-ICE)	68	82,1562	28,2061	3650				2019-12-03	2019-12-04	not completely filled box
2019-12-04	02:53	04:19	Bongonet 64 um	P7 (DEEP-ICE)	263	82,1606	28,1542	3660	1000	1000	0	2019-12-04	2019-12-04	Metabarcoding, biomass, comm, FA

2019-12-04	13:34	14:33	TS probe	NLEG24	87	81,6850	30,5270	2845	1000	1000	0	2019-12-04	2019-12-04	Acoustics
2019-12-04	14:57	17:48	CTD w/bottles	NLEG24	427	81,6930	30,5270	2488				2019-12-04	2019-12-04	
2019-12-04	19:00	21:14	CTD w/bottles	NLEG23	428	81,6182	30,6704	1969				2019-12-04	2019-12-04	
2019-12-04	22:05	23:17	TS probe	P6	87	81,6851	30,5271	914		900		2019-12-04	2019-12-04	P6 beginner
2019-12-05	23:27	00:29	CTD w/bottles	P6	429	81,5530	30,8221	938				2019-12-04	2019-12-05	
2019-12-05	01:21	02:20	MIK-net 1500 um	P6	137	81,5342	30,9438	818		800	0	2019-12-05	2019-12-05	Comm; Tom/B. depth end 838m
2019-12-05	02:51	03:51	MIK-net 1500 um	P6	138	81,5430	30,8759	838		800	0	2019-12-05	2019-12-05	Ecotox; SI/FA
2019-12-05	03:55	04:45	CTD w/bottles	P6	430	81,5465	30,8399	880				2019-12-05	2019-12-05	CTD StD shallow
2019-12-05	04:45	06:06	Multinet 64 um	P6	139	81,5495	30,8118	907		850	0	2019-12-05	2019-12-05	Comm./B. depth 937 at end
2019-12-05	06:46	08:01	Multinet 64 um	P6	140	81,5421	30,9462	844		750	0	2019-12-05	2019-12-05	Forams; Kasia/B. deptn
2019-12-05	08:16	09:30	CTD w/bottles	P6	431	81,5458707	30,86962	881		871		2019-12-05	2019-12-05	CTD std DEEP/ End B. depth 914
2019-12-05	09:48	10:02	Phytoplankton net 20 um	P6	264	81,5518454	30,757738	978		50		2019-12-05	2019-12-05	
2019-12-05	10:10	11:10	Bongonet 180 um	P6	265	81,5525854	30,74887192	1009		800		2019-12-05	2019-12-05	
2019-12-05	12:04	12:27	CTD w/bottles	P6	432	81,5430	30,9339	851		120		2019-12-05	2019-12-05	NOON CTD
2019-12-05	12:35	13:37	Bongonet 64 um	P6	266	81,5463	30,9033	867		800		2019-12-05	2019-12-05	
2019-12-05	13:44	15:09	GO-FLO	P6	267	81,5552	30,8386	959		500		2019-12-05	2019-12-05	
2019-12-05	16:05	17:15	Multinet 180 um	P6	141	81,5452	30,9284	861				2019-12-05	2019-12-05	
2019-12-05	17:50	18:33	Box core	P6	69	81,5428	30,9424	848				2019-12-05	2019-12-05	
2019-12-05	18:42	19:27	WP3 1000 um	P6	142	81,5442	30,9014	858		700	400	2019-12-05	2019-12-05	
2019-12-05	20:24	21:00	Box core	P6	70	81,5469	30,8633	879				2019-12-05	2019-12-05	
2019-12-05		21:31	Bongonet 64 um	P6	268	81,5460	30,8819	871		100		2019-12-05	2019-12-05	
2019-12-05	21:32	22:45	Bongonet 64 um	P6	269	81,5461	30,8804	872		800		2019-12-05	2019-12-05	
2019-12-05	23:18	23:59	Box core	P6	71	81,5500	30,8920	870				2019-12-05	2019-12-05	
2019-12-06	00:24	00:48	MIK-net 1500 um	P6	143	81,5531	30,8172	969		300	0	2019-12-06	2019-12-06	
2019-12-06	00:57	01:52	MIK-net 1500 um	P6	144	81,5557	30,7814	1009		800	0	2019-12-06	2019-12-06	
2019-12-06	03:34	04:18	CTD w/bottles	NLEG19	433	81,4593	31,0617	507		500	0	2019-12-06	2019-12-06	
2019-12-06	05:58	06:22	TS probe	NLEG15	89	81,3124	31,3490	188		178	0	2019-12-06	2019-12-06	B. depth at end: 530m
2019-12-06	06:28	07:02	CTD w/bottles	NLEG15	434	81,3139	31,3213	215				2019-12-06	2019-12-06	B. depth at end: 233m
2019-12-06	13:23	13:43	TS probe	NLEG14	90	80,9980	34,0012	211				2019-12-06	2019-12-06	
2019-12-06	13:51	14:21	CTD w/bottles	NLEG14	435	80,9981	33,9685	211				2019-12-06	2019-12-06	
2019-12-06	20:30	00:30		P5	ICEWORK	80,5333	34,3877	155				2019-12-06	2019-12-07	
2019-12-06	20:30	20:46	TS probe	P5	91	80,5333	34,3877	155				2019-12-06	2019-12-06	
2019-12-06	21:04	21:15	MIK-net 1500 um	P5	145	80,5317	34,3821	154		120	0	2019-12-06	2019-12-06	
2019-12-06	21:32	21:42	MIK-net 1500 um	P5	146	80,5300	34,3766	154				2019-12-06	2019-12-06	
2019-12-06	21:50	22:02	MIK-net 1500 um	P5	147	80,5288	34,3687	151				2019-12-06	2019-12-06	

2019-12-06	22:15	22:41	CTD w/bottles	P5	436	80,5270	34,3643	149				2019-12-06	2019-12-06	due to failure are the temperature data of this cast not of highest quality, better to use TS from next CTD cast nr 437
2019-12-06	22:50	10:30	Sediment trap (short term)	P5		80,5270	34,3643	149				2019-12-06	2019-12-07	deployed from hole in sea ice
2019-12-06	23:35	00:06	CTD w/bottles	P5	437	80,5376	34,3177	147				2019-12-06	2019-12-07	
2019-12-06	00:27	00:42	Multinet 64 um	P5	148	80,5173	34,2736	143,58				2019-12-07	2019-12-07	
2019-12-07	01:03	01:18	Multinet 64 um	P5	149	80,5149	34,2602	146,55				2019-12-07	2019-12-07	
2019-12-07	01:26	01:40	Bongonet 64 um	P5	270	80,5134	34,2183	149				2019-12-07	2019-12-07	
2019-12-07	01:59	02:14	MIK-net 1500 um	P5	150	80,5113	34,1852	139				2019-12-07	2019-12-07	
2019-12-07	02:43	05:30	Active water sampler	P5	272	80,509	34,141	155				2019-12-07	2019-12-07	Filtration pump
2019-12-07	07:27	07:27	Multinet 180 um	P5	151	80,496	33,937	162	140	140	0	2019-12-07	2019-12-07	
2019-12-07	07:50	08:03	Bongonet 64 um	P5	273	80,509	34,848	162	140	140	0	2019-12-07	2019-12-07	in ship log written Bongonet 180
2019-12-07	08:07	08:19	Bongonet 180 um	P5	274	80,492	33,918	159	140	140	0	2019-12-07	2019-12-07	retrival from hole in sea ice
2019-12-07	11:29	11:49	CTD	P5		80,459	33,760					2019-12-07	2019-12-07	Fail - sensors frozen
2019-12-07	12:06	12:50	GO-FLO	P5	275	80,460	33,766	186	175			2019-12-07	2019-12-07	
2019-12-07	12:57	13:27	CTD w/bottles	P5	438	80,459	33,760	186				2019-12-07	2019-12-07	
2019-12-07	13:29	13:36	Phytoplankton net 10 um	P5	152	80,455	33,732	189	50	50	0	2019-12-07	2019-12-07	
2019-12-07	18:39	19:00	TS probe	NLEG12	92	79,999	34,000	225				2019-12-07	2019-12-07	
2019-12-07	19:10	19:40	CTD w/bottles	NLEG12	439	79,997	33,989	215				2019-12-07	2019-12-07	
2019-12-07	22:14	22:39	TS probe	P4	276	79,812	33,991	297				2019-12-07	2019-12-07	
2019-12-07	22:48	23:20	CTD w/bottles	P4	440	79,807	33,977	296				2019-12-08	2019-12-08	
2019-12-08	00:53	01:15	MIK-net 1500 um	P4	153	79,837	34,209	253		222	0	2019-12-08	2019-12-08	
2019-12-08	01:24	01:42	MIK-net 1500 um	P4	154	79,832	34,194	266				2019-12-08	2019-12-08	
2019-12-08	02:13		Sediment trap (short term)	P4	277	79,825	34,171	271				2019-12-08	2019-12-08	
2019-12-08	03:21	03:46	MIK-net 1500 um	P4	155	79,821	34,094	274				2019-12-08	2019-12-08	
2019-12-08	04:12	06:55	Active water sampler	P4	278	79,815	34,076	283				2019-12-08	2019-12-08	40m and 140m depths
2019-12-08	07:40	08:15	GO-FLO	P4	279	79,797	34,052	304				2019-12-08	2019-12-08	
2019-12-08	08:33	08:58	CTD w/bottles	P4	441	79,792	34,053	317				2019-12-08	2019-12-08	
2019-12-08	09:09	09:33	Multinet 180 um	P4	156	79,787	34,054	323		280	0	2019-12-08	2019-12-08	280-200-100-50-20-0m
2019-12-08	09:51	10:19	Multinet 180 um	P4	157	79,783	34,055	327		300	0	2019-12-08	2019-12-08	300-200-100-50-20

2019-12-08	10:28	11:01	CTD w/bottles	P4	442	79,778	34,055	326				2019-12-08	2019-12-08	NOON CTD
2019-12-08	11:30	12:02	Bongonet 64 um	P4	280	79,770	34,052	326		300	0	2019-12-08	2019-12-08	comm/biomass
2019-12-08	12:11	13:08	Bongonet 180 um	P4	281	79,765	34,049	326		300	0	2019-12-08	2019-12-08	comm/biomass
2019-12-08	13:13	13:27	Bongonet 180 um	P4	282	79,754	34,041	332		300	0	2019-12-08	2019-12-08	SI/FA
2019-12-08	13:36	13:50	Bongonet 64 um	P4	283	79,750	34,036	335	100	100	0	2019-12-08	2019-12-08	Angela expm
2019-12-08	13:55	14:23	Bongonet 64 um	P4	284	79,747	34,033	339	300	300	0	2019-12-08	2019-12-08	Christine expm and comm
2019-12-08	14:28	15:06	CTD w/bottles	P4	443	79,742	34,026	339				2019-12-08	2019-12-08	CTD standard shallow
2019-12-08	15:09	15:23	Phytoplankton net 20 um	P4	158	79,735	34,014	342		50	0	2019-12-08	2019-12-08	
2019-12-08	15:41	12:26	CTD w/bottles	P4	444	79,733	34,009	344				2019-12-08	2019-12-08	
2019-12-08	17:03	17:36	Multinet 64 um	P4	159	79,725	33,991	344				2019-12-08	2019-12-08	
2019-12-08	17:53	18:27	Multinet 64 um	P4	160	79,722	33,989	346				2019-12-08	2019-12-08	
2019-12-08	21:05	21:34	Multinet 180 um	P4	161	79,762	33,989	330				2019-12-08	2019-12-08	
2019-12-08	22:18	22:34	Box core	P4	72	79,759	33,995	330				2019-12-08	2019-12-08	
2019-12-09	00:00	00:34	Box core	P4	73	79,750	34,003	337				2019-12-09	2019-12-09	
2019-12-09	02:03	02:20	Box core	P4	75	79,739	34,004	338				2019-12-09	2019-12-09	
2019-12-09		06:24	Sediment trap (short term)	P4	285	79,675	34,068	360		120	30	2019-12-09	2019-12-09	sediment trap and PP bottles retrieved
2019-12-09	11:34	11:57	TS probe	NLEG9	93	79,241	34,435	211				2019-12-09	2019-12-09	
2019-12-09	12:09	12:43	CTD w/bottles	NLEG9	445	79,239	34,001	211				2019-12-09	2019-12-09	
2019-12-09	12:30	13:00		NLEG9		79,239	34,001	211				2019-12-09	2019-12-09	Frost flower sampling
2019-12-09	17:48	18:17	TS probe	P3	94	78,749	34,000					2019-12-09	2019-12-09	
2019-12-09	18:24	18:52	MIK-net 1500 um	P3	162	78,749	33,999	307		280	0	2019-12-09	2019-12-09	
2019-12-09	18:58	19:22	MIK-net 1500 um	P3	163	78,749	33,998	307		280	0	2019-12-09	2019-12-09	
2019-12-09	19:53	21:41	Active water sampler	P3		78,749	33,996	307	40			2019-12-09	2019-12-09	in parallel to CTD, no station ID
2019-12-09	20:00	20:25	CTD w/bottles	P3	446	78,750	33,996	307				2019-12-09	2019-12-09	
2019-12-09	21:09	21:47	CTD w/bottles	P3	447	78,750	33,994	306				2019-12-09	2019-12-09	
2019-12-09	21:57	22:24	Multinet 64 um	P3	164	78,750	33,993	305		300	0	2019-12-09	2019-12-09	
2019-12-09	22:39	23:08	Multinet 64 um	P3	165	78,750	33,993	306		300	0	2019-12-09	2019-12-09	
2019-12-09	23:25	23:54	Multinet 180 um	P3	166	78,749	33,995	306		300		2019-12-09	2019-12-09	
2019-12-10	00:16	00:28	Phytoplankton net 20 um	P3	286	78,747	33,993	301		50	0	2019-12-10	2019-12-10	
2019-12-10	00:00	01:05	Bongonet 64 um	P3	287	78,746	33,992	304		290	0	2019-12-10	2019-12-10	
2019-12-10	01:19	01:39	Bongonet 180 um	P3	288	78,744	33,989	303		290	0	2019-12-10	2019-12-10	
2019-12-10	01:54	02:37	GO-FLO	P3	289	78,742	33,987	304				2019-12-10	2019-12-10	

2019-12-10	09:43	10:00	TS probe	NLEG 5	95	78,000	34,003	192				2019-12-10	2019-12-10	
2019-12-10	10:09	10:41	CTD w/bottles	NLEG 5	448	77,999	34,003	192				2019-12-10	2019-12-10	
2019-12-10	15:12	15:35	TS probe	P2	96	77,500	34,002	190		160	0	2019-12-10	2019-12-10	
2019-12-10	15:41	16:00	MIK-net 1500 um	P2	167	77,500	34,002	190		160	0	2019-12-10	2019-12-10	
2019-12-10	16:06	16:23	MIK-net 1500 um	P2	168	77,500	34,005	190				2019-12-10	2019-12-10	
2019-12-10	16:38	17:07	CTD w/bottles	P2	449	77,500	34,005	190				2019-12-10	2019-12-10	
2019-12-10	17:40	18:12	CTD w/bottles	P2	450	77,500	34,004	190				2019-12-10	2019-12-10	
2019-12-10	18:21	18:42	Multinet 64 um	P2	169	77,500	34,002	190			0	2019-12-10	2019-12-10	
2019-12-10	18:57	19:17	Multinet 64 um	P2	170	77,500	34,000	190			0	2019-12-10	2019-12-10	
2019-12-10	19:25	19:41	Multinet 180 um	P2	171	77,500	33,997	192			0	2019-12-10	2019-12-10	
2019-12-10	20:15	20:21	Phytoplankton net 20 um	P2	290	77,496	33,985	184		50	0	2019-12-10	2019-12-10	
	20:15	20:21				77,496	33,985	184		50	0	2019-12-10	2019-12-10	SAIV 208 CTD on net
2019-12-10	20:35	21:12	GO-FLO	P2	291	77,494	33,981	187			0	2019-12-10	2019-12-10	
2019-12-10	21:42	21:51	Box core	P2	77	77,491	33,969	190				2019-12-10	2019-12-10	
2019-12-10	22:17	22:34	Bongonet 64 um	P2	292	77,488	33,968	189			0	2019-12-10	2019-12-10	
2019-12-10	22:39	22:52	Bongonet 180 um	P2	293	77,487	33,964	188			0	2019-12-10	2019-12-10	
2019-12-10	23:30	23:40	Box core	P2	78	77,486	33,961	189				2019-12-10	2019-12-10	note: only two box cores on this station, three fails.
2019-12-11	01:15	01:26	Box core	P2	79	77,485	33,971	188				2019-12-11	2019-12-11	fail
2019-12-11	01:33	01:45	Box core	P2	80	77,485	33,972	189				2019-12-11	2019-12-11	fail
2019-12-11	05:58	06:16	Macroplankton trawl		112	77,058	34,093	155				2019-12-11	2019-12-11	written Pelagic trawl in ship log, V- haul
2019-12-11	07:05	07:25	TS probe	NLEG 3	97	77,005	34,005	159				2019-12-11	2019-12-11	
2019-12-11	07:32	07:25	CTD w/bottles	NLEG 3	451	77,005	34,005	159				2019-12-11	2019-12-11	
												2019-12-11	2019-12-11	SAIV 208 CTD on side
2019-12-11	08:29	08:55	Macroplankton trawl	NLEG 3	113	77,009	34,065	150		100	0	2019-12-11	2019-12-11	in scattering layer at 100 m
2019-12-11	12:05	12:25	Campelen trawl		114	76,849	32,579	204				2019-12-11	2019-12-11	
2019-12-11	17:00	17:29	TS probe	NLEG2	98	76,499	31,217	314				2019-12-11	2019-12-11	
2019-12-11	17:38	18:17	CTD w/bottles	NLEG2	452	76,499	31,217	314				2019-12-11	2019-12-11	
2019-12-12	16:11	16:42	CTD w/bottles	P1	453	76,000	31,219	327				2019-12-12	2019-12-12	
2019-12-12	17:13	17:51	CTD w/bottles	P1	454	76,000	31,219	326				2019-12-12	2019-12-12	
2019-12-12	17:57	18:39	Multinet 64 um	P1	172	76,000	31,219	326				2019-12-12	2019-12-12	fail, taken from aft ship
2019-12-12	19:32	20:08	Multinet 64 um	P1	173	76,000	31,219	326				2019-12-12	2019-12-12	success through moonpool

2019-12-12	20:22	20:59	Multinet 64 um	P1	174	76,000	31,219	326				2019-12-12	2019-12-12	
2019-12-12	21:20	21:43	Multinet 180 um	P1	175	76,000	31,219	326				2019-12-12	2019-12-12	
2019-12-12	21:57	22:23	Multinet 180 um	P1	176	76,000	31,219	326				2019-12-12	2019-12-12	
2019-12-12	22:35	23:07	Multinet 64 um	P1	177	76,000	31,219	326				2019-12-12	2019-12-12	
2019-12-12	23:18	23:50	Multinet 64 um	P1	178	76,000	31,219	326				2019-12-12	2019-12-12	
2019-12-13	00:09	00:38	CTD w/bottles	P1	455	76,000	31,219	326				2019-12-13	2019-12-13	
2019-12-13	01:03	01:25	Box core	P1	81	76,000	31,219	326				2019-12-13	2019-12-13	disturbed sediment surface
2019-12-13	02:31	02:50	Box core	P1	82	76,000	31,219	326				2019-12-13	2019-12-13	disturbed sediment surface
2019-12-13	03:49	04:38	TS probe	P1	99	76,000	31,219	326				2019-12-13	2019-12-13	winch problems, took longer
2019-12-13	05:51	06:24	MIK-net 1500 um	P1	179	76,000	31,219	326		295	0	2019-12-13	2019-12-13	vertical haul-quantitative (Tom)
2019-12-13	07:07	07:32	MIK-net 1500 um	P1	180	75,999	31,224	326				2019-12-13	2019-12-13	V-haul (Robynne, Julia, Anette)
2019-12-13	08:08	08:35	Macroplankton trawl	P1	115	76,002	31,205	328		100	0	2019-12-13	2019-12-13	scattering layer 100m (Julia, Robynne)
2019-12-13	09:42	10:05	Macroplankton trawl	P1	116	76,001	31,203	324		200	0	2019-12-13	2019-12-13	V-haul (Tom)
2019-12-13	10:23	10:52	CTD w/bottles	P1	456	75,995	31,280	322				2019-12-13	2019-12-13	NOON CTD
2019-12-13	13:06	13:23	Campelen trawl	P1x	117	76,085	30,846	327				2019-12-13	2019-12-13	
2019-12-13	14:34	15:27	GO-FLO	P1x	294	76,086	31,006	334				2019-12-13	2019-12-13	
2019-12-13	15:39	16:11	CTD w/bottles	P1x	457	76,086	31,007	331				2019-12-13	2019-12-13	
2019-12-13	16:20	16:29	Phytoplankton net 10 um	P1x	181	76,087	31,001	333		50	0	2019-12-13	2019-12-13	
2019-12-13	16:33	16:30	Bongonet 180 um	P1x	182	76,087	31,001	333		20	0	2019-12-13	2019-12-13	
2019-12-13	17:08	17:31	Bongonet 180 um	P1x	183	76,087	31,001	333		300	0	2019-12-13	2019-12-13	
2019-12-13	17:40	18:08	Bongonet 64 um	P1x	184	76,087	31,001	333		20	0	2019-12-13	2019-12-13	
2019-12-13	18:11	18:41	Bongonet 64 um	P1x	185	76,087	31,001	333		300	0	2019-12-13	2019-12-13	
2019-12-13	18:50		Bongonet 64 um	P1x	186	76,087	31,001	333		300	0	2019-12-13	2019-12-13	not recorded in station ship log
2019-12-13	20:16	20:37	Box core	P1	83	76,002	31,214	327				2019-12-13	2019-12-13	
2019-12-13	22:50	23:14	CTD	P1-1	458	76,167	31,213	316				2019-12-13	2019-12-13	only one water sample taken for salinity
2019-12-14	00:40	01:03	CTD	P1-2	459	76,334	31,212	314				2019-12-14	2019-12-14	
2019-12-14	08:07	11:23	Active water sampler	P1	295	76,000	31,220	327		120	20	2019-12-14	2019-12-14	
2019-12-14	13:14	13:35	CTD	extra 1	460	75,857	30,875	326				2019-12-14	2019-12-14	extra stn south of P1
2019-12-14	16:09	16:40	CTD	extra 2	461	75,565	30,238	354				2019-12-14	2019-12-14	extra stn south of P1
2019-12-16	13:15	16:30		extra 3	no ID	75,5650	20,1745	239		100	0	2019-12-16	2019-12-16	AUV test, deployed from small boat

Appendix A1.2 Q4 Cruise participants

#	Topic	Name	Institution	Task description	WP	E-mail
1	(zooplankton)	Janne E. Søreide	UNIS	Cruise leader	RF2/RF3	jannes@unis.no
2	(Primary prod.	Rolf Gradinger	UiT	Co-cruise leader	RF3	Rolf.gradinger@uit.no
3	Safety	Audun Gjerland	NPI	Safety	RA-A	audun.gjerland@npolar.no
4	Chemistry	Ylva Ericsson	IMR	Carbonate chemistry and pCO2 underway systems	RF2	ylva.ericson@npolar.no
5	Chemistry	Elisabeth Jones	IMR	Carbonate chemistry water, nutrients and sea ice, OA	RF2	elizabeth.jones@hi.no
6	Chemistry	Helene H. Lødemel	IMR	Carbonate chemistry water, nutrients and sea ice, OA	RF2	helene.hodal.loedemel@hi.no
7	CTD/Protists/f	Miriam Marquardt	UiT	budget/ sea ice/ sed traps	RF3	Miriam.marquardt@uit.no
8	Protists	Rita Amundsen	UiO	Protist/ microzooplankton? water comm. Samples, Chla fltration/ macrozooplankton helping Julie	RF3	rita.amundsen@ibv.uio.no
9	Flux	Yasemin Bodur	UiT	Filtrations, sediment traps, respiration exp.	RF3	yasmin.v.bodur@uit.no
10	Primary Prod.	Marti Amargant	UiT	Prim prod, 14C incubations. In-situ, P vs I and P vs T curves,	RF3	marti.a.arumi@uit.no
11	Microbiology	Lise Øverås	UiB	Microbiology (std+sea ice) comm./ food web	RF3	Lise.Ovreas@uib.no
12	Protists	Anna Vader	UNIS	Filtration, Metabarcoding, metatrar	RF3	anna.vader@unis.no
13	Protists	Snorre Flo	UNIS	DNA/RNA filtrations , zooplankton and benthic molecular diet	RF3	Snorre.Flo@UNIS.no
14	Protists	Hilde Stabel	UiB	Abundance of phytoplankton, heterotrophic flagellates, bacteria	RF3	Hilde.Stabell@uib.no
15	Zooplankton	Anette Wold	NPI	Zooplankton, POM for CSIA of FA	RF3	anette.wold@npolar.no
16	Zooplankton	Anglea Stippkugel	NTNU	Micro- and mesozooplankton grazing experiments (dilution	RF3	angela.stippkugel@ntnu.no
17	Zooplankton	Konrad Karlsson	UNIS	Zooplankton, grazing experiments, respiration measurements	RF2/RF3	Konrad.Karlsson@slu.se
18	Zooplankton	Christine Gawinski	UiT	Zooplankton sampling, small zooplankton secondary production	RF3	christine.gawinski@uit.no
19	Zooplankton	Amalia Keck	NPI	Zooplankton	RF3	Amalia.Keck@npolar.no
20	Fish/macrozoo	Robynne Nowicki	UNIS	Zooplankton and fish	RF2	robynne.nowicki@unis.no
21	Fish/macrozoo	Øystein Varpe	UNIS/UiB	Ecotox sampling (zooplankton /fish) and helping out in	RF2/RF3	oystein.varpe@uib.no
22	Fish/macrozoo	Julia Giebichenstein	UiO	Ecotox zooplankton, fish, water pump	RF2	julia.giebichenstein@ibv.uio.no
23	Fish	Siv Hoff	UiB	Ecotox sampling (zooplankton /fish) and helping out in	RF2	s.n.k.hoff@ibv.uio.no
24	Macrozoo/Aqu	Tom van Engeland	IMR	Zooplankton (macro)	RF3	tom.van.engeland@hi.no
25	Aqustic	Nils Olav Handegard	IMR	TS probe	RF3	nilsolav@hi.no
26	Fish	Julie Bitz-Thorsen	UiT	Ecotox sampling (zooplankton /fish) and helping out in	RF2/RF3	julie.bitz-thorsen@uit.no

27	Benthos	Silivia Hess	UiO	living benthic forams, exp with	RF3	silvia.hess@geo.uio.no
28	Benthos	Eric Jorda	Nord	Benthic sampling. Stable isotope sampling benthic meiofauna (UiT/UNIS PhD), invertebr. for OC content (Ecopath need), ice	RF3	eric.jorda-molina@nord.no
29	Benthos	Arunima Sen	Nord	Benthic respiration, experimental with Silvia and Thaise	RF3	arunimas@unis.no
30	Benthos	Thaise Ricardo de Freitas	UiO	Living benthic forams and benthic meiofauna, experiments with Arunima	RF3	t.r.de.freitas@geo.uio.no
31	zooplankton	Kasia Zamelczyk	NPI	Carbonate chemistry, pteropods, forams, OA, sediment	RF2	kasia.zamelczyk@npolar.no
32	Trace metals	Maria Digernes, PhD	NTNU	Trace metals and perhaps DOC characterization	RF2	maria.g.digernes@ntnu.no
33	Trace metals	Stephen Kohler	NTNU	Trace metals and perhaps DOC characterization	RF2	stephen.g.kohler@ntnu.no
34	Technology	Tore Mo Bjørklund	NTNU	AUV, AZFP, ROV (Blueeye)	RA-C	toremobj@stud.ntnu.no
35	Technology	Ruochen Yang	NTNU	AUV, AZFP, ROV (Blueeye)	RA-C	ruochen.yang@ntnu.no
36	Instrument	Jan Vidar Nordstrand	IMR	Instrument responsible		jan.vidar.nordstrand@hi.no
37	Instrument	Jarle Kristiansen	IMR	Instrument		jarle.kristiansen@hi.no
38	Instrument	Kristoffer Ingebrigsten Monsen	IMR	Instrument trainee		kristoffer.ingebrigtsen.monsen@hi.no

Appendix A1.3 Q4 Working hours and cabin distributions

Working hours 0400-1200; 1600-2000	Working hours 2000-0400; 1200-1600	Cabin
Janne E. Søreide		605
Nils Olav Hanegard	Tom van Engeland	419
Kristoffer I. Monsen	Audun Gjerland	421
Lise Øverås	Hilde Stabel	456
Stephen Kohler	Øystein Varpe	458
	Rolf Gradinger	468
Siv Hoff	Julie Giebichenstein	327
Anette Wold	Amalie Keck	329
Marti Amargant	Eric Jorda	330
Anna Vader	Miriam Marquardt	332
Robynne Nowicki	Thaise Ricardo de Freitas	333
Tore Mo Bjørklund	Ruochen Yang	335
Rita Amundsen	Silvia Hess	377
Snorre Flo	Konrad Karlsson	379
Julie Blitz-Thorsen	Arunima Sen	380
Christine Gawinski	Yasmine Bodour	382
Maria Digernes	Angela Stippkugel	383
Helene Lødemel	Elisabeth Jones	385
Kasia Zamelczyk	Ylva Ericson	386

Appendix A1.4 Lab-use during the Nansen Legacy Q4 cruise

Lab no.	Name of laboratory	Use during JC3	Lab users
102	Clean seawater sample room	Seawater intake room & TSG, pCO_2 underway instrumentation	Instrument crew + Ylva/Libby
301	Chilled lab	Mesozooplankton experiments	Angela, Christine
302	Dry lab common (Chem. lab)	Analyses of AT, DIC, pH, dissolved oxygen, ice core processing	Libby/Helene/Ylva
303	Wet lab common, (Zoopl. lab) Thermax 1+2	Meso- and macrozooplankton, filtration (viruses, bacteria, XRF)	Anette, Amalie, Konrad, Julia and Robynne
307	Radioisotope lab	Primary (PP) and bacterial production (PB)	Marti
308/309	Wet lab biology (fish lab)	ocean physics	Zoe/Julie/Pedro, Marius
310	Catch sample room	Trawl processing, rinsing & storage of sea ice equipment (ice stations)	Siv, Julie (trawl) All ice teams
311	Toxicology lab	Trace metal clean lab	Stephen, Maria
312	Cooler room (inside fish lab)	OA & pollutants exp.	Siv, Julie
313	Freezer room converted to cold room (accessible from fish lab)	Experiments, cultures	Angela
314	Cold room (by benthos lab)	Benthos exp. (Temp +2°C)	Arunima, Eric
315	Cold room (by benthos lab)	Benthos exp. (Temp. in situ), storage samples (<4°C)	Arunima, Eric
316	Filtration lab	Filtration (metabarcoding)	Anna, Miriam, Lise, Hilde
317	Education lab	Label printer, microscope, fluorometer, sample labeling & logging, common use	Hilde (microscope) Miriam (fluorometer) Kasia (stereomicroscope) Label printer, Miriam CTD logs, others
319	Wet Lab Geology/Benthos	Benthos	Arunima, Eric, Thaise, Silvia
320	Microbiology lab	Filtrations (Chl a, POC/PON, FA/SI/HBI, and more). –	Julia, Rita
322	Ice Lab	Storage of phys/chem ice cores	Ice core handling
323	Cold room (Greenland)	ice core melting (°C), zooplankton sample temporary storage, storage filtered seawater	Microbes & zoopl. teams
325	Freezer ice samples	For biological frozen samples	Primarily biologists
AUD	Auditorium	Meetings; drying ice containers	All; ice bio group
701 (deck 9)	Observation Central	Common, ice observation support	Rolf, Ylva, everyone
Incubators			
Thermax1	303 Wet lab	Zooplankton live storage	Anette, Amalia, Konrad
Thermax2	303 Wet lab	Zooplankton, OA experiment	Konrad, Janne

Thermax3	Hangar	Zooplankton egg production exp.	Christine, Hilde
Thermax4	Hangar	Zooplankton exp. OA	Christine, Hilde
Lab cont.	Deck main	RA-C, AUV; ROV etc	Tore, Ruochen
Safety/logistic storage	Deck2/little CTD hangar (radios charging area, weapons)	Logistics	Audun
Atmosphere equipment	Heli deck/heli hangar	Not in use/ some storage	

Appendix 1.5 Q4 Water budget

Miriam Marquardt organized the CTD Rosette water budget based on the cruise participants requests.

WATERBUDGET SQ4 - 2019

only moonpool sampling possible, i.e. No 5 m

Order	Parameter	Name	Stations	Depth	Volumes	Depth	10	20	30	40	50	60	90	120	150	200	BOTTOM-10	CHLA MAX	500m at deep station	750	1000	1500	1750	2000	2500	3000	3500	4000
pre-station	trap and benthic	Arunima	station	Bottom -10m	100	Cast 1/before											100											
pre-station	trap and benthic	Angela	station	Chla max	15-20 L	Cast 1/before station												20										
pre-station	trap and benthic	Yasemin	station	Bottom -10m	40	Cast 1/before station											40											
						SUM vol	0	0	0	0	0	0	0	0	0	0	140	0										

CAST 2

Order	Parameter	Name	Stations	Depth	Volumes	Depth	10	20	30	40	50	60	90	120	150	200	BOTTOM-10	CHLA MAX	500m at deep station	750	1000	1500	1750	2000	2500	3000	3500	4000
exp. Water	Primary Production	Marti	All	5m, 30m or Chla max	6L	exp. Water	6											6										
exp. Water	Primary Production	Marti	All	20, 40, 60, 90	2L	exp. Water		2		2		2	2															
exp. Water	Primary Production	Marti	P1, P7	5 m (or 10 m if	68 L	exp. Water	68																					
exp. Water	Particle absorbtion	Anette/Miriam	All Process	5, 10, 20, Chla max, 30, 40, 50,	0,5	exp. Water	0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,5				0,5										
exp. Water	Dilution experiment	Angela	Exp. Stations (P1,	Chla max	50	exp. Water												50										
exp. Water	zooplankton experiments	Konrad	P1, P4, P7 (all process)	Chla max	60	exp. Water												60										
exp. Water	zooplankton experiments	Christine	Zooplanton experiment station	Chla max	5	exp. Water												5										
exp. Water	Aggregation experiment	Yasemin	P1, P2 or P4, P6 or P7	Chla max, 30 m	15	exp. Water			15																			

NOON	metatranscriptomics	Anna	Process	5m (10 m if	35	NOON	35																								
NOON	Grazer-exclusion exp	UiB Microbio	P4, P7 (dvs. En sør for	Chla max alternatively	50	NOON											50														
NOON	Experiments	Marti	P1, P6	10	12	NOON	12																								
NOON	P vs I curves	Marti	All	10	1	NOON	1																								
NOON	Fatty acids POM + H	Anette, Bodil	Process	chl max	18	NOON											6														
NOON	Virus-diversity	UiB Microbio	Process	Chla max/20m, bottom-10m, and	40 L	NOON										40	40	40													
NOON	Microzooplankton community	Angela	P1, P4, P7	5, 10, 20, Chla max, 40 and 60	1,2 L	NOON	1,2	1,2		1,2		1,2					1,2														
Std	Carbonate chemistry	Helene/Libby	all Process, all Nleg and mooring	Standard 12 depths, more than 12 depths	0,85	Std	0,9	0,9	0,9	0,9	0,9	0,9	0,9	0,9	0,9	0,9	0,85	0,85	0,85	0,9	0,85	0,85	0,85	0,85	0,85	0,85	0,85	0,85			
Std	Chl a	Anna, Miriam	All	Standard 12	2	Std	2	2	2	2	2	2	2	2	2	2	2	2	2		2	w		2	2						
Std	POC/PON	Miriam	All	Standard 12 depths	3 L	Std	3	3	3	3	3	3	3	3	3	3	3	3	3		3			3							
Std	Phytoplankton (ice a	Bente, Anna	Process stations	5, 10, Chla max, 30, 60, 90	0,3	Std	0,3		0,3			0,3	0,3				0,3														
Std	XRF	UiB Microbio	All	5, 10, 20, 30, 60, 90, 200, bottom-10 (+if available Chla max, deep stations 500, 1000, 1500, 2000, 2500)	5 L	Std	5	5	5			5	5			5	5	5	5		5	5		5	5						
Std	SEM	UiB Microbio	All	Chla max, 120m, bottom -10m	0,5	Std								0,5			0,5	0,5													
Std	Bacterial Production (BP),	UiB Microbio	All	Standard 12 depths	0,1	Std	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1													
Std	metabarcoding incl I	Anna, Bente, Kar	All	5, Chla max,	25	Std	25									25	25	25													
Std	Coccolithophore diversity (same CTD as	Bente, Karoline	Process stations	5/10 (if moonpool), Chla max, 200, deep	0,5	Std	0,5									0,5	0,5	0,5													

other param.	PFAS	Julia	all	1 Arctic water, 1	6 L	other param.	3					3																			
other param.	Dissolved Organic Matter	Maria, Stephen	P1-P5	10, 20, 30, 50, deep, chla max	10L	other param.	10	10	10		10							10	10												
other param.	Dissolved Organic Matter	Maria, Stephen	P6	10, 20, 30, 120, deep, chla max	10L	other param.	10	10	10					10				10	10												
other param.	Dissolved Organic Matter	Maria, Stephen	P7	10, 20, 30, 200, deep, chla max	10L	other param.	10	10	10							10		10	10												
other param.	Total Mercury, Methylmercury	Stephen, Maria	P6, P7	Depth 500, and all >500m	0,5 L	other param.														0,5		0,5			0,5						
other param.	Mercury Experiment Water	Stephen, Maria	P7	deep only	10 L	other param.												10													
other param.	stable isotopes from bottom water	Yasemin	all process	deep only	10 L	other param.												10													
						SUM vol	193	45	57	9,7	16	18	14	17	6	46	126,95	286	51,35		11,35			11,35				0,85

Appendix 2.1 Q4 Outreach activities.

Blogs written by cruise participants in collaboration with project office and published in Norwegian on the Nansen Legacy Blog at Forskning.no https://blogg.forskning.no/arven-etter-nansen/ and translated to English (by Eva Therese Jensen, UNIS) and published on Science of Norway https://sciencenorway.no/arctic-ocean-blog-nansen-legacy-project-blog/ during the Nansen Legacy seasonal cruise Q4 2019

No	Title	Author(s)	Online link	Status
1	Unike utfordringer på en arktisk vinterekspedisjon Unique Challenges at the start of an Arctic winter Expedition	Rolf Gradinger	Forskning.no/AeN/1602551	Pub. 4/12/2019
2	«Blowing in the wind»	Rolf Gradinger	Forskning.no/AeN/1602796	Pub. 5/12/2019
3	I Polhavet og på skuldrene til giganter In the Arctic Ocean and on the shoulders of giants	Øystein Varpe og Janne Søreide	Forskning.no/AeN/1603356	Pub. 6/12/2019
3	Vet de at det er Polarnatt? Do the animals at the bottom of the ocean know it's dark season?	Arunima Sen	Forskning.no/AeN/1605582	Pub. 10/12/2019
4	Kjernevirksomhet! Care for your core!	Miriam Marquardt	Forskning.no/AeN/1607304	Pub. 12/12/2019
5	Hot Spots i kulden! Hot topics from the cold!	Lise Øverås	Forskning.no/AeN/1608323	Pub 13/12/2019
6	Blomstersanking i polarnatta	Anna Vader og Lise Øverås	Forskning.no/AeN//1610141	Pub. 17/12/2019
7	På forskningstokt i drivisen til 82°N i polarnatten	Janne E. Søreide	Svalbardposte.no/kronikker/469655	Pub. 16/12/2019

Appendix 3.1 Overview of data sets collected during the Seasonal cruise Q4 from 28 November to 17 December, 2019.

Who		Sample info		Analyses					Legacy implementation plan		Data				
Cruise participant	PI	Sample type	Intended method	Parameter	Analysis protocol	Dataset	Where will analyses be done	When are analyses planned for	RF	Task/Subtask	Sharing within project	Publishing data	Ask for embar	If yes, why?	Comments
Anette Wold	Mats Granskog; Børge Hamre; Pedro Duarte; Philipp Assmy	Particulate absorbtion	Spectophotometer with integrating sphere	absorption spectra for algal and non-algal particles	Instrument: QFT-ICAM	Particulate absorbtion from standard depth sampled from CTD at all process stations	Rudiger Röttgers (Germany) (Tristan Petit)	Analysed by Tristan Petit at UiB.	RF1; RF3	T1-2.3/T1T3-1.3/T3.3.1	2021	2021-2022	yes	PD project	Samples have to be analysed within 6 months of sampling. If can be done depends on the travel (Norway, Germany) and working (Germany) regulations due to corona situation. Abroad in collaboration with Rudiger Röttgers (Germany) (Tristan Petit)
Amalia Keck	Mats Granskog	Snow depth	Snow depth measurements	Snow depth	NL v5 14.4	Snow depth	NPI (Sebastian Gerland)	2021-2022	RF1	T1-2.2	2020	2022-2023	no	Post doc, not hired yet	Only few snow depth measuremens were conducted on SQ4, too little data to be published on its own. Only worth publishing after more cruises if sufficient data.
Janne E. Søreide	Janne E. Søreide/ everyone	CTD upper 20-30 m	Hydrography	CTD and fluroescense, Oxygen	NA	CTD and fluroescense, Oxygen	UNIS (Janne Søreide)	2020-2021	RF1		2021	2021	no		Handheld CTD taken at a few stations since upper 10 m lost from ship CTD
Anette Wold; Amalia Keck	Janne Søreide; Kim Præbel	Mesozooplankton metabarcoding >180 um	Metabarcoding	CO1	NL v5 9.2.2 (9.1.2)	Barcoding Biodiversity	UiT (Kim Præbel)	2020-2022	RF4	T3-1.1 & 2.1 T3-2.1 & 2.3	2021-2022	2021-2022	yes	master student	The Bongonet for Metabarcoding split in two 1/2 for Metabarcoding & 1/2 for taxonomy (formaldehyde). This was not done during Q3 cruise
Anette Wold; Amalia Keck	Janne Søreide	Mesozooplankton community > 180 um	Morphology	community	NL v6 9.2.1.4	Integrated community	UNIS (Janne Søreide)	2021	RF3	T3 - 2.1 & 4.2	2021	2021-2022	no		Søreide & Kim Præbel The Bongonet sample taken for Metabarcoding was
Anette Wold; Amalia Keck	Janne Søreide	Mesozooplankton biomass and food quality > 180 um	mesozooplanton dry matter, CN and stable	Dry matter, CN and C and N stable isotopes	NL v6 9.2.1.4	Integrated biomass, CN, stable isotopes,	UNIS (Janne Søreide)	2021	RF3	T3 - 2.1 & 4.2	2021	2021-2022	no		Søreide The Bongonet sample taken for Metabarcoding was

Anette Wold; Amalia Keck	Janne Søreide; Kim Præbel	Mesozooplankton metabarcoding >64 um	Metabarcoding	CO1	NL v5 9.2.2 (9.1.2)	Barcoding Biodiversity	UiT (Kim Præbel)	2020-2022	RF4	T3-1.1 & 2.1 T3-2.1 & 2.3	2021-2022	2021-2022	yes	master student	Svensen, Janne Søreide & Kim Præbel The Bongonet sample taken
Anette Wold; Amalia Keck	Janne Søreide	Mesozooplankton community > 64 um	Morphology	community	NL v5 9.2.2 (9.1.2)	Integrated community	UNIS (Janne Søreide)	2021	RF3	T3 - 2.1 & 4.2	2021	2021-2022	no		Svensen, Janne Søreide & Kim Præbel The Bongonet sample taken
Anette Wold; Amalia Keck	Janne Søreide	Mesozooplankton biomass and food quality > 64 um	Bulk mesozooplankton dry matter, CN and stable isotopes	Dry matter, CN and C and N stable isotopes	NL v5 9.2.2 (9.1.2)	Integrated biomass, CN, stable isotopes,	UNIS (Janne Søreide)	2021	RF3	T3 - 2.1 & 4.2	2021	2021-2022	no		Bongonet sample 1/1 taken for biomass. Not done during Q3 cruise
Anette Wold; Amalia Keck	Camilla Svensen, Janne Søreide, Anette Wold/Haakon Hop	Depth stratified mesozooplankton community > 180 um	Morphology	community	NL v5 9.2.2 (9.1.2)	Depth stratified community composition	IO PAS (Slawek Kwasniewski)	2021	RF3	T3 - 1.1 & 2.1	2021	2021-2022	yes	PhD project	More flexible, take contact with PI`s
Anette Wold; Amalia Keck	Janne Søreide, Anette Wold/Haakon Hop	Depth stratified mesozooplankton community > 64 um	Morphology	community	NL v5 9.2.2 (9.1.2)	Depth stratified community composition	IO PAS (Slawek Kwasniewski)	2021	RF3	T3 - 1.1 & 2.1	2021	2021-2022	yes	PhD project	PhD project
Anette Wold; Amalia Keck	Anette Wold; Camilla Svensen, Janne Søreide (in collabaoration with sanna Majaneva at NTNU)	Gelatinous zooplankton	Genetic analyses, counts, size measurements	species list; ind/m3; ml/m3	NL v5 9.1.1.6	Gelatinous zooplankton abundance (ind/m3), volume & species composition (species list)	Counts, weight and lengths done onboard. Species barcoding later at NTNU	2020	RF3	T3-1.1 & 2.1 T3-2.1 & 2.2	2021-2022	2021-2022	Yes	Post doc project	From standard MIK net, each taxa counted, weighted (WW) and measured L. Individuals picked out, photographed and storedin EtOH (to NTNU/S. Majaneva).
Anette Wold; Amalia Keck	Philipp Assmy; Doreen Kohlbach	Fatty acids	Analysis of relative proportions of lipid classes by HPLC and individual	Relative proportions of neutral and polar lipid classes and fatty acids, and carbon stable isotope	NL v5 9.2.5 (9.1.5)	Fatty acids of POM, main zooplankton taxa & fish	AWI (collaboration w/ Martin Graeve) University la Rouchelle (collaboratio	2020	RF3	T3-1.3	2021-2022	2021-2022	Yes	Post doc project	Dataset shared with Ecotox group (see comment for Stable istope)to be finalised by P. Assmy & Doreen. Kohlbach
Anette Wold; Amalia Keck	Philipp Assmy; Doreen Kohlbach	Highly branched isoprenoids (HBIs) NOT IN SAMPLE TYPE LIST	Analysis of relative abundances of pelagic	Relative abundances of highly branched isoprenoids'	NL v5 9.2.5 (9.1.5)	HBI of POM, main zooplankton taxa & fish	Plymoth University (in collaboration with Simon	2020	RF3	T3-1.3	2021-2022	2021-2022	Yes	Post doc project	
Anette Wold; Amalia Keck; Julia	Philipp Assmy; Doreen Kohlbach	POM, zooplankton & fish stable isotopes	Stable isotopes	d13C; d14N (species specific?)	NL v5 9.2.5 (9.1.5)	Stable isotopes of POM, main zooplankton taxa & fish	UiO	2020	RF3	T3-1.3	2021-2022	2021-2022	Yes	Post doc project	SI & FA samples taken of same taxa of mesozooplankton, macrozooplankton & fish. These two datasets will be shared between J. Giebichenstein, R. Nowicki & D. Kohlbach. SI sampled by J. Giebichenstein will be analysed at UiO. FA analysed by D. Kohlbach (NPI) at AWI. Zooplankton SI dataset is also referred to in row 28 (Meso & macrozooplankton SI) and also linked to the Oithona SI dataset (row 27)

Angela Stippkugel	Angela Stippkugel	Two point dilution experiment	Flow Cytometry, nutrient analysis, phytoplankton and microzooplankton diversity,	Flow Cytometry, nutrient analysis, phytoplankton and microzooplankton diversity, HPLC, Fluorometry, CN analysis	NL v5 9.2.1 (should be 9.3.1)	Dynamics of lower trophic level food web structure	NTNU	2018 - 2021	RF3	T3-3.1 & T3-4.2	2021	2021	Yes, possibly	PhD project	
Anna Vader, Miriam	Anna Vader	Chlorophyll a	Fluorometric analysis	Chl a total and > 10um biomass	NL v5 7.11.1	Chl a total and > 10um biomass	Onboard KPH	During cruise	3	T3-1.1	des.19	feb.20	No		
Anna Vader, Snorre Flo, Rita Amundsen	Anna Vader, Tove M. Gabrielsen	Microbial diversity (DNA and RNA)	rRNA	Protist diversity		diversity across season based on rRNA metabarcoding	UNIS	2019-20	RF3	T3-1.1/T3-1.2/T3-1.3/T3.2.1/	2020	2020	No		Will be analysed partly by PostDoc to be hired august 2021
Anna Vader, Snorre Flo	Anna Vader, Tove M. Gabrielsen	Microbial activity (RNA)	mRNA	Protist activity		Metatranscriptomics and quantification of gene expression of select genes across season	UNIS	2020	RF3	T3-2.2	2021	2021	No		Will be analysed by PostDoc to be hired august 2021
Anna Vader, Snorre Flo, Rita Amundsen	Bente Edvardsen; Anna Vader; Tove M. Gabrielsen	Microbial diversity (DNA and RNA)	metabarcoding using rDNA	Protist diversity		Protist diversity, proportional abundance, seasonal dynamics and distribution	UiO and UNIS	2019-2021	RF3	T3.1.1, T3.1.2, T3.2.1	2020	2020-2021	Yes	PhD-project	Part of Karoline Saubrekkas thesis
Christine Gawinski	Camilla Svensen	Productivity of Oithona similis	Egg hatching experiment	egg production rate, weight specific egg production rate	NL v5 chapter 9.2.3.	spatial and temporal variability of copepod secondary production, specific egg production rate as an estimate for copepod production	UiT	2019 - 2021	RF3	T3-2.2	2020	2021	yes	PhD project	
Christine Gawinski	Camilla Svensen, Janne Søreide	Productivity of Calanus hyperboreus, Calanus glacialis, Metridia longa	Egg production experiments	egg production rate, weight specific egg production rate	NL v5 chapter 9.2.3.	spatial and temporal variability of copepod secondary production, specific egg production rate as an estimate for copepod production	UiT	2019 - 2021	RF3	T3-2.2	2020	2021	yes	PhD project	
Christine Gawinski	Camilla Svensen	small mesozooplankton	Secondary production	Female:egg ratio, taxonomy and abundance of nauplii	NL v5 chapter 9.2.3.	spatial and temporal variability of copepod secondary production, female:egg ratio as an estimate for copepod production, copepod reproduction during the polar night	UiT	2019 - 2021	RF3	T3-2.2	2020	2021	yes	PhD project	
Christine Gawinski	Camilla Svensen	small mesozooplankton	Sorting and morphological identification	composition, zooplankton abundance (ind/m3) and biomass (mg	NL v5 chapter 9.2.1.2	characterization of the mesozooplankton community in relation to hydrography and seasons	UiT	2019 - 2021	RF3	T3-2.2	2020	2021	yes	PhD project	
Christine Gawinski, Hilde Rief Armo, Lise Øvreås	Camilla Svensen	Grazing experiment of Oithona and Calanus	Bacterial production, Flow Cytometry, microbial diversity, microzooplankton diversity	Bacterial production, Flow Cytometry, microbial diversity, microzooplankton diversity	Samples will be analyzed at UiB	Influence of Oithona and Calanus on the microbial food web (top down control?), comparison between the two different feeding strategies	UiB	2019-2020	RF3	T3-4.1	2020	2021	yes	PhD project	

Julia Giebichenstein, Christine Gawinski	Camilla Svensen	stable isotopes	from Oithona	d13C; d14N (species specific?)	samples will be analysed by Julia Giebichstein	Determine trophic position of Oithona	UiO	2019 - 2021	RF3	T3-2.2	2020	2021	yes	PhD project	
Christine Gawinski	Doreen Kohlbach	fatty acids	from Oithona	Relative amount of fatty acid	samples will be analysed by Doreen Kohlbach	determine the quality of food of Oithona in different seasons	NPI	2019 - 2021	RF3	T3-2.2	2020	2021	yes	PhD project	
Eric Jorda, Arunima Sen, Silvia Hess, Thaise Freitas, Snorre Flo	Anna Vader/Bodil Bluhm/Camilla Svensen/Kim Præbel	Sediment in ethanol	Benthos sample from box core for DNA analysis of benthic diets and prey based on DNA	Benthos diet/prey diversity	NL v5 10	Diversity of zoobenthos prey, possibly also genetic identification of benthic species	UNIS/UiT	2020-21	3	T4-4.1	2021	2021	Yes, possibly	PhD project	Sample type not found in log sheet, should be added
Kasia Zamelczyk	Agneta Fransson, Tine L. Rasmussen	Plankton sample	Carbonate contribution (from the abundances of marine calcifiers)	mg CaCO3/m3, (% and #/m3)	tba 64 um multinet - fixed depths	Relative and absolute abundance of marine calcifiers on the water column and their contribution to the carbonate pump	NPI, CAGE-UiT (Tromsø)	2020	RF2	T2-1.4	2021	2021	yes	Post Doc project	
Hilde Stabell / Lise Øvreås	Gunnar Bratbak	Bacterial activity (Radioactively labelled bacteria)	Bacterial production of carbon biomass	Bacterial production rate ([2,3,4-3H] leucine) in µgC L-1-d-1	NL v5 7.19	Bacterial production rate	UiB	2019-2020	RF3	T3-2.3/T3-3.1/	2020	2021	No		Confirm with the PI
Hilde Stabell / Lise Øvreås	Gunnar Bratbak, Aud Larsen	Microbial abundance	Flow cytometry	Planktonic cell per ml	NL v5 7.18	Abundance tables	UiB	2019-2020	RF3	T3.1.1, T3.1.2, T3.2.1	2020	2021	No		Confirm with the PI
Hilde Stabell / Lise Øvreås	Gunnar Bratbak	SEM filter	Scanning electron microscoppy	Qualitative analysis of small plankton	NL v5 7.22	Plankton diversity, dynamics and distribution	UiB	2019-2020	RF3	T3.1.1, T3.1.2, T3.2.1	2020	2021	No		Confirm with the PI
Hilde Stabell / Lise Øvreås	Gunnar Bratbak, Jorun K. Egge, Tatiana Tsagaraki	XRF filter	X-Ray Fluorescence (XRF)	Concentration of total particulate elements in µM	NL v5 7.9	Concentration of total particulate O, P, Na, Mg, Si, S, Ca, Mn, Fe, Zn (µM)	UiB	2019-2020	RF3	T3.1.1, T3.1.2, T3.2.1	2020	2021	No		Confirm with the PI
Hilde Stabell / Lise Øvreås	Gunnar Bratbak, Ruth-Anne Sandaa	Virus diversity	Recover viruses from natural waters via iron chloride	Virus diversity	NL v5 7.20	Virus diversity across season based on metabarcoding	UiB	2019-2020	RF3	T3.1.1, T3.1.2, T3.2.1	2020	2021	No		Confirm with the PI
Hilde Stabell / Lise Øvreås	Gunnar Bratbak, Oliver Müller, Lasse Mørk Olsen	Grazer exclusion experiment	Bacterial production, Flow Cytometry, microbial diversity, nutrient analysis, microzooplankton diversity	Bacterial production, Flow Cytometry, microbial diversity, nutrient analysis, microzooplankton diversity	NL v5 7.27.1	Dynamics of lower trophic level food web structure	UiB	2019-2020	RF3	T3-4.1	2020	2021	No		Confirm with the PI

Janne E. Søreide	Janne E. Søreide	zooplankton community respiration	Physiology; respiration; energetic needs	respiration	NL v5 9.2.2	Basal metabolic rate	UNIS	autumn 2020	RF3	T3-2.1; 4.2	2020	2021	no		this was a test experiment run once and only during Q4
Janne E. Søreide	Janne E. Søreide	Zooplankton community from ship's surface water intake	stable isotopes and community	13C and 15N	NL v5 9.2.5 (9.1.5)	Stable isotopes of zooplankton community	UNIS	2021	RF3	T3-4.2	2021	2021	no		surface waterintake collected a lot of zooplankton while steaming - this collected for stable isotope samples
Konrad Karlsson, Janne E. Søreide	Janne E. Søreide	Individual Calanus males	DNA (antenna) and Dry matter	DNA and Dry matter	NL v5 9.2.2	Individual dry weight of species identified Calanus males	UNIS	2021	RF3	T3-4.2	2021	2021	no		Many C. hyperboreus and C. glacialis males in December so special focus on sampling them
Konrad Karlsson	Konrad Karlsson, Janne E. Søreide	Individual copepod basal metabolism	Physiology; respiration; energetic	respiration, images, dry matter	NL v5 9.2.2	individual dry weight, Calanus species ID molecular tools	UNIS	2021	RF3		2021	2021	no		
Julia Giebichenstein	Katrine Borgå	PFAS water samples	PFAS analyses	food web contaminant biomagnification	NL v5 13.1.2	food web contaminant biomagnification	UiO	2019-2022	RF2	T2-2.1	2022	2022	yes	PhD project	
Julia Giebichenstein, Rita Amundsen,	Katrine Borgå	Meso- and Macrozooplankton	stable isotopes, mercury, persistent	food web contaminant biomagnification	NL V5 chapter 13	food web contaminant biomagnification	UiO	2019-2021	RF2	T2-2.1	2021	2022	yes	PhD project	
Julia Giebichenstein, Rita	Katrine Borgå	In-situ filtration pump	persistent organic pollutant	food web contaminant biomagnification	NL V5 chapter 13	food web contaminant biomagnification	UiO	2019-2021	RF2	T2-2.1	2021	2022	yes	PhD project	
Julia Giebichenstein, Øystein Varpe	Katrine Borgå	frozen (-20C) whole and dissected fishes: muscle, otoliths, stomach	isotopes, mercury, persistent organic pollutants,	food web contaminant biomagnification	NL V5 chapter 13	food web contaminant biomagnification	UiO / NP	2019-2021	RF2	T2-2.1	2021	2022	yes	PhD project	SI analyses will be done at UiO, fatty acid analyses by post-doc at NP, if she needs this data.
Libby Jones, Helena Hodal Lødemel, Ylva Ericson	Melissa Chierici, Agneta Fransson	Water samples from the CTD	Carbonate chemistry and chemical parameters	dissolved oxygen, pH, dissolved inorganic carbon, alkalinity, nutrients, d18O	NL v5	dissolved oxygen, pH, dissolved inorganic carbon, alkalinity, nutrients, d18O	IMR/NPI	2019-2021 (analysed onboard, except nutrients post.crusie analyses)	RF2	T2-1.1	2020	2021	No		Onboard analyses except nutrients and O18 which are samples for pot-cruise analysis in 2020
Libby Jones, Helena Hodal Lødemel, Ylva Ericson	Melissa Chierici, Agneta Fransson	Sea ice, snow, brine, under-ice water	Carbonate chemistry and chemical parameters	pH, dissolved inorganic carbon, alkalinity, nutrients, d18O	NL v5	pH, dissolved inorganic carbon, alkalinity, nutrients, d18O	IMR/NPI	2019-2021	RF2	T2-1.1	2020	2021	No		Onboard analyses except nutrients and O18 which are samples for pot-cruise analysis in 2020
Lise Øvreås, Anna Vader	Lise Øvreås	Microbial diversity (DNA and RNA)	rDNA and rRNA	Bacterial and archean diversity	NL v5 7.15	Prokaryote diversity based on rDNA and rRNA metabarcoding	UiB	2020	3	T3-1.1	2020	2021	No		
Maria Digernes, Stephen Kohler, Nicolas	Murat V. Ardelan	Dissolved organic matter characterization, TOC	HPLC-MS	Type and composition of DOM, TOC, ancillary POC and DOC	NL v5 7.6	Variation, composition, and distribution of DOM and TOC, with ancillary POC and DOC measurements	NTNU	2019-2020	RF2	T2-2.2	2020	2021	yes	phd project	Maria Digernes PhD project

Martí Amargant-Arumí	Rolf Gradinger	Radioactively labelled algae on GF/F filters	Primary production in situ	Primary production rate (14C uptake)	NL v6 7.26	Vertical profiles of primary production across latitude and seasons	UiT	2019-2020	RF3	T3-1.1/T3-1.2/T3-1.3/T3.2.1/	2020	2021	Yes	PhD-project	
Martí Amargant-Arumí	Rolf Gradinger	Radioactively labelled algae on GF/F filters	Light intensity vs. Photosynthesis curves	Primary production rate (14C uptake)	NL v6 7.27	Primary production response to various light intensitites	UiT	2019-2020	RF3	T3-1.1/T3-1.2/T3-1.3/T3.2.1/	2020	2021	Yes	PhD-project	
Martí Amargant-Arumí	Rolf Gradinger	Isotopically labelled algae on GF/F filters	Nitrogen uptake in situ incubations	d13C, d15N	TBD	Ratios of Carbon and Nitrogen stable isotopes before and after incubations, F-ratios of primary production	?	2019-2020	RF3	T3-1.1/T3-1.2/T3-1.3/T3.2.1/	2020	2021	Yes	PhD-project	
Martí Amargant-Arumí	Rolf Gradinger	Fixed water samples and Sterivex filters from experimental bottles	see comments	Community composition, cell abundances	TBD	Protist DNA sequences, phylogenetic positions and corresponding abundances at different incubation times	UiT	2019-2020	RF3	T3-1.1/T3-1.2/T3-1.3/T3.2.1/	2020	2021	Yes	PhD-project	Quantification of phytoplankton resting spores' germination rates, and connectivity between sea ice and sediments
Miriam Marquardt	Marit Reigstad, Gunnar Bratbak	POC/PON	CN analyses	µg/L	NL v5 7.4	POC/PON	UiT/UiB	2020-2023	RF3		2020-2023	2022	yes	PhD project	
Miriam Marquardt	Miriam Marquardt, Rolf	Ice meiofauna abundance/taxono	Microscopy	Ind/m3; ml/m3	NL v5 14.6.4	Ice meiofauna abundance/taxonomy	UiT	2020-2023	RF3		2020-2023	2022	Yes, possib		
Miriam Marquardt, Libby Jones,	Melissa Chierici, Agneta Fransson	Nutrients from sea ice cores	Nutrient analyzer	µg/L	NL v5 14.6 + 7.10	Nutrients	IMR	2020-2023	RF3		2020-2023	2023	No		
Nicolas Sanchez, Stephen Kohler, Maria	Murat V. Ardelan	Total trace elements and dissolved trace elements	Preconcentration via SeaFAST and ICP-MS	Concentration of elements in nM	NL v5 7.7	Total and dissolved trace elements transect profile	NTNU	2019-2020	RF2	T2-2.2	2020	2021	Need to ask PI		Confirm with the PI
Nils Olav Handegard, Tom Van	Nils Olav Handegard	TS probe	Echo integration	Acoustic bacscattering strength	NL v5 9.1.3	Zooplankton target strengths	Onboard KPH	During cruise	RA-C	TC-1-1	2020	2020-2022	No		
Nils Olav Handegard, Tom Van	Nils Olav Handegard	Shipp mounted echo sounders	Echo integration	Acoustic bacscattering strength	NL v5 9.1.3	Zooplankton acoustic backscatter	Onboard KPH	During cruise	RA-C	TC-1-1	2020	2020-2022	No		
Rita Amundsen	Luka Supraha	Coccolithophores on PC filters	Scanning electron microscoppy (SEM)	taxonomic composition, abundance and distribution	NL v5 7.22	Coccolithophore diversity, dynamics and distribution	UiO	2019-2020	RF3	T3.1.1, T3.1.2, T3.2.1	2021-2022	2021-2022	Need to ask PI	PhD-project	Part of Karoline Saubrekkas thesis. Confirm with the PI
Rita Amundsen	Philipp Assmy, Rolf Gradinger, Bente Edvardsen	Fixed water samples from Niskin bottles 6 depths and ice stations	Utermöhl cell counts under the microscope	Cell abundances of protists > 10 µm	NL v5 7.13 + 7.14	Phytoplankton/protist abundance	ISOP	2019-2020	RF3	T3.1.1	2020 or when ready	2021	No		We would like to compare metabarcoding results with micoscopical cell counts in Karoline Saubrekkas PhD-project
Rita Amundsen, Anna Vader, Snorre Flo	Bente Edvardsen; Anna Vader	Protist diversity (DNA and RNA)	metabarcoding using rDNA and rRNA	Protist diversity	NL v5 7.15	Protist diversity, proportional abundance, dynamics and distribution through the seasons	UiO and UNIS	2019-2021	RF3	T3.1.1, T3.1.2, T3.2.1	2021	2021-2022	Yes	PhD-project	Part of Karoline Saubrekkas thesis

Rita Amundsen	Bente Edvardsen, Philipp Assmy	Fixed phytoplankton	Light and electron	Protist diversity > 10 µm	NL v5 9.1	Species lists and micrographs	UiO and IOPAS	2020-2021	RF3	T3.1.1	2020-2021	2021	Need to ask	PhD-project	Part of Karoline Saubrekkas thesis.
Robynne Nowicki	Øystein Varpe, Katrine borga, Geir Wing gabrielsen	Macro-zooplankton and fish	Energetics analysis using bomb calorimetry and Cellular Energy Allocation	Energy, protein and lipid content; pollutant concentration of polar cod brain	NL v5 13.2-13.3	Seasonal variation in macrozooplankton and fish energy content; Seasonal remobilization of pollutants in polar cod	UiT/UNIS/UiO	2020-2021	RF2	T2-2.5	2021	2021-2022	Unsure	PhD project	
Silvia Hess, Thaise Freitas, Arunima Sen, Eric Jorda	Paul Renaud	Sediment pigment	Fluorometric analysis	mg Chl a / m2, mg phaeopigment / m2	(10.3.2)	Sediment pigments	APN	2019-2021	3	T3-1.2	2020	2020-2022	No		to be finalized by PI
Silvia Hess, Thaise Freitas, Arunima Sen, Eric Jorda	Elisabeth Alve & PhD- Thaise Freitas	Grain size	Laser Diffraction Particle Size Analyzer (grain size); combustion in muffle furnace (TOC,	sediment grain size fractions, sediment total organic carbon (TOC, %), sediment total nitrogen (TN, %), d13C (per mil), d15N (per mil)	(10.3.3)	sediment grain size fractions, sediment total organic carbon (TOC, %), sediment total nitrogen (TN, %), d13C (per mil), d15N (per mil)	UiO	2019-2022	1, 3	RF1, RF3 T3-1.2	2020	2021-2022	Yes, possibly	PhD project	to be finalized by PI
Silvia Hess, Thaise Freitas, Arunima Sen, Eric Jorda	Elisabeth Alve & PhD student- Thaise Freitas (Foraminifera), Bodil Bluhm (metazoan	Meiofauna abundance	Sorting and morphological identification	number of (taxon) / cm2	(10.3.5)	Foraminifera abundance, diversity and composition; metazoan meiofauna abundance, diversisty and composition	UiO (Foraminifera), UiT / IOPAS (metazoan meiofauna)	2019-2022	1, 3		2020	2021-2022	Yes, possibly	PhD project	
Silvia Hess, Thaise Freitas, Arunima Sen,	Paul Renaud	Sediment pigments	HPLC	mg pigment type / m2	(10.3.1)	sediment pigments HPLC	Plymouth Marine Laboratory	2019-2020	RF3, CAO	T3-1.2	2020	2021-2022	no	no embargo	to be finalized by PI
Silvia Hess, Thaise Freitas, Arunima Sen, Eric Jorda	Henning Reiss, Paul Renaud	Macrofauna diversity and abundance	Sorting and morphological identification	number of (taxon) / cm2, diversity indexes, community analysis	(10.3.1)	Macrofauna abundance, diversity and composition; metazoan macrofauna abundance, diversisty and composition, community analysis	Nord/IOPAN	2019-2020	3	T3-1.1, T3-1.2, T3-1.3	2021-2023	2021-2023	Yes, possibly	PhD project	to be finalized by PI
Silvia Hess, Thaise Freitas, Arunima Sen, Eric Jorda	Lise Øvreås	Microbial diversity (sediment)	Metabarcoding	taxonomic composition, abundance and distribution	NL v5-10.3.4	Microbial eukaryote diversity in sediment across season based on metabarcoding	UiB	2019-2021	RF3	T3-1.1, T3-1.2, T3-1.3, T3-4.1	2021	?	Unsure		to be finalized by L. Øvreås
Silvia Hess, Thaise Freitas, Arunima Sen,	Paul Renaud	Sediment community incubations	Sediment community oxygen uptake	oxygen uptake mmol / h	NL v5 10.3.8	oxygen uptake	onboard	2019-2020	RF3	T3-4.3	2019-2020	2020-2021	no	no embargo	
Silvia Hess, Thaise Freitas, Arunima Sen, Eric Jorda	Bodil Bluhm, Andreas Altenburger	Megafauna taxonomy	Museum archival	Taxonomic voucher inventory of Nansen Legacy fauna collected	Nl v5 10.2.3	Taxonomic voucher inventory of Nansen Legacy fauna collected	UiT Museum	2020-2023	RF3	T3-3.1	n/a	n/a	No	no embargo	Museum archival timeline tbd by new collection employee
Silvia Hess, Thaise Freitas, Arunima Sen,	Bodil Bluhm, Lis Jørgensen	d13C / d15N organisms (mostly benthic)	IRMS coupled to C/N analyser	d13C, d15N	Nl v5 10.3.1	Carbon and nitrogen stable isotope composition	UiO (Nansen Legacy agreement?)	2021-2023	RF3	T3-3.4	2022-2023	2023	possibly	Post doc project	

Silvia Hess, Thaise Freitas, Arunima Sen, Eric Jorda	Paul Renaud, Henning Reiss	Nutrient concentrations in incubations	nutrient analyzer	Macronutrient concentrations in bottom water before and after incubation	NL v5 10.3	Macronutrient concentrations in bottom water before and after incubation	APN	2019-2020	RF3	T3-3.4	2021-2023	2021-2023	no	no embargo	
Siv Hoff, Julie Bitz-Thorsen	Sissel Jentoft	Tissue (of capelin, polar cod and cod)	analysis (individual level)	De novo genome assembly	NL v5 11.3	Whole-genome sequences	UiO	2019-2022	2	T2-3.1	2020-2022	2020-2022	Yes, possibly	PhD project	
Siv Hoff, Julie Bitz-Thorsen	Sissel Jentoft	Tissue (of capelin, polar cod and cod)	Genomic analysis (population level)	Population-genetic data (diversity) along climate gradient in two seasons	NL v5 11.3	Whole-genome sequences	UiO	2019-2022	2	T2-3.1	2020-2022	2020-2022	Yes, possibly	PhD project	
Siv Hoff, Julie Bitz-Thorsen	Sissel Jentoft	Tissue (of capelin, polar cod and cod)	Investigation of candidate genes	Population-genetic data (linked to function) along climate gradient in two seasons	NL v5 11.3	Population-genomic statistics	UiO	2019-2022	2	T2-3.1	2020-2022	2020-2022	Yes, possibly	PhD project	
Snorre Flo, Anna Vader	Anna Vader/Bodil Bluhm/Camilla Svensen/Kim Præbel	Plankton sample	64 um plankton sample for DNA analysis of diet of	Zooplankton diet/prey diversity	NL v5 10.3.13	Diversity of small zooplankton prey, possibly also zooplankton genetic identification	UNIS/UiT	2020-21	3	T4-4.1	2021	2021	Yes, possibly	PhD project	
Snorre Flo, Anna Vader, Anette Wold	Anna Vader	C. finmarchicus samples in ethanol.	Metabarcoding of C. finmarchicus prey diversity	C. finmarchicus prey diversity	Sample type not found in log sheet, should be added.	Diversity of prey in C. finmarchicus diet. Possible identification of symbiotes.	UNIS/UiT	2020-2021	RF3	T4-4.1	2021	2021	Yes, possibly	PhD project	C. finm were picked from shallow 180 um net haul at P7 and isolated in ethanol. Additional C. finm were starved, and will serve as a control for symbiotes/eDNA in dietary profiles.
Stephen Kohler, Nicolas Sanchez, Maria Digernes	Murat V. Ardelan, Stephen Kohler	Total mercury and methylmercury	Cold vapor atomic fluorescence spectrometry (CVAFS) for THg and MeHg, or GC-	THg, MeHg in pM	NL v5 7.7.1	Total mercury and methylmercury transect profile	Mediterranean Institute of Oceanography (MiO) in Marseille, France	2019	RF2	T2-2.2	2020-2021	2021	yes	PhD project	Stephen Kohler PhD project
Stephen Kohler, Nicolas	Murat V. Ardelan	Sediment samples	Sequential extraction for trace	Trace element concentrations	Nansen Legacy v4 10.4	Distribution of trace elements in sediments	NTNU	2019-2020	RF2	T2-2.2	2021	2021	maybe, check with		
Tom Van Engeland	Espen Bagøien, Post Doc	Macrozooplankton	Sorting and morphological identification, isotopic analysis	taxonomic composition, biomass	NL v5 7.11.1	Key organims, e.g. Euphausiids and amphipods, Map spatial distribution, taxonomic compostion and biomass indices, temporal and spatial variation in abundance, biomass, diveristy	IMR	2019-2021	3	T3-1.1; T3-2.1	2020	2020-2022	No		to be finalized by PI

Tore Mo-Bjørkelund,	Martin Ludvigsen	Underwater Video	N/A	Zooplankton stratification	n/a	Video	NTNU/On board KPH	2019	RA-C	TC-2.2	2019	2020	no		Can be used for outreach.
Tore Mo-Bjørkelund, Ruochen Yang	Mrtin Ludvigsen	Echo sounder data (AZFP)	Echo integration	Acoustic backscattering strength	n/a		NTNU/On board KPH	2019	RA-C	TC-2.2	2019	2020	no		
Yasemin Bodur	Yasemin Bodur	Chlorophyll a	algal	Chl a total	chapter 8	Chlorophyll a	Onboard KPH	During cruise	RF3	T3-2.2; 4.4	2020	2021	yes	project	
Yasemin Bodur	Marit Reigstad, Yasemin Bodur	Chlorophyll a >10µm	fractionated algal pigments, filtered through Polycarbonate filters from	Chl a >10µm	NL v5 chapter 8	Chlorophyll a >10µm	Onboard KPH	During cruise	RF3	T3-2.2; 4.4	2020	2021	yes	PhD-project	
Yasemin Bodur	Marit Reigstad, Yasemin Bodur	POC/PON	CN analyses from sediment trap samples	µg/L	NL v5 chapter 8	POC/PON	UiT	2019-21	RF3	T3-2.2; 4.4	2020	2021	yes	PhD-project	
Yasemin Bodur	Marit Reigstad, Yasemin Bodur	stable isotopes	from sediment trap samples	d13C; d14N	NL v5 chapter 8	stable isotopes	UiO	2019-21	RF3	T3-2.2; 4.4	2020	2021	yes	PhD-project	
Yasemin Bodur	Marit Reigstad, Paul Renaud, Yasemin Bodur	water column pigments	HPLC from sediment trap samples	mg pigment type / m2	NL v5 chapter 8	HPLC	UK	2019-21	RF3	T3-2.2; 4.4	2020	2021	yes	PhD-project	
Yasemin Bodur	Marit Reigstad, Paul Renaud, Yasemin Bodur	sea ice algae proxy	IP25 from sediment trap and boxcore	mg pigment type / m2	NL v5 chapter 8	IP25	UK	2019-21	RF3	T3-2.2; 4.4	2020	2021	yes	PhD-project	
Yasemin Bodur	Marit Reigstad, Yasemin Bodur	phytoplankton communities	from sediment trap samples	community composition and counts	NL v5 chapter 8	phytoplankton communities	UiT	2019-21	RF3	T3-2.2; 4.4	2020	2021	yes	PhD-project	
Yasemin Bodur	Marit Reigstad, Yasemin Bodur	fecal pellets	from sediment trap samples	fecal pellet types and counts	NL v5 chapter 8	fecal pellets	UiT	2019-21	RF3	T3-2.2; 4.4	2020	2021	yes	PhD-project	
Yasemin Bodur	Kim Præebel; Paul Renaud	molecular diet analysis for Pandalus borealis	indidivuals stored in 96% EthOH at -20C	DNA extraction	NL v5 chapter 10.03.14	molecular diet analysis	UiT	2020	RF2/RF3	All that need b	yes	yes	no		
Yasemin Bodur	Marit Reigstad; Paul Renaud	particulate biogenic Silica	biogenic silica from sediment trap	biogenic silica	NL v5 chapter 8	bSi	UiT	2019-21	RF3	T3-2.2; 4.4	2020	2021	yes	PhD-project	
Yasemin Bodur	Marit Reigstad; Paul Renaud	stable isotopes	stable isotopes from bottom water (CTD) filtrated	stable isotopes	not established	stable isotopes	UiO	2019-21	RF3	T3-2.2; T3-4.4; T2-1.2	2020	2021	yes	PhD-project	
Yasemin Bodur; Maria Guadalupe	Marit Reigstad	POC/PON	POC/PON from Aggregation	POC/PON	NL v5 chapter 7.27.2	POC/PON	UiT	2019-21	RF3	T3-2.2; T3-4.4; T2-1.2	2020	2021	yes	PhD-project	
Yasemin Bodur; Maria Guadalupe	Marit Reigstad	DOC	DOC from Aggregation experiment	DOC	NL v5 chapter 7.27.2	DOC	NTNU	2019-21	RF3	T3-2.2; T3-4.4; T2-1.2	2020	2021	yes	PhD-project	
Yasemin Bodur; Maria Guadalupe Digernes	Marit Reigstad	DOC characterization	DOC characterization on from Aggregation	DOC characterization	NL v5 chapter 7.27.2	DOC characterization	NTNU	2019-21	RF3	T3-2.2; T3-4.4; T2-1.2	2020	2021	yes	PhD-project	
Yasemin Bodur; Miriam Marquardt	Marit Reigstad, Yasemin Bodur	Metatranscriptomics	DNA/RNA from sediment trap samples	biological diversity & activity on particles	NL v5 chapter 8; chapter 7.15	Metatranscriptomics	UiT/UNIS	2019-21	RF3	T3-2.2; 4.4	2020	2021	yes	PhD-project	
Ylva Ericson, Rolf Gradinger, Kasia Zamelczyk, Audun Gerland	Dmitry Divine, Sebastian Gerland	Sea ice observations	Sea ice observations/ pictures from the bridge follow ASSIST	Sea ice coverage, Sea ice age and type, Snow cover	NL v5 4.1	Sea ice observations	NPI	2020	RF1	T1.1-1.2	2020	2021	No		

Appendix 3.2 Q4 continuous measurement data sets from 28 November to 17 December, 2019.

Who		Sample info		Analyses					Nansen Legacy		Data				
Cruise participant	PI	Sample type	Intended method	Para-meter	Analysis protocol	Dataset	Where will analyses be done	When are analyses planned for	RF	task	Sharing within project	Publishing data	Ask for embargo of data?	If yes, why?	Comments
KHP instrumentation	Randi Ingvaldsen					Acoustic data surveying fish and xooplankton, logged continuously					2019, NIRD	2020			EK80
KHP instrumentation	Tom Arne Rydingen					Multibeam mapping					NIRD	2020			EM302
KHP instrumentation	Øystein Godøy					Air and sea temperature (8 m depth), air pressure, wind speed and direction, relative humidity and solar radiation logged continuously					NIRD	2020			Weather station
KHP instrumentation	Helge Sagen					Temperature, salinity, density and fluorescence at 4m, logged continuously					NIRD	2020			Thermosalinograph
KHP instrumentation	Randi Ingvaldsen					Currents in the upper ~500 m legged continuously					NIRD	2020			ADCP 150 kHz
KHP instrumentation	Agneta Fransson					pCO2 in air and ocean, dissolved O2 in ocean, saturation of O2 in ocean, sea water temperature					NIRD	2021	No		pCO2 underway, takes time to quality-check data thus later publication
KHP instrumentation	Marit Reigstad					Temperature, salinity, density fluorescence, oxygen profiles from NLEG stations					NIRD	2020			CTD

The Nansen Legacy in numbers

6 years

The Nansen Legacy is a six-year project, running from 2018 to 2023.

1 400 000 km² of sea

The Nansen Legacy investigates the physical and biological environment of the northern Barents Sea and adjacent Arctic Ocean.

>10 fields

The Nansen Legacy includes scientists from the fields of biology, chemistry, climate research, ecosystem modelling, ecotoxicology, geology, ice physics, meteorology, observational technology, and physical oceanography.

>350 days at sea

The Nansen Legacy will conduct 15 scientific cruises and spend more than 350 days in the northern Barents Sea and adjacent Arctic Ocean between 2018 and 2022. Most of these cruises are conducted on the new Norwegian research icebreaker RV *Kronprins Haakon*.

280 people

There are about 230 researchers working with the Nansen Legacy, of which 73 are early career scientists. In addition, 50 persons are involved as technicians, project coordinators, communication advisers and board members.

10 institutions

The Nansen Legacy unites the complimentary scientific expertise of ten Norwegian institutions dedicated to Arctic research.

50/50 financing

The Nansen Legacy has a total budget of 740 million NOK. Half the budget comes from the consortiums' own funding, while the other half is provided by the Research Council of Norway and the Ministry of Education and Research.

Norwegian Ministry of Education and Research

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