HEINCKE-Berichte

Influence of climate change on interactions and biodiversity in Arctic ecosystems

Cruise No. HE 560

3.8. – 8.9.2020,
Bremerhaven (Germany) – Bremerhaven (Germany)
ARCTIC INTERACTION 4

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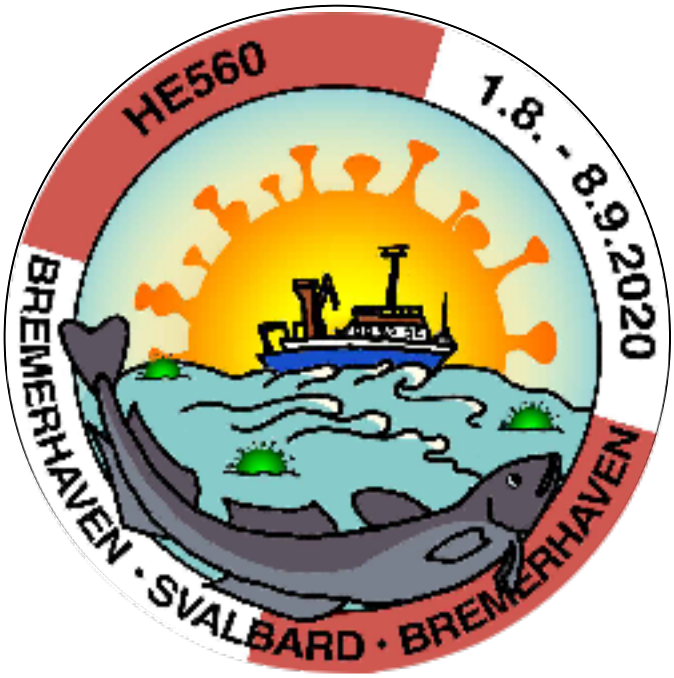

AUTHORS

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2020

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1 Cruise Summary

1.1 Summary in English

The primary aim of this expedition was to investigate the spatial and temporal distribution, the ecology and physiology, as well as competition of co-occurring gadoid species (Atlantic cod, Polar cod, haddock) in the communities of Arctic and Atlantic influence around Svalbard. We sampled the benthic and pelagic communities (including plankton) on the shallow shelf regions of Svalbard to estimate the effects of climate change on Arctic ecosystems to obtain a picture of the entire system structure and function for a long-term monitoring program of the 'Atlantification' of the Svalbard region. We assessed the potential impact of changes in trophic interaction (predator-prey relations) of Atlantic cod (*Gadus morhua*), Polar cod (*Boreogadus saida*), haddock (*Melanogrammus aeglefinus*) and decapod crabs on the productivity and stability of benthic and pelagic communities in Arctic ecosystems, into which their distribution ranges now extend due to ocean warming. In addition to a stock assessment and distribution analysis of gadoid fish and decapod crabs, we aimed to obtain specimens of these species in the Atlantic and polar waters around Svalbard, which were transported alive back to Germany. Laboratory experiments under scenarios of climate change at the Alfred Wegener Institute then provided (and still provide) further insight into capacities for adaptation, performance and interaction of selected species of the Arctic ecosystem around Svalbard. The results will on the one hand be used in an international Norwegian-German project and the pan-Arctic data management system (Piepenburg et al. 2011), on the other hand they will flow into fisheries modelling at the University of Hamburg, the Thuenen Institute and socio-economic modelling approaches that build on the German ocean acidification project BIOACID (www.bioacid.de).

1.2 Zusammenfassung

Im Rahmen dieser Expedition soll die räumliche und zeitliche Verbreitung, Ökologie und Physiologie sowie die potentielle Konkurrenz gemeinsam vorkommender gadoider Fische (Kabeljau, Polardorsch und Schellfisch) in Gemeinschaften, die unter arktischem oder atlantischem Einfluss in den Gewässern um Spitzbergen stehen, untersucht werden. Es werden sowohl benthische als auch pelagische Gemeinschaften auf dem flachen Schelf beprobt, um im Rahmen einer Langzeitstudie zur ‚Atlantifizierung' der Spitzbergenregion die Einflüsse des Klimawandels auf arktische Ökosysteme für ein Gesamtbild ihrer Struktur und Funktion abschätzen zu können. Wir werden den Einfluß von Veränderungen in trophischen Interaktionen von Fischen und dekapoden Krebsen auf die Produktivität und Stabilität benthischer und pelagischer Gemeinschaften im arktischen Ökosystem, in welches atlantische Arten zunehmend vordringen, untersuchen. Neben einer Verbreitungsanalyse von Kabeljau, Polardorsch, Schellfisch und dekapode Krebse sollen auch lebende Individuen dieser Arten für physiologische Experimente zurück nach Deutschland transportiert werden. Hier sollen durch Experimente unter verschiedenen Klimawandelszenarien Anpassungs- und Leistungsvermögen dieser Arten untersucht werden. Die Ergebnisse werden zum einen in einem internationalen Projekt mit norwegisch-deutscher Kooperation verwertet, zum anderen werden sie auch in den modellierenden Ansätzen an der

Universität Hamburg, dem Thünen Institut und aufbauend auf das BMBF Verbundprojekt BIOACID für Fischerei- und sozio-ökonomische Modellierung verwendet.

2 Participants

2.1 Principal Investigators

Name	Institution
Mark, Felix Christopher, Dr.	AWI

2.2 Scientific Party

Name	Discipline	Institution
Mark, Felix Christopher, Dr.	Marine Ecophysiology / Chief Scientist	AWI
Cremer, Charlotte	Marine Geology	ULG
Gorniak, Rebekka	Marine Biology/Geology	AWI
Kempf, Sarah	Marine Ecophysiology	AWI
Krebs, Nina	Marine Ecophysiology	AWI
Koschnick, Nils	Marine Ecophysiology	AWI
Luckenbach, Till	Environmental Ecotoxicology	UFZ
Murray, Ayla	Marine Ecology	UHB
Spotowitz, Lisa	Marine Ecology	AWI
Withelm, Caroline	Marine Biology	UMZ
Verhaegen, Gerlien	Marine Ecology	JAMSTEC

2.3 Participating Institutions

AWI	Alfred-Wegener-Institut Helmholtz-Zentrum für Polar- und Meeresforschung
JAMSTEC	Japan Agency for Marine-Earth Science and Technology
UHB	Universität Bremen
UFZ	Helmholtz-Zentrum für Umweltforschung, Leipzig
ULG	Leuphana Universität Lüneburg
UMZ	Johannes Gutenberg-Universität Mainz

3 Research Program

3.1 Description of the Work Area

The cruise stations of our monitoring programme stretch out from Bear Island (Norway) to Nordaustlandet (Svalbard) within the coordinates: 74 N 10 E to 81 N 27 E. The order of the stations depend on weather, port of departure, and occurrence of sea-ice and growlers. They normally stretch from Bear Island (33 X 638542 8269882; 74.47 N 19.64 E) in the South West of the working area to Rijpfjorden (35 X 408050 8933508; 80.43 N 22.04 E) in the North East. Due to good weather conditions early in the summer, we were able to start our research in Rijpfjorden in the North East of Svalbard and gradually work towards the South Western tip of Svalbard, visiting many major fjord systems and several open shelf stations on the way (cf. fig 3.1). Hornsund was the last station, as the weather deteriorated end of August and all stations further South had to be cancelled.

3.2 Aims of the Cruise

The primary aim of the proposed expedition is to investigate the spatial and temporal distribution, the ecology and physiology, as well as potential competition of co-occurring gadoid species (Atlantic cod, Polar cod, haddock) in the communities of Arctic and Atlantic influence around Svalbard. Horizontal and vertical patterns in species distribution and body size distribution are going to be investigated to elucidate potential spatial niche separation or overlap and to presence or absence of diel vertical migration. Abiotic parameters (temperature, PCO_2, pH, salinity, etc.) are going to be measured at all stations throughout the entire water column. Diet composition of individuals from different areas and water depths are going to be studied and related to the availability of prey (plankton and benthos). To get a clear picture of overall structure, production and available biomass, the major parts of the food web are going to be sampled and analysed: phytoplankton, zooplankton, fish, and benthos. Among benthic organisms, particular focus will be on large decapod crustaceans, a group occupying a high trophic position in the benthic part of the food web. Live individuals of the different cod species and decapod crabs are going to be transported back to the Alfred Wegener Institute for further physiological experiments and analyses on, e.g. acclimation capacities and performance under scenarios of ocean acidification and warming, thermal tolerance and reproductive and energetic condition.

With its central focus on fjord systems and coastal shelfs of the Svalbard archipelago, this research project is connected to the larger sampling programs in the Fram Strait and the open Arctic Ocean, e.g. FRAM, SIPCA (PS106) and MOSAiC (R/V Polarstern 2019/2020).

3.3 Agenda of the Cruise

After transit to Southern Svalbard, we conduct station work from southwest to northeast to obtain a thorough picture of fish distribution and composition of benthic communities. To this end, we use bottom trawls, as well as box and multi corers, while pelagic samples (phyto- and zooplankton) are taken by plankton nets (Bongonet, Multinet) and water sampler. Furthermore, we use a pelagic trawl in combination with a fish lifter, which sorts the catch according to size and helps to surface specifically sensitive juvenile fish. This technique has already been successfully applied on-board R/V Heincke during the cruises HE 408 (08-09/13) HE 451 (09/15) and HE 519 (09/18), and increases the chances for survival of juvenile fish significantly. In accordance with the BSH StUK 4 and long-term experience from Antarctic expeditions with R/V Polarstern, trawl times are kept rather short (<15 minutes) to further maximise survival, which decreases the total number of trawls needed (and thus the impact on the ecosystem). There is no trawling at stations deeper than 350m (e.g. Kongsfjord series), benthic communities will only be sampled by means of corers and grabs (cf. Table 5.3.1, 5.3; 7.1).

Daily station work follows a rather fixed schedule to improve comparability between stations and cruises. We start each station with a CTD in the morning, followed by plankton nets. The rest of the morning is dedicated to pelagic trawls, which are continued or substantiated by bottom trawls (where applicable) in the afternoon. Box and multi corers are deployed in the evening. We aim to catch 50 individuals of Atlantic cod per station for genotyping and stock identification, trawl sampling is substantiated by scientific angling, if needed. Some additional sampling and trawling is conducted at different depths and times of day to account for diel vertical migration patterns of juvenile and adult fish that were observed during HE 408 and HE451. We also include sampling along geographic transects from the inner fjord systems (Rijpfjorden, Kongsfjorden/Krossfjorden, Hinlopen Strait) to the Atlantic shelf to further substantiate existing monitoring series by R/V Polarstern in deeper waters (Fram Strait, Hausgarten).

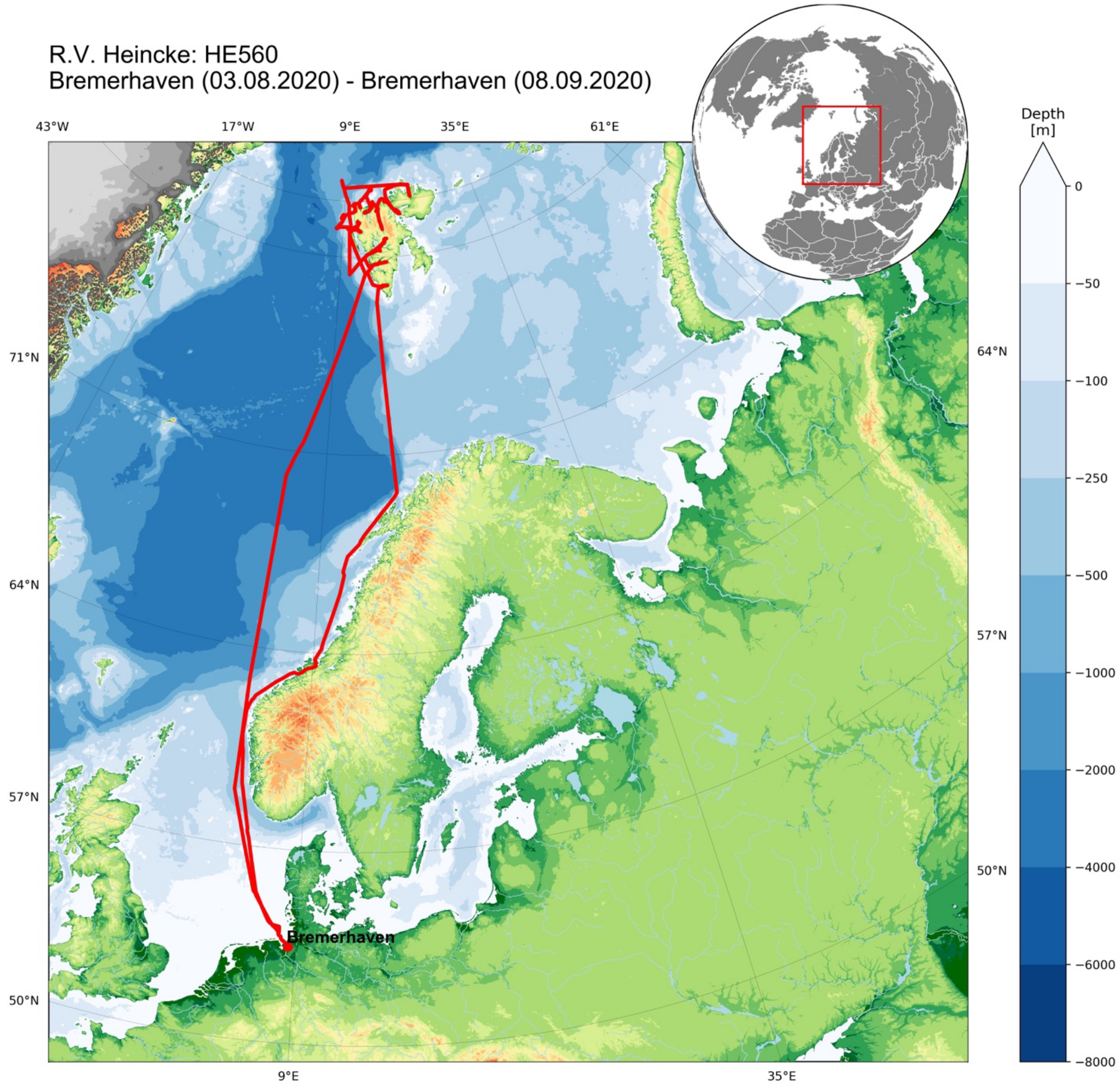

Fig. 3.1 Track chart of R/V HEINCKE Cruise HE560 with the cruise track from Bremerhaven to the main working area around Svalbard (www.pangaea.de).

4 Narrative of the Cruise

After 3 days of quarantine onboard R/V Heincke, we left port in Bremerhaven around noon of August 3rd, all having been tested twice for COVID19. With a steady southerly breeze and next to no swell, we had a very smooth sailing straight across the Atlantic Ocean, heading towards the Western coast of Svalbard at 79° N. We could already see the pointed mountain tops of Spitsbergen in the late evening of August 8th, and spent the next day travelling along the coast further North

to the eastern flanks of Yermak plateau to start our station work. Unfortunately, we encountered drift ice at 81° N and had to change plans, now directly heading for Rijpfjorden in Nordaustland.
We started practical scientific station work on Monday, August 10th, with deployment of a fish trap lander and regular station work (HE560_1; HE560_2):
First, a CTD, a van Veen grab and a multicorer were deployed, to sample to the water column and first 30cm of sediment. Afterwards, we towed a shallow (30-40m) and a deep (up to 400m) Bongo net to sample zooplankton at 1.5kn. Following this, we ran several juvenile fish trawls with fish lift at different depths from surface waters to close to the bottom, specifically aiming for flocks of juvenile fish under the surface, at the thermocline and above ground (water layers of interest derived from CTD and EK80 profiles). This daily sampling protocol was repeated at all other stations unless stated otherwise.
The first week of station work was dedicated to the Northern fjords, we sampled Hinlopen Stretet on August 11th (HE560_4), and Wijdefjorden between August 13th and 14th (HE560_5, 6, 7), followed by Liefdefjorden on August 15th (HE560_8), North West Svalbard, August 16th (HE560_9), and Raudfjorden (HE560_10) and Smeerenburgfjorden (HE560_11), on August 17th and 18th, respectively.
With the exception of the shallow station ‘North West Svalbard’, which is located on the shelf north of Moffen Island and clearly under Atlantic influence, all fjords showed polar characteristics with a shallow thermocline and a very cold bottom water body. Fauna was dominated by amphipods, ctenophores and polar cod (*B. saida*).
On August 19th, we continued off the west coast on the southern Yermak Plateau (HE560_12), before leaving the shelf for a deep-water station at 1200m depth in direction of the AWI Hausgarten (HE560_13, 14 on August 20th). From there we followed the transect (HE560_15, 16 on August 21st) back into Krossfjorden (HE560_17) and finally Kongsfjorden on August 23rd. The stations on the shelf and on the shelf break were all typically Atlantic, though still quite cool and did not display the same numbers of Atlantic fish species (Atlantic cod and haddock) as found previously later in the season.
We stayed in Kongsfjorden from August 23rd-25th (HE560_18-20), deploying the lander and the ROV and also paying Ny Alesund a quick visit to collect expedition cargo and samples of the AWIPEV summer campaign to be brought back to AWI in Bremerhaven.
On August 26th, we sampled a second deep water station on the shelf break under perfectly calm conditions, Deep Plankton II (HE560_21), before heading into Isfjorden and stopping over in Longyearbyen for fresh provisions and fuel in the morning of August 27th. We spent the afternoon and the following day in one of the most Arctic and protected fjords of Svalbard, Billefjorden (HE560_22, 23), where we deployed a fish trap lander and caught mainly Polar cod throughout the whole water column.
Van Mijenfjorden on August 29th (HE560_24) was a new addition to our station list, in addition to the general sampling protocol, we carried out a calibration of the ship’s EK80 echo sounder in a protected part of the fjord.
August 30th found us in deteriorating weather conditions in Hornsund (HE560_25, 26), where we spent two days weathering off and trying to complete our sampling protocol over two days. We found the western part of the fjord’s basin to be strongly influenced by Atlantic waters, while its land-locked eastern part behind the second sill bore Arctic characteristics (again, many Polar cod as the main pelagic fish species throughout the whole water body).

This was the last station to be sampled on this cruise, due to bad weather we had to cancel the last two stations around Bear Island on our way to the Norwegian coast and steamed home directly, having to seek shelter in Norwegian waters twice before heading into the North Sea and arriving home in Bremerhaven on September 8th.

Here ended a very successful research cruise, with excellent results throughout. We were able to carry out all of the planned station work, and took a great amount of sediment cores and biological samples. In 21 days of station work, we carried out 27 CTD profiles, 34 towed bongo nets, 20 multicorer placements, and 19 van Veen grabs. 5 bottom trawls and 50 pelagic fish trawls with fish lift were realised. We brought more than 500 juvenile Polar cod back to the home institute in Bremerhaven alive.

Table 4.1 Station list of HE560

Date	Station	Name	Lat N [°]	Long E [°]	Notes
10.8.20	001	Rijpfjorden II, RIF II	80,5	22,01	CTD, Fish lander
10.-11.8.20	002	Rijpfjorden I, RIF I	80,16	22,12	Full station
11.8.20	003	Rijpfjorden II, RIF II	80,5	22,01	Lander recovery
12.8.20	004	Hinlopen South, HL II	79,52	19,47	Full station
13.-14.8.20	005, 006, 007	Wijdefjorden, WIF I + II	79,16	16,00	Full station
15.8.20	008	Liefdefjorden, LIF	80,33	14,00	Full station
15.8.20		Moffen	80,04	14,59	
16.8.20	009	North Svalbard, NSB	80,33	14,00	Full station, **bottom trawl**
17.8.20	010	Raudfjorden	79,81	12,00	Full Station
18.8.20	011	Smeerenburgfjorden, SMF	79,72	11,09	Full Station
19.8.20	012	Yermak Plateau II, YP II	79,46	8,71	Full station, **bottom trawl**
20.8.20	013	Deep Plankton 3, DP 3	79,00	7,89	CTD, Bongo, Sediment (MIC)
20.8.20	014	SciFi	79,07	9,3	Angling
21.8.20	015, 016	Kongsfjorden 2, KF 2	79,02	10,73	Full station, Angling
22.8.20	017	Krossfjorden, KRF	79,20	11,85	Full station
23.8.30	018	Kongsfjord East, KFE	78,93	12,13	Fish trap
24.8.20	019	Kongsfjord Inner, KFI	78,955	11,917	Full station, ROV
24.8.20		Ny Alesund	78,893	11,9156	port call
25.8.20	020	Kongsfjord Inner, KFI	78,955	11,917	Full station, Lander recovery
26.8.20	21	Deep Plankton 2, DP 2	77,50	10,55	CTD, Bongo, Grab, MIC
27.8.20		Longyearbyen	78,2277	15,6216	port call
27.-28.8.20	022, 023	Billefjorden, BIF	78,59	16,47	Full station, fish trap
29.8.20	024	van Mijenfjorden, VMF	77,77	15,26	Full station
30./31.8.20	025, 026	Hornsund, HOS	76,99	15,81	Full station

5 Preliminary Results

5.1 Fisheries data

(Felix Christopher Mark[1])
[1] Integrative Ecophysiology, AWI

In the following, a preliminary overview of the fishery activities is presented. All stations with net deployments are listed, plus fish trap landers and scientific angling. For the trawling, maximum depth and temperature at maximum depth are listed for each station, as well as the main net contents with total weight, where applicable. We conducted 50 pelagic and 5 bottom trawls in total.

10.08.20 **Rijpfjorden II**:
Lander with fishtrap,
HE560_1-3, 265m (amphipods)
11.08.20 **Rijpfjorden I**:
Pelagic Trawl with Fish Lift:
HE560_2-5, 25m, 1.6 °C (empty net);
HE560_2-6, 50m, 0 °C (juvenile Atlantic cod, Polar cod, ctenophores, krill);
HE560_2-7, 180m, -1.9 °C (Polar cod, krill, pandalid shrimp)
HE560_2-8, 195m, -1.8 °C (Polar cod, krill, pandalid shrimp)
HE560_2-9, 188m, -1.8 °C (Polar cod, krill, pandalid shrimp)
12.08.20 **Hinlopen II**:
Pelagic Trawl with Fish Lift:
HE560_4-5, 30m, -0.1 °C (jellyfish)
HE560_4-6, 67m, 0.4 °C (jellyfish)
HE560_4-7, 234m, 1.1 °C (Polar cod)
HE560_4-8, 248m, 1.1 °C (Polar cod)
13.08.20 **Wijdefjorden I**:
Lander with fishtrap:
HE560_5-1, 160m (amphipods, shrimps)
Pelagic Trawl with Fish Lift:
HE560_5-8, 38m, 4.9 °C (11,7 kg capelin, fish larvae)
HE560_5-9, 130m, 2.1 °C (20,6 kg Polar cod)
HE560_5-10, 167m, 0.4 °C (Polar cod)
14.08.20 **Wijdefjorden II**:
Pelagic Trawl with Fish Lift:
HE560_6-6, 23m, 3.0 °C (Plankton, ctenophores)
HE560_6-7, 90m, -1.3 °C (Plankton)
HE560_6-8, 218m, -1.9 °C (Polar cod)
14.08.20 **Moffen:** HE560_7B scientific angling, 35m (16 Atlantic cod, 10 kg)
15.08.20 **Liefdefjorden**:
Pelagic Trawl with Fish Lift:
HE560_8-6, 130m, -0.1 °C (21 kg krill)
HE560_8-7, 170m, -0.6 °C (juv. capelin, Polar cod)
HE560_8-8, 30m, 6.0 °C (Plankton, krill)
Scientific angling:
HE560_8-9 (very few Atlantic cod)
16.08.20 **NorthSvalbard:**
Bottom Trawl:
HE560_9-5, 132m, 3.2 °C (empty net)

HE560_9-6, 90m, 3.0 °C (some Atlantic cod, some long rough dab)
Scientific Angling:
HE560_9-7, 85m (no success)
Pelagic Trawl with Fish Lift:
HE560_9-8, 30m, 6.8 °C (Plankton)

17.08.20 **Raudfjorden:**
Pelagic Trawl with Fish Lift:
HE560_10-7, 20m, 7.1 °C (some plankton)
HE560_10-8, 220m, 1.3 °C (194 kg Polar cod, 200kg Atlantic cod),
HE560_10-9, 120m, 3.0 °C (empty net)

18.08.20 **Smeerenburgfjorden:**
Pelagic Trawl with Fish Lift:
HE560_11-6, 18m, 6.9 °C (empty net)
HE560_11-7, 41m, 7.1 °C (1 Atlantic cod, 1 Polar cod)
HE560_11-8, 203m, 2.0 °C (Polar cod, Atlantic cod, krill, pandalid shrimps)
HE560_11-9, 131m, 3.0 °C (empty net)

19.08.20 **Yermak Plateau:**
Bottom Trawl:
HE560_12-6, 174m (net ripped)
HE560_12-7, 160m, 3.4°C (net not open)
Pelagic Trawl with Fish Lift:
HE560_12-8, 22m, 5.8 °C (empty net)
HE560_12-9, 80m, 3.9 °C (empty net)

20.08.20 **SciFi:**
Scientific Angling:
HE560_14-1, 55m (23 Atlantic cod, 95 kg)

21.08.20 **Kongsfjorden II:**
Pelagic Trawl with Fish Lift:
HE560_15-6, 322m, 0.9 °C (few Polar cod)
HE560_15-7, 35m, 6.7 °C (YOY (young of year): Polar cod, Atlantic cod, capelin),
Bottom Trawl:
HE560_15-8, 281m, 1.4 °C (Polar cod, Atlantic cod, long rough dab, pandalid shrimp)
Scientific Angling:
HE560_16-1, 60m (no success)

22.08.20 **Krossfjorden:**
Pelagic Trawl with Fish Lift:
HE560_17-6, 344m, -0.9 °C (many Polar cod, juv. Atlantic cod)
HE560_17-7, 199m, 3.1 °C (some Polar cod, some Atlantic cod)
HE560_17-8, 106m, 3.9 °C (juv. Atlantic cod, juv. Haddock, Polar cod)
HE560_17-9, 34m, 7.1 °C (juv. Atlantic cod, YOY Polar cod)
Scientific Angling:
HE560_17-10 (no success)

23.08.20 **Kongsfjorden:**
Lander with fishtrap:
HE560_18-6, 192m (amphipods, shrimps)

Pelagic Trawl with Fish Lift:
HE560_18-7, 227m, 2.4 °C (juv. Polar cod, juv. Atlantic cod, YOY Atlantic cod)
HE560_18-8, 29m, 6.6 °C (empty net)

24.08.20 **Kongsfjorden East:**
Scientific Angling:
HE560_19-6, 60m (juv. Atlantic cod)

25.08.20 **Kongsfjorden East:**
Pelagic Trawl with Fish Lift:
HE560_20-1, 276m, 1.8 °C (5 Atlantic cod)
HE560_20-2, 337m, 1.3 °C (Polar cod)

26.08.20 **Deep Plankton II:**
Pelagic Trawl with Fish Lift:
HE560_21-7, 30m, 7.7 °C (Plankton)
HE560_21-8, 347m, 3.0 °C (Plankton)

27.08.20 **Billefjorden:**
Lander with fishtrap:
HE560_22-1, 59m (amphipods, shrimps)

28.08.20 **Billefjorden:**
Pelagic Trawl with Fish Lift:
HE560_23-3, 182m, -1.8 °C (adult Polar cod, liparids, jellyfish)
HE560_23-4, 29m, 4.0 °C (some liparids)
HE560_23-5, 147m, -1.8 °C (Polar cod (juv. + YOY), juv. Lumpsucker)
HE560_23-6, 35m, 2.8 °C (YOY Polar cod, juv. Lumpsucker)
HE560_23-7, 120m, -1.8 °C (empty net)
Scientific Angling:
HE560_23-8 (no success)

29.08.20 **Van Mijenfjorden:**
Pelagic Trawl with Fish Lift:
HE560_24-6, 60m (some Polar cod)
HE560_24-7, 80m (some Polar cod)
HE560_24-8, 17m (empty net)

30.08.20 **Hornsund West:**
Scientific Angling:
HE560_25-8, 48m (juv. Atlantic cod, haddock)
Hornsund East:
Pelagic Trawl with Fish Lift:
HE560_25-9, 110m (Polar cod)

31.08.20 **Hornsund East:**
Pelagic Trawl with Fish Lift:
HE560_26-1, 30m, 3.9 °C (101 kg Polar cod)

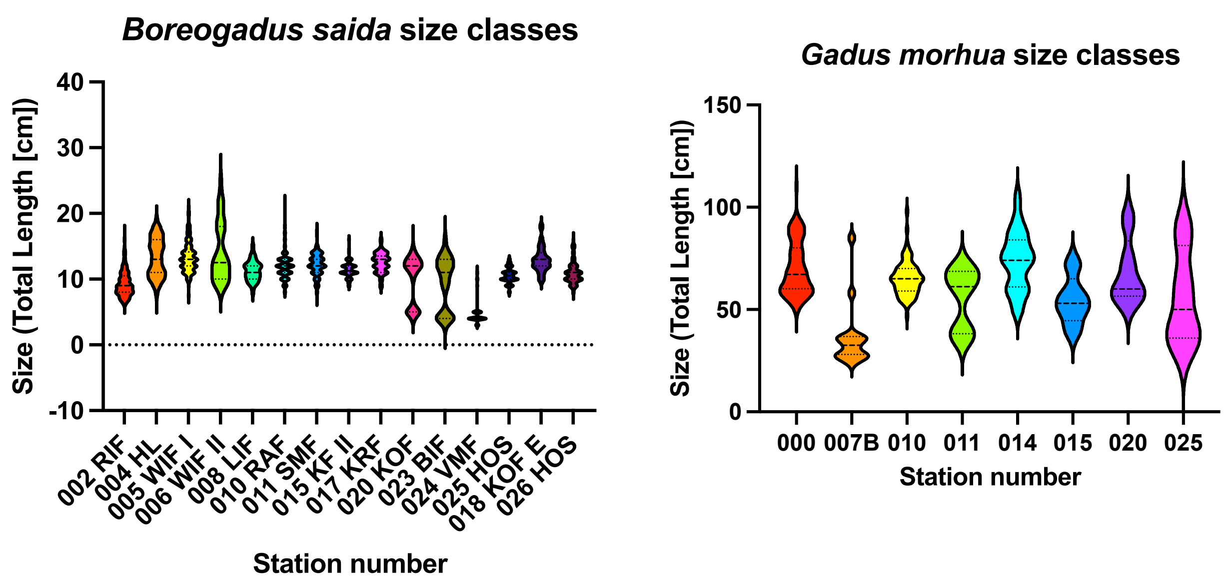

Figure 5.1.1: Size classes of Polar cod (*B. saida*, left panel) and Atlantic cod (*G. morhua*, right panel) resolved for individual stations

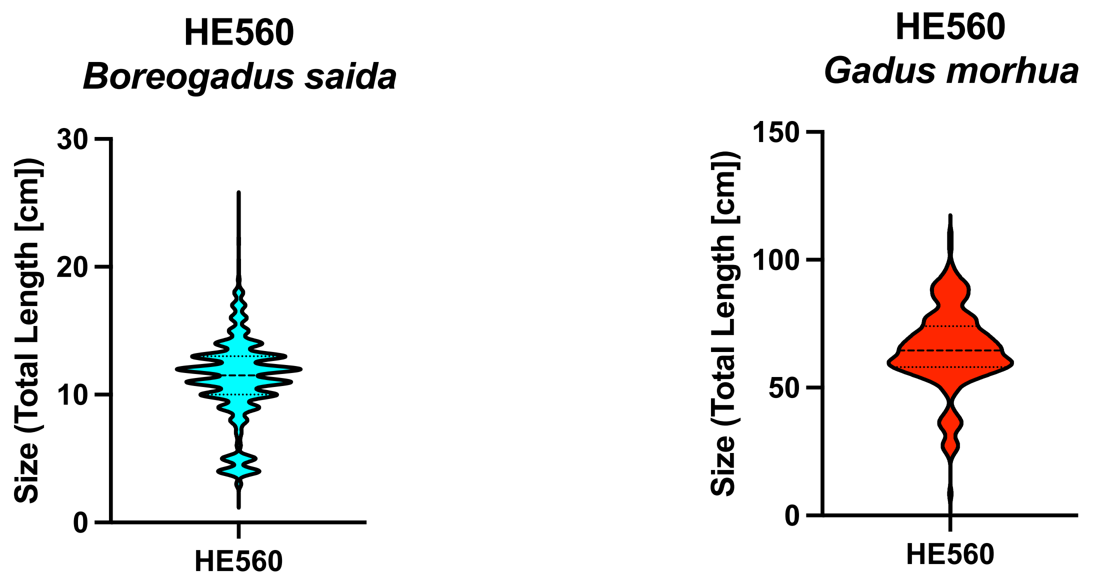

Figure 5.1.2: Size classes of Polar cod (*B. saida*, left panel, n = 2812) and Atlantic cod (*G. morhua*, right panel, n = 225) of all measured individuals

Preliminary data exploration and descriptive statistics display a strong dominance of Polar cod in most samples fjord systems, which is in contrast to previous expeditions. This may be related to time of sampling (1 month earlier than in previous cruises) but also to general prevailing winter weather conditions in this specific year. For both species analysed, several size/age classes can be made out in figures 5.1.1 and 5.2.2, while the young of the year (YOY) size class in shallow surface waters was less strongly observed than in previous cruises, especially so in Atlantic cod.

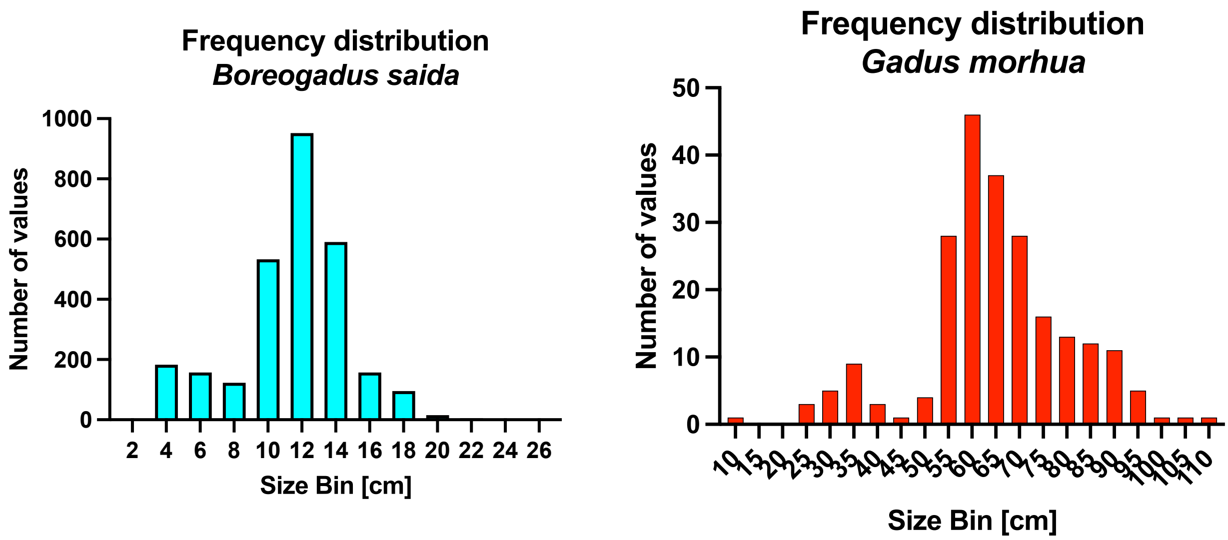

Figure 5.1.3: Total size frequency distribution of Polar cod (*B. saida*, left panel, n = 2812) and Atlantic cod (*G. morhua*, right panel, n = 225) of all measured individuals

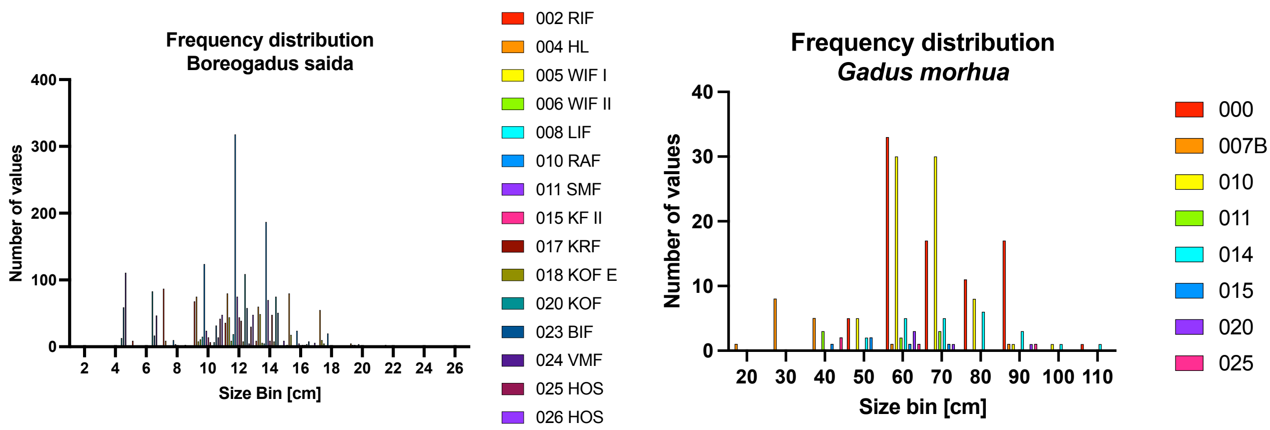

Figure 5.1.4: Size frequency distribution of Polar cod (*B. saida*, left panel, n = 2812) and Atlantic cod (*G. morhua*, right panel, n = 225) resolved for individual stations

5.2 Pelagic communities with a focus on the understudied gelatinous fauna

(Gerlien Verhaegen[1], Charlotte Havermans[2,*], Ayla Murray[2,3])

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Environmental changes are occurring at an unprecedented pace in the Arctic Ocean with warming occurring faster than anywhere else in the world (Blunden & Arndt 2016). This is accompanied by a pronounced decline of the overall summer sea ice extent with the earliest prediction of a sea-ice free Arctic summer within the next decade (Overland & Wang 2013). At the same time, there has been a growing inflow of warmer Atlantic water, entering the Fram Strait and the Barents Sea, a phenomenon referred to as "Atlantification" (Polyakov et al. 2017). This warm-water inflow carries along nutrients and advected warmer-affinity species (Wassmann et al. 2015). Hence, the Arctic Ocean has already experienced noticeable changes in species composition and poleward range shifts or expansions of species of Atlantic origin, from phytoplankton (Neukermans et al. 2018), to copepods (Weydmann et al. 2014), krill (Buchholz et al. 2010), and amphipods (Schröter et al. 2019; Havermans et al. 2019) to fish (Fossheim et al. 2015). These shifts will entrain a system-wide reorganisation through the Arctic food web with novel interactions between resident and incoming species, affecting top predators and key biological processes such as vertical carbon export (Grebmeier 2012). Therefore, surveys with accurate taxonomic and distribution records are needed to accomplish a successful monitoring of range shifts and detection of potential invaders.

Gelatinous zooplankton (GZP), or jellies, group phylogenetically distant taxa including ctenophores (or "comb jellies"), hydrozoans (such as the colonial siphonophores), scyphozoans (or "true" jellyfish) and pelagic tunicates. One common point that these taxa share is that they are soft-bodied organisms, easily fragmented or destroyed with traditional net or trawl sampling. This sampling bias, together with the few studies targeting jellies in particular, has led to critical scarcity of reliable baseline data on GZP species richness and abundances. Over recent decades, increases in GZP biomass and blooms worldwide have been the subject of debate, since accurate and long-term datasets on jellies are missing (Condon et al. 2013). Nonetheless, this "jellification" has become a major ecological concern, with the increased jelly biomass and outbreaks severely impacting the ecosystem and food web structure (Richardson et al. 2009). In the Arctic, only a handful of studies have aimed to characterize jelly abundances, distribution and trophic ecology. These studies have however proven jellies to be extremely abundant in the Arctic ecosystem, several of which being very effective predators exerting a high footprint on lower trophic levels (Raskoff et al. 2010; Majaneva et al. 2013). Whether the Arctic is also undergoing a "jellification" with poleward shifts of Atlantic species or an increase of Arctic populations, cannot be predicted based on the current knowledge. Hence, ARJEL-Arctic Jellies project aims to fill in these knowledge gaps by characterizing the diversity, distribution, abundances, trophic role and resilience to change of Arctic GZP communities by means of integrative field surveys, state-of-the-art molecular methods, and modelling.

5.2.1 Objectives

Through the deployment of plankton nets, trawls, camera systems and sediment sampling during the HE560 expedition, we aim to:

- Compare the zooplankton community in Atlantic- vs. Arctic-water influenced fjords – *Bongo net deployments and species identifications;*
- Investigate the distribution and genetic connectivity of dominant pelagic amphipods from the hyperiid genus *Themisto;*
- Study GZP species abundances, distributions and abundances and link these to environmental parameters. The obtained data will be used for modelling efforts in order to better understand habitat preferences and predicting future niches of GZP under warming scenarios – *Net, trawl and optical sampling, Species and Community Distribution Modelling*;
- Characterize the molecular diversity and genetic connectivity of various zooplankton species between the different fjords and compare these with other Arctic regions (central-Arctic, Fram Strait, …) – *Net and trawl sampling of GZP, Themisto amphipods, pteropods, and krill species, DNA barcoding and phylogeographic analyses*.
- Elucidate the trophic role of the dominant GZP in Svalbard fjords, and compare these with other regions. The feeding ecology of jellies and its regional variation will be assessed as well as the importance of jellies as prey for pelagic and demersal fish, as well as pelagic amphipods - *Net, trawl sampling, biomarker and molecular diet (metabarcoding) analyses;*
- Evaluate the role of jellies in vertical carbon flux by assessing the presence of jelly DNA in the sediment of various fjord systems – *Sediment sampling, environmental DNA analyses (metabarcoding).*

5.2.2 Methods

Sampling

Zooplankton, including GZP, was collected by means of Bongo nets from 17 stations (Table 5.2.1). The Bongo nets constituted of two nets of different mesh size: a 300 µm net for quantitative sampling, and a 500 µm net for non-quantitative sampling. Two oblique bongo net casts were conducted per station: a shallow cast (SB), targeting the water column above and around the Chlorophyll *a* maximum layer (wire length at depth of 20-45m), and a deep cast (DB), above the sea floor, (wire length at depth of 90-400m). The Bongo nets were deployed with a ship speed of 1.5-2.0 knots, a wire speed of 0.3-0.5 m/s, and a profile time at depth of 30 seconds. Additional GZP (i.e., Cnidaria, Ctenophora, or Siphonophora) was collected from Young Fish Trawls (YFT), bottom trawls (BT), and a single Calcofi Ringnet haul (CC) (Table 5.2.1).
In order analyze zooplankton community composition and abundances around Svalbard, all zooplankton caught in the 300 µm quantitative Bongo net hauls were identified to the lowest possible taxa and preserved in 96% undenatured ethanol. A mechanical flow meter was attached to the Bongo nets in order to estimate species abundances using the water volume that travelled through the nets. Future in-depth community composition analyses and abundance calculations will take place in the home lab. Examples of collected non-gelatinous zooplankton taxa included: *Thyanoessa* spp., *Calanus* spp., *Themisto Libellula, Themisto abyssorum, Clione limacina limacina, Limacina* spp., *Onismus* sp., and various fish larvae.
Themisto amphipods were collected in Bongo net hauls, Young Fish Trawls and a single Calcofi ring net haul (Table 5.2.1), from depths ranging from the surface to 1100m. All nets deployed sampled the whole water column from the maximum depth to the surface. Individuals were identified to species level and immediately fixed in 96% denatured ethanol and stored for future molecular and morphological analysis in the home lab. *Themisto* individuals were collected from 19 stations in total.

Table 5.2.1 Data collected by the ARJEL working group. Numbers in brackets refer to the number of hauls if more than one.

Data	Gear	Stations
Zooplankton samples	Bongo nets (17)	01, 02, 04, 05, 06, 08, 10, 11, 12, 13, 15, 17, 18, 21, 23, 24, 25
	YFT (31)	02(3), 04(2), 05, 06(2), 08(2), 09(1), 10 (2), 11, 12, 15, 17(3), 18(2), 20(2), 21, 23(3), 24(3), 25
	BT	15
	CC	13
Underwater footage	Go Pro on CTD (20)	01, 04, 06, 08, 09, 10, 11, 12, 13, 15, 17, 18, 21(2), 22, 24(2), 25(2), 26
	Go Pro on YFT	23
	Go Pro on SB (17)	01, 02, 04, 05, 06, 08, 10, 11, 12, 13, 15, 17, 18, 21, 23, 24, 25

	BlueROV2 (3)	19(3)
Sediments for eDNA	MIC or van Veen (9)	01, 06, 10, 15, 21(2), 22, 24, 25

Underwater video footage

Presence data of GZP were collected by means of underwater video footages. Underwater footages with a 4K resolution were taken at 21 stations (Table 5.2.1) with a Go Pro Hero5 in a BENTHIC^{TM} 3 case and GPH-1750m led lamp mounted pointing downwards on the CTD. Additional underwater footages (2.7K resolution) were taken by mounting the Go Pro and lamp horizontally on a YFT at station 23, mounting a Go Pro Hero3 horizontally without lamp on all SB casts (1080p), and from three dives with the BlueROV2 (HD resolution) at station 19. The presence data collected will be used in ulterior ecological niche and species distribution models of GZP.

Sediments for eDNA

Sediment samples for eDNA analyses of GZP were collected from 8 stations (Table 5.2.1), from either the Mini-corer (MIC) or Van Veen grab. For each grab, three sub- samples were taken from 0-2 cm depth layer and/or 10-12cm depth layer.

Stomach content analysis using DNA swabs

DNA swabs were taken of the stomach of five individuals of *Beroe abyssicola* collected from YFT 23/3. For each individual, two type of swabs (ZYMO vs. FLOQ Copan) and two different preservation methods of the swabs (snap-freezing in liquid nitrogen vs. preserved in DNA/RNA shield stabilizing buffers) were tested. Thus, a total of four swabs were used per individual. The swabs were then stored at -80°C. The stomachs were then retrieved, after letting the body of the ctenophores being partly dissolved over a few hours in Ethanol (100%), and stored at -80°C. The aim of these tests will be the optimization of the methodology for the molecular diet analyses of dominant Arctic ctenophores.

Snap-frozen samples

Ten individuals of *Mertensia ovum* (five for SB and five for DB) were collected from four stations (05, 06, 23, 25) and snap-frozen in liquid nitrogen upon collection before being preserved at -80°C. These samples will be used in ulterior biomarker and transcriptomic analyses.

5.2.3 Preliminary results

A total of 898 individuals of GZP was collected, the majority of which being ctenophores (59%) and cnidarians (39%). Thirteen different species were collected (Fig. 5.2.1). Some of these species were nearly exclusively collected through Bongo nets (e.g., *Bougainvillia superciliaris*, *Catablema vesicarium*, and *Aeginopsis laurentii*), whereas other species were mostly from the YFT (e.g., *Cyanea capillata*, *Ptychogena lactea*, and *Bolinopsis infundibulum*). Thus, our holistic approach, of collecting GZP from different net types, allowed us to obtain a more complete view of the biodiversity present. Both the abundance (Fig. 5.2.2) and diversity (Fig. 5.2.3) of GZP was higher at the more “Arctic” stations in northern and south-east Svalbard, compared to the more “Atlantic” west of Svalbard. Statistically analyses linking abundances and diversity with hydrographic data from the CTD, will be used to test whether a future “Atlantification” of Arctic marine ecosystems will lead to a loss in abundance and biodiversity of the observed GZP species.

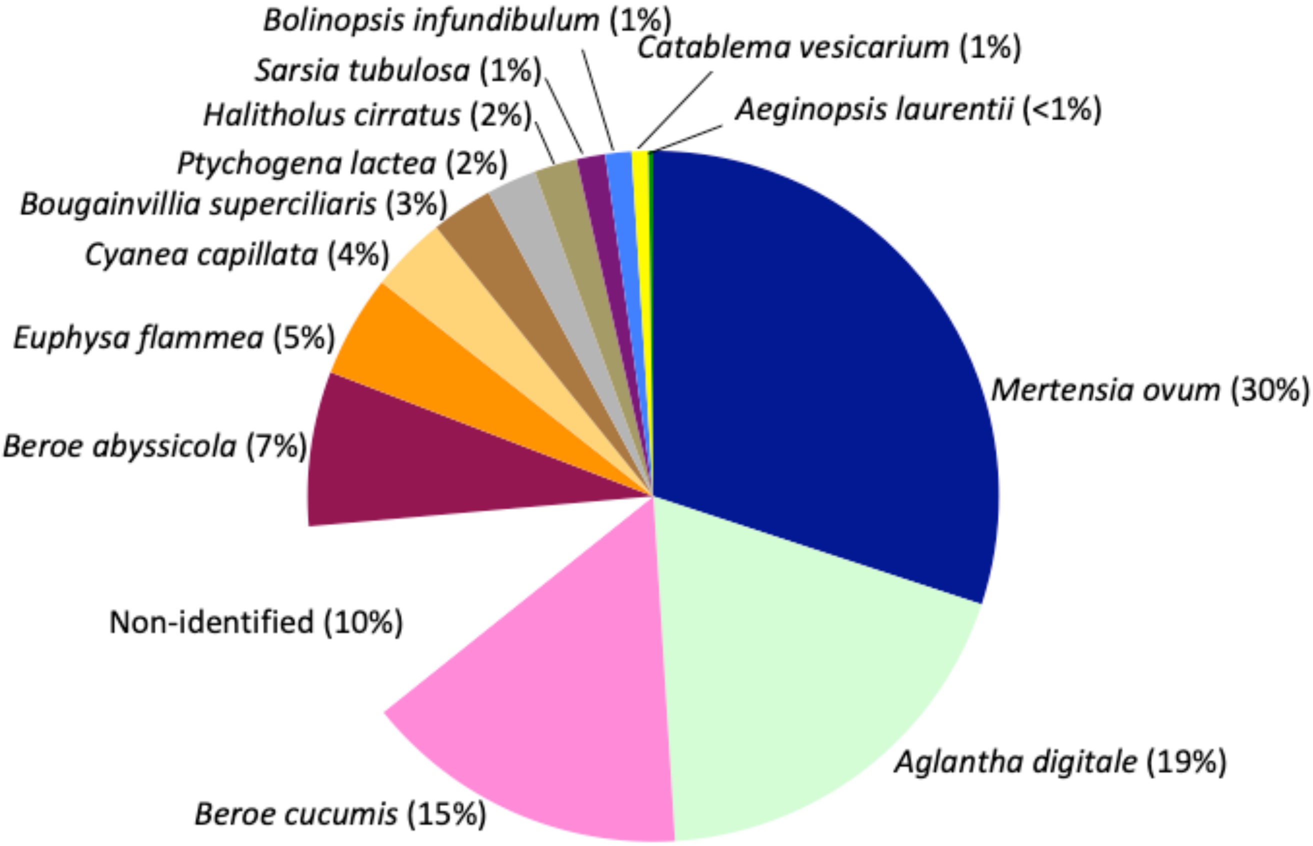

Fig. 5.2.1 Abundances of gelatinous zooplankton species collected.

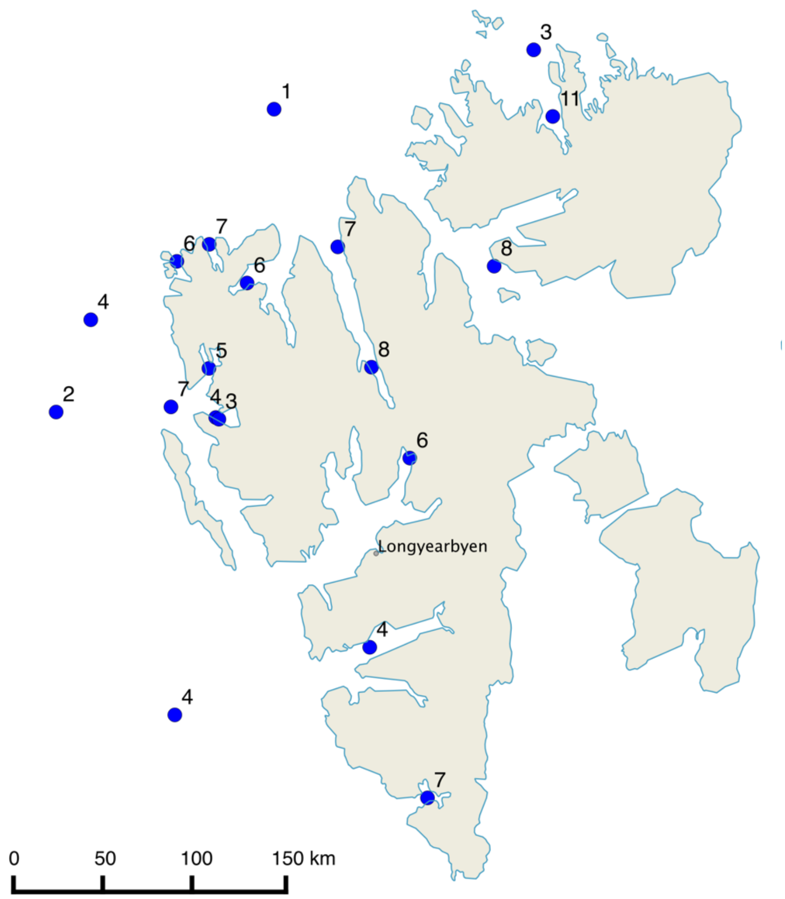

Fig. 5.2.2 Gelatinous zooplankton species diversity (i.e., number of sampled species)

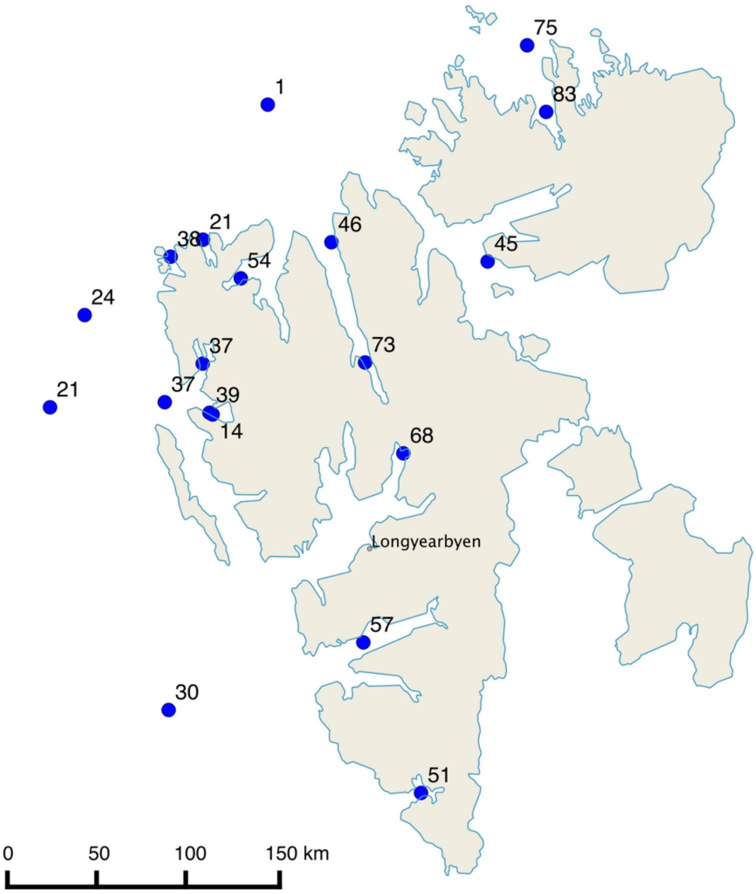

Fig. 5.2.3 Number of collected gelatinous zooplankton individuals for analyses

5.3 Seafloor sampling

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To analyse the composition and distribution of living benthic and epilithic foraminifera, samples were taken off the north and west coast of Svalbard. The sediment cores were used to compare the distribution of living benthic foraminifera and for DNA-analysis as well as to extract pore-water for trace element and amino acid analysis. Additionally, rocks were obtained for comparison of epilithic foraminiferal fauna and living samples for subsequent culturing experiments. The sampling was conducted at 15 different locations of which 11 were inside different fjords (Rijpfjorden, Hinlopen, Wijdefjorden, Lifjdefjorden, Raudfjorden, Smeerenburgfjorden, Kongsfjorden, Krossfjorden, Billefjorden, Van Mijenfjorden and Hornsund, Table 5.3.1) and 4 offshore (North Svalbard, Yermak Plateau, Deep Plankton 3 und Deep Plankton 2). Sediments were collected with a Minicorer (MIC; Fig. 5.3.1A). To check the surface characteristics a Van-Feen-Grab (VG; Fig. 5.3.1C) was used, making the rock sampling possible (Fig. 5.3.1B) and also allowing the use of a push-corer for collecting the upper 5 cm of the seafloor sediments at the stations with difficult conditions for the MIC. At each station the MIC was deployed 2 cores were sliced in 1 cm segments, one for faunal analysis and one for DNA analysis.

Another core was used for pore-water extraction. Exceptions were made at the stations Deep Plankton 2 and 3 where living foraminifera were collected and Wijdefjorden 1 (Table 5.3.1).

Table 5.3.1: Overview of sampling locations (Van-Feen-Grab & MIC).

Region	Station	Latitute	Longitute	Waterdepth [m]	Date	Work program						
						Sediment	DNA	Porewater	Living Forams	Rocks	Gear	Comments
Rijpfjorden	RIF I	80° 31,156' N	022° 03,466' E	244	10.08.2020	X					VG	
Rijpfjorden	RIF II	80° 10,047' N	022° 09,201' E	187	10.08.2020	X					MIC	
Rijpfjorden	RIF III	80° 30,586' N	022° 03,601' E	257	11.08.2020	X	X	X	X		2 MICs	
Hinlopen	HL II	79° 31,335' N	019° 39,506' E	192	12.08.2020					X	VG	rocky surface
Wijdefjorden	WIF I	79° 44,225' N	015° 31,867' E	168	13.08.2020	X				X	BC, MIC	
Wijdefjorden	WIF II	79° 07,658' N	016° 01,327' E	228	14.08.2020	X	X	X			MIC	
Lifjdefjorden	LIF	79° 35,998' N	012° 56,877' E	213	15.08.2020	X	X	X			MIC	
North Svalbard	NSB	80° 24,947' N	013° 47,818' E	175	16.08.2020	X					VG	rocky surface
Raudfjorden	RAF	79° 48,271' N	012° 00,691' E	215	17.08.2020	X	X	X			MIC	
Smeerenburgfj.	SMF	79° 43,864' N	011° 04,888' E	208	18.08.2020	X	X	X			MIC	
Yermak Plateau	YP II	79° 27,180' N	008° 42,107' E	154	19.08.2020	X				X	VG	rocky surface
Deep Plankton	DP III	78° 59,987' N	007° 53,427' E	1124	20.08.2020	X			X	X	VG, MIC	rocky surface & deep
Kongsfjorden	KF2	79° 01,149' N	010° 44,726' E	318	21.08.2020	X	X	X			MIC	
Krossfjorden	KRF	79° 11,767' N	011° 47,554' E	358	22.08.2020	X	X	X			MIC	
Kongsfjorden	KF1	78° 57,616' N	011° 54,736' E	348	23.08.2020	X	X	X			MIC	
Deep Plankton	DP II	77° 29,997' N	010° 32,820' E	1183	26.08.2020	X			X		VG, MIC	
Billefjorden	BF	78° 39,624' N	016° 40,357' E	181	27.08.2020	X	X	X			MIC	
van Mijenfjorden	VMF	77° 45,845' N	015° 08,009' E	101	29.08.2020	X	X	X			MIC	
Hornsund	HOS	76° 59,771' N	015° 26,511' E	123	30.08.2020	X	X	X			MIC	
Hornsund	HOS II	76° 57,794' N	015° 49,910' E	126	30.08.2020	X					VG	

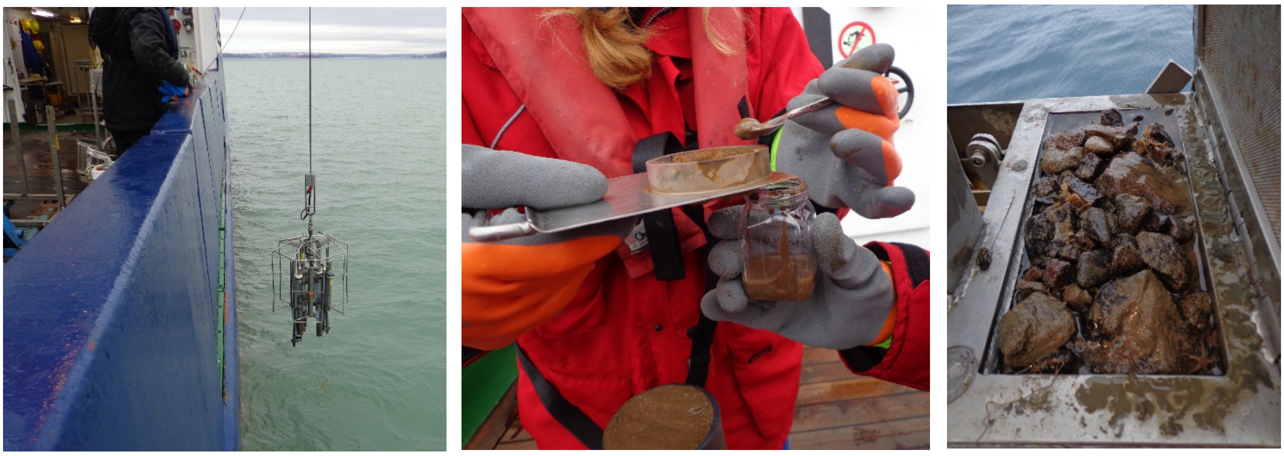

Fig. 5.3.1: Retrieval of the MIC (A), slicing a Core and transfering it to the storage container (B) and rock obtainment with the Van-Feen-Grab (C).

Sediment Sampling

The sampling of the sediments included samples for living foraminiferal fauna analysis, DNA analysis and also obtainment of living foraminifera for culturing experiments. For both the faunal and the DNA analysis the upper 10 cm of 1 core were sliced into 1 cm segments and transferred to storage containers. The DNA samples were immediately frozen at -20°C while the samples for the faunal analysis were cooled at 4°C for later fixation with an ethanol-rose-bengal-solution. For the sampling of living foraminifera for culturing experiments the upper 3 cm of 4 cores were collected and kept alive in a air-flushed container with filtered seawater at 2.2°C for the length of the cruise.

Pore Water Sampling

After the retrieval of the MIC, 1 core tube was brought the cold laboratory with a controlled temperature around 4°C. The pore water was extracted from the sediments with the use of Rhizons

(Rhizon CSS: length 5 cm, pore size 0.15 µm; Rhizosphere Research Products, Wageningen, Netherlands). Those were inserted into the sediments through pre-drilled holes in the MIC tube. Syringes were screwed on the Luer lock, the piston was pulled out and fixated with a retainer to keep the vacuum in the syringe. At 11 stations pore-water samples were collected every 2 cm for the entire core length. The pore water was distributed into different storage containers for subsequent trace element analysis (1 mL) and amino acid analysis (2-4 mL) and stored at -20°C right after the extraction.

Rock Sampling

For the analysis of living epilithic foraminiferal fauna and sampling of living foraminifera for culturing experiments it was possible to collect rocks from the seafloor at 3 stations with the Van-Feen-Grab (VG) and at 1 station with a Box Corer (BC; Table 5.3.1). At each station several rocks were collected and distributed equally for the two different purposes. The epilithic foraminifera were kept alive in air-flushed containers with filtered seawater at 2.2°C for the length of the cruise. The samples for the fauna analysis were kept under the same conditions as the live samples for the subsequent culturing experiments and later fixed with an ethanol-rose-bengal-solution.

5.4 Expected Results

So far, some of the data have been published, but the major part is still being analysed. We expect further data publications for fisheries, pelagic communities and sediment cores, as well as laboratory experimental data from individual specimens of Polar cod (*B. saida*) that were brought back to the Alfred-Wegener-Institute alive, to be published in 2023, 2024 and 2025. As this expedition was part of a series of monitoring cruises to Svalbard, the fisheries data will be entered into a publication of joint datasets from the earlier cruises in this time series (HE408 (2013), HE451.1 (2015) and HE519 (2018)).

6 Ship's Meteorological Station

n.a.

7 Station List HE560

7.1 Overall Station List

Station No.		Gear	Action	Latitude	Longitude	Water Depth	Remarks/Recovery
Heincke	Timestamp			[°N]	[°E]	[m]	
HE560_1-1	10.08.20 11:59	CTD	max depth	80° 31,187' N	022° 03,449' E	247	SLmax = 235 m
HE560_1-2	10.08.20 12:21	Grab	max depth	80° 31,156' N	022° 03,466' E	244	SLmax= 242 m
HE560_1-3	10.08.20 12:49	Lander (generic)	in the water	80° 31,119' N	022° 03,644' E	237,1	
HE560_1-4	10.08.20 13:17	Lander (generic)	on deck	80° 31,103' N	022° 03,832' E	243,2	Gerät hat unerwartet ausgelöst
HE560_1-5	10.08.20 13:30	Bongo Net	on deck	80° 30,893' N	022° 04,028' E	256,9	20-30m tiefe
HE560_1-6	10.08.20 13:50	Bongo Net	on deck	80° 30,239' N	022° 04,134' E	183,9	tiefer als 30m
HE560_1-7	10.08.20 14:06	Lander (generic)	in the water	80° 30,767' N	022° 04,370' E	260,9	

HE560_2-1	10.08.20 16:47	CTD	max depth	80° 10,126' N	022° 08,645' E	195,7	SL: 185m
HE560_2-2	10.08.20 16:58	Multi Corer	in the water	80° 10,058' N	022° 08,983' E	184,1	
HE560_2-3	11.08.20 06:07	Bongo Net	max depth	80° 10,655' N	022° 09,184' E	193,2	SL: 25m
HE560_2-4	11.08.20 06:20	Bongo Net	max depth	80° 10,353' N	022° 08,802' E	205,9	SL: 180m
HE560_2-5	11.08.20 06:58	Young Fish Trawl	profile start	80° 09,732' N	022° 07,104' E	193,9	50m KL
HE560_2-5	11.08.20 07:13	Young Fish Trawl	profile end	80° 10,429' N	022° 07,108' E	210,2	
HE560_2-6	11.08.20 07:57	Young Fish Trawl	profile start	80° 09,730' N	022° 07,478' E	181,1	100m KL
HE560_2-6	11.08.20 08:14	Young Fish Trawl	profile end	80° 08,883' N	022° 07,691' E	188,3	
HE560_2-7	11.08.20 09:03	Young Fish Trawl	profile start	80° 10,543' N	022° 08,421' E	208,7	420m KL
HE560_2-7	11.08.20 09:18	Young Fish Trawl	profile end	80° 11,304' N	022° 08,578' E	169,7	
HE560_2-8	11.08.20 11:15	Young Fish Trawl	profile start	80° 10,277' N	022° 08,591' E	204,7	SL= 440 m
HE560_2-8	11.08.20 11:32	Young Fish Trawl	profile end	80° 09,524' N	022° 07,937' E	123,4	
HE560_2-9	11.08.20 13:05	Young Fish Trawl	profile start	80° 07,724' N	022° 09,223' E	196,7	SL= 410 m
HE560_2-9	11.08.20 13:24	Young Fish Trawl	profile end	80° 08,618' N	022° 08,644' E	190,7	
HE560_3-1	11.08.20 16:11	Multi Corer	in the water	80° 30,627' N	022° 03,493' E	241,7	
HE560_3-2	11.08.20 16:54	Lander (generic)	on deck	80° 30,748' N	022° 04,512' E	260	
HE560_3-3	11.08.20 17:01	Multi Corer	in the water	80° 30,724' N	022° 04,710' E	241,6	
HE560_4-1	12.08.20 06:14	CTD	max depth	79° 31,316' N	019° 39,192' E	192,4	SL: 183m
HE560_4-2	12.08.20 06:30	Grab	max depth	79° 31,320' N	019° 39,445' E	192,2	SL: 192m
HE560_4-3	12.08.20 06:45	Bongo Net	max depth	79° 31,237' N	019° 40,020' E	187,8	SL: 35m
HE560_4-4	12.08.20 06:57	Bongo Net	max depth	79° 31,048' N	019° 41,607' E	179,7	SL: 180m
HE560_4-5	12.08.20 08:03	Young Fish Trawl	profile start	79° 36,397' N	019° 24,768' E	265,9	KL: 50m
HE560_4-5	12.08.20 08:18	Young Fish Trawl	profile end	79° 35,751' N	019° 26,542' E	255,6	
HE560_4-6	12.08.20 08:44	Young Fish Trawl	profile start	79° 34,662' N	019° 29,771' E	186,2	SL: 100m
HE560_4-6	12.08.20 09:00	Young Fish Trawl	profile end	79° 34,063' N	019° 32,069' E	183,4	
HE560_4-7	12.08.20 11:40	Young Fish Trawl	profile start	79° 38,786' N	019° 02,539' E	261,8	SL = 490 m
HE560_4-7	12.08.20 11:55	Young Fish Trawl	profile end	79° 38,093' N	019° 03,311' E	283,9	SL = 530 m
HE560_4-8	12.08.20 13:33	Young Fish Trawl	profile start	79° 37,552' N	018° 59,398' E	326,8	KL: 500m
HE560_4-8	12.08.20 13:49	Young Fish Trawl	profile end	79° 37,116' N	019° 02,284' E	316,6	
HE560_5-1	13.08.20 09:58	Lander (generic)	in the water	79° 44,240' N	015° 32,552' E	154,5	
HE560_5-2	13.08.20 10:18	CTD	max depth	79° 44,224' N	015° 31,790' E	170,4	SL max = 163 m
HE560_5-3	13.08.20 10:33	Box Corer	max depth	79° 44,224' N	015° 31,838' E	169,2	SLmax = 168 m

HE560_5-4	13.08.20 10:49	Multi Corer	max depth	79° 44,225' N	015° 31,867' E	168,6	SLmax = 169 m
HE560_5-5	13.08.20 11:03	Multi Corer	max depth	79° 44,231' N	015° 31,888' E	167,7	SLmax = 171 m
HE560_5-6	13.08.20 11:16	Bongo Net	max depth	79° 44,115' N	015° 32,237' E	159,4	SLmax = 40 m
HE560_5-7	13.08.20 11:35	Bongo Net	max depth	79° 44,304' N	015° 28,924' E	153	SLmax = 160 m
HE560_5-8	13.08.20 12:12	Young Fish Trawl	profile start	79° 43,987' N	015° 23,517' E	138,3	SL= 80 m
HE560_5-8	13.08.20 12:29	Young Fish Trawl	profile end	79° 43,232' N	015° 24,100' E	137,5	
HE560_5-9	13.08.20 13:11	Young Fish Trawl	profile start	79° 43,130' N	015° 24,215' E	137,2	SL= 240 m
HE560_5-9	13.08.20 13:26	Young Fish Trawl	profile end	79° 42,449' N	015° 24,570' E	135	
HE560_5-10	13.08.20 14:52	Young Fish Trawl	profile start	79° 43,661' N	015° 30,931' E	169,8	KL: 330m
HE560_5-10	13.08.20 15:07	Young Fish Trawl	profile end	79° 43,022' N	015° 31,432' E	170,8	
HE560_6-1	14.08.20 06:07	CTD	max depth	79° 07,509' N	016° 01,738' E	228,2	SL: 220m
HE560_6-2	14.08.20 06:25	Grab	max depth	79° 07,590' N	016° 01,467' E	228	SL: 230m
HE560_6-3	14.08.20 06:42	Multi Corer	max depth	79° 07,658' N	016° 01,327' E	228,4	SL max: 226 m
HE560_6-4	14.08.20 06:57	Bongo Net	max depth	79° 07,658' N	016° 01,476' E	227,9	SL: 20m
HE560_6-5	14.08.20 07:13	Bongo Net	max depth	79° 07,265' N	016° 01,945' E	228,4	SL: 220m
HE560_6-6	14.08.20 08:00	Young Fish Trawl	profile start	79° 09,675' N	015° 58,436' E	151,3	SL: 50m
HE560_6-6	14.08.20 08:15	Young Fish Trawl	profile end	79° 08,982' N	015° 59,162' E	190,1	
HE560_6-7	14.08.20 08:38	Young Fish Trawl	profile start	79° 08,073' N	016° 00,538' E	223,7	KL: 160m
HE560_6-7	14.08.20 08:53	Young Fish Trawl	profile end	79° 07,393' N	016° 01,465' E	229,3	KL: 180m
HE560_6-8	14.08.20 11:14	Young Fish Trawl	profile start	79° 07,548' N	016° 01,380' E	228,2	KL: 440m
HE560_6-8	14.08.20 11:30	Young Fish Trawl	profile end	79° 08,284' N	016° 00,438' E	215,2	
HE560_7-1	14.08.20 16:08	Lander (generic)	on deck	79° 44,464' N	015° 31,866' E	161,9	
HE560_8-1	15.08.20 06:12	CTD	max depth	79° 35,988' N	012° 56,616' E	217,5	SL: 210m
HE560_8-2	15.08.20 06:27	Grab	max depth	79° 35,979' N	012° 56,781' E	216,3	SL: 214m
HE560_8-3	15.08.20 06:41	Multi Corer	max depth	79° 35,998' N	012° 56,877' E	213	SL: 215m
HE560_8-4	15.08.20 06:58	Bongo Net	max depth	79° 36,189' N	012° 57,961' E	192,2	SL: 20m
HE560_8-5	15.08.20 07:14	Bongo Net	max depth	79° 36,156' N	013° 00,365' E	194,2	SL: 180m
HE560_8-6	15.08.20 08:11	Young Fish Trawl	profile start	79° 38,646' N	013° 06,354' E	120,1	
HE560_8-6	15.08.20 08:26	Young Fish Trawl	profile end	79° 38,295' N	013° 02,925' E	151,3	SL: 250m
HE560_8-7	15.08.20 10:46	Young Fish Trawl	profile start	79° 37,979' N	013° 00,223' E	171,6	
HE560_8-7	15.08.20 11:01	Young Fish Trawl	profile end	79° 37,439' N	012° 57,705' E	179,9	SL: 350m
HE560_8-8	15.08.20 12:08	Young Fish Trawl	profile start	79° 38,078' N	013° 01,814' E	159,6	SL: 45m

HE560_8-8	15.08.20 12:23	Young Fish Trawl	profile end	79° 37,507' N	012° 59,433' E	159,4	
HE560_8-9	15.08.20 14:30	Trap (generic)	station start	79° 37,907' N	013° 08,534' E	45,2	scientific angling
HE560_9-1	16.08.20 06:02	CTD	max depth	80° 24,955' N	013° 48,133' E	175,2	SL: 128m, Fehler
HE560_9-2	16.08.20 06:13	Grab	max depth	80° 24,962' N	013° 47,942' E	174,9	SL: 177m
HE560_9-3	16.08.20 06:24	Grab	max depth	80° 24,947' N	013° 47,818' E	175,1	SL: 180m
HE560_9-4	16.08.20 06:42	CTD	max depth	80° 24,937' N	013° 47,618' E	173,2	SL: 167m
HE560_9-5	16.08.20 07:30	Bottom Trawl	profile start	80° 28,504' N	013° 52,922' E	132,1	SL: 450m
HE560_9-5	16.08.20 07:50	Bottom Trawl	profile end	80° 29,833' N	013° 53,820' E	127,6	
HE560_9-6	16.08.20 10:10	Bottom Trawl	profile start	80° 26,191' N	014° 13,310' E	79,6	SL: 300m
HE560_9-6	16.08.20 10:35	Bottom Trawl	profile end	80° 27,734' N	014° 15,570' E	93,2	SL max: 340m
HE560_9-7	16.08.20 11:25	Trap (generic)	profile start	80° 26,242' N	014° 13,017' E	80,8	scientific angling
HE560_9-8	16.08.20 12:42	Young Fish Trawl	profile start	80° 27,606' N	014° 11,259' E	94,2	SL= 50m
HE560_9-8	16.08.20 12:58	Young Fish Trawl	profile end	80° 28,316' N	014° 12,532' E	103,2	60m
HE560_10-1	17.08.20 06:10	CTD	max depth	79° 48,405' N	012° 00,040' E	205,3	SL: 181m Technisches Problem
HE560_10-2	17.08.20 06:30	Grab	max depth	79° 48,336' N	012° 00,323' E	213,8	SL: 215m
HE560_10-3	17.08.20 06:48	Multi Corer	max depth	79° 48,271' N	012° 00,691' E	215,6	SL: 215m
HE560_10-4	17.08.20 07:00	CTD	on deck	79° 48,275' N	012° 00,608' E	213,7	Keine Daten
HE560_10-5	17.08.20 07:05	Bongo Net	max depth	79° 48,355' N	012° 00,155' E	215,1	SL: 30m
HE560_10-6	17.08.20 07:25	Bongo Net	max depth	79° 48,690' N	012° 00,215' E	205,5	SL: 190m
HE560_10-7	17.08.20 07:54	Young Fish Trawl	profile start	79° 47,708' N	012° 02,427' E	196,8	SL: 40m
HE560_10-7	17.08.20 08:09	Young Fish Trawl	profile end	79° 47,088' N	012° 04,407' E	173,7	
HE560_10-8	17.08.20 08:51	Young Fish Trawl	profile start	79° 48,148' N	012° 00,802' E	213,4	SL: 420m
HE560_10-8	17.08.20 09:06	Young Fish Trawl	profile end	79° 48,797' N	011° 59,173' E	203,3	SL max: 500m
HE560_10-9	17.08.20 11:16	Young Fish Trawl	profile start	79° 48,982' N	012° 00,221' E	173,3	SL= 250 m
HE560_10-9	17.08.20 11:31	Young Fish Trawl	profile end	79° 49,689' N	011° 59,714' E	155,3	
HE560_10-10	17.08.20 12:30	CTD	max depth	79° 48,552' N	012° 00,242' E	209,9	SLmax= 198 m
HE560_10-11	17.08.20 12:55	Trap (generic)	profile start	79° 48,497' N	012° 00,489' E	209,8	scientific angling
HE560_10-11	17.08.20 15:41	Trap (generic)	profile start	79° 56,245' N	011° 43,959' E	29,9	
HE560_11-1	18.08.20 06:12	CTD	max depth	79° 43,780' N	011° 04,694' E	206,3	SL: 199m
HE560_11-2	18.08.20 06:33	Grab	max depth	79° 43,835' N	011° 04,888' E	208,2	SL: 210m
HE560_11-3	18.08.20 06:49	Multi Corer	max depth	79° 43,864' N	011° 04,888' E	208,6	SL: 211 m
HE560_11-4	18.08.20 07:01	Bongo Net	max depth	79° 43,854' N	011° 05,026' E	209,4	SL: 20m

HE560_11-5	18.08.20 07:16	Bongo Net	max depth	79° 43,535' N	011° 06,673' E	199,5	SL: 190m
HE560_11-6	18.08.20 07:47	Young Fish Trawl	profile start	79° 42,455' N	011° 07,797' E	175,5	
HE560_11-6	18.08.20 08:04	Young Fish Trawl	profile end	79° 41,618' N	011° 07,718' E	194,7	KL: 40m
HE560_11-7	18.08.20 08:35	Young Fish Trawl	profile start	79° 42,191' N	011° 06,538' E	200,1	KL: 70m
HE560_11-7	18.08.20 08:50	Young Fish Trawl	profile end	79° 42,930' N	011° 05,707' E	202,2	KL: 80m
HE560_11-8	18.08.20 10:58	Young Fish Trawl	profile start	79° 42,850' N	011° 05,531' E	203,4	KL: 450m
HE560_11-8	18.08.20 11:16	Young Fish Trawl	profile end	79° 42,049' N	011° 05,285' E	214,7	KL: 390m
HE560_11-9	18.08.20 12:36	Young Fish Trawl	profile start	79° 41,381' N	011° 06,191' E	199,8	KL: 270m
HE560_11-9	18.08.20 12:54	Young Fish Trawl	profile end	79° 42,249' N	011° 06,112' E	205,8	KL: 290m
HE560_12-2	19.08.20 06:11	CTD	max depth	79° 27,219' N	008° 42,272' E	153,4	SL: 145m
HE560_12-3	19.08.20 06:23	Grab	max depth	79° 27,180' N	008° 42,107' E	153,9	SL: 155m
HE560_12-4	19.08.20 06:36	Bongo Net	max depth	79° 27,293' N	008° 42,145' E	153,5	SL: 25m
HE560_12-5	19.08.20 06:51	Bongo Net	max depth	79° 27,736' N	008° 41,882' E	149,5	SL: 140m
HE560_12-6	19.08.20 07:53	Bottom Trawl	on deck	79° 30,218' N	008° 50,951' E	180,6	abgebrochen
HE560_12-7	19.08.20 11:24	Bottom Trawl	profile end	79° 24,903' N	008° 47,647' E	149,2	
HE560_12-7	19.08.20 11:44	Bottom Trawl	on deck	79° 25,326' N	008° 52,283' E	137,8	
HE560_12-8	19.08.20 12:36	Young Fish Trawl	in the water	79° 25,819' N	008° 56,914' E	125,6	
HE560_12-8	19.08.20 12:46	Young Fish Trawl	profile start	79° 26,188' N	008° 58,881' E	121,2	SL= 50 m
HE560_12-8	19.08.20 13:01	Young Fish Trawl	profile end	79° 26,676' N	009° 01,573' E	122,3	KL: 40m
HE560_12-8	19.08.20 13:11	Young Fish Trawl	on deck	79° 26,947' N	009° 02,946' E	124,5	
HE560_12-9	19.08.20 13:17	Young Fish Trawl	in the water	79° 27,162' N	009° 03,900' E	124,7	
HE560_12-9	19.08.20 13:30	Young Fish Trawl	profile start	79° 27,691' N	009° 05,925' E	118,6	SL= 150 m
HE560_12-9	19.08.20 14:04	Young Fish Trawl	profile end	79° 28,905' N	009° 11,342' E	146,1	KL: 180m
HE560_12-1	19.08.20 14:27	Bongo Net	on deck	79° 29,468' N	009° 15,015' E	161	Bongo fand nicht statt
HE560_13-1	20.08.20 06:32	CTD	max depth	79° 00,007' N	007° 53,414' E	1124,3	SL: 1099m
HE560_13-2	20.08.20 07:15	Grab	max depth	78° 59,987' N	007° 53,427' E	1124	SL: 1022m
HE560_13-3	20.08.20 07:53	Multi Corer	max depth	78° 59,983' N	007° 53,528' E	1123,1	SL: 1119m
HE560_13-4	20.08.20 08:41	World Plankton Net 2	max depth	78° 59,879' N	007° 52,381' E	1130,7	SL: 1070m
HE560_13-5	20.08.20 10:17	Bongo Net	max depth	79° 00,053' N	007° 47,823' E	1155,4	SL:40m
HE560_13-6	20.08.20 10:45	Bongo Net	max depth	79° 00,855' N	007° 46,693' E	1164,3	SL: 400m
HE560_14-1	20.08.20 14:00	Trap (generic)	station start	79° 04,588' N	009° 47,817' E	46,4	Scientific fishing
HE560_15-1	21.08.20 06:16	CTD	max depth	79° 01,172' N	010° 44,223' E	317,8	SL: 312m

HE560_15-2	21.08.20 06:39	Grab	max depth	79° 01,124' N	010° 44,373' E	318,6	SL: 321m
HE560_15-3	21.08.20 06:58	Multi Corer	max depth	79° 01,136' N	010° 44,726' E	318,6	SL: 320m
HE560_15-4	21.08.20 07:15	Bongo Net	max depth	79° 01,042' N	010° 45,501' E	322,3	SL: 45m
HE560_15-5	21.08.20 07:34	Bongo Net	max depth	79° 00,812' N	010° 48,041' E	329,9	SL: 300m
HE560_15-6	21.08.20 08:40	Young Fish Trawl	profile start	79° 02,257' N	010° 39,387' E	332,7	SL: 680m
HE560_15-6	21.08.20 09:00	Young Fish Trawl	profile end	79° 02,948' N	010° 36,100' E	316	
HE560_15-7	21.08.20 11:07	Young Fish Trawl	profile start	79° 02,593' N	010° 37,763' E	329,2	SL= 70 m
HE560_15-7	21.08.20 11:22	Young Fish Trawl	profile end	79° 02,083' N	010° 40,236' E	335	
HE560_15-8	21.08.20 12:57	Bottom Trawl	profile start	79° 01,214' N	010° 14,429' E	263,7	SL: 660m
HE560_15-8	21.08.20 13:22	Bottom Trawl	profile end	79° 00,364' N	010° 20,649' E	255,2	KL: 750m
HE560_16-1	21.08.20 17:00	Trap, drifting	station start	79° 05,339' N	011° 08,535' E	72,9	scientific angling
HE560_17-1	22.08.20 06:17	CTD	max depth	79° 11,754' N	011° 47,322' E	356,9	SL: 348m
HE560_17-2	22.08.20 06:42	Grab	max depth	79° 11,780' N	011° 47,426' E	361,9	SL: 360 m
HE560_17-3	22.08.20 07:03	Multi Corer	max depth	79° 11,767' N	011° 47,554' E	358,2	SL: 368m
HE560_17-4	22.08.20 07:23	Bongo Net	max depth	79° 11,845' N	011° 47,616' E	360,9	SL: 25m
HE560_17-5	22.08.20 07:42	Bongo Net	max depth	79° 11,572' N	011° 47,625' E	349,9	SL: 340m
HE560_17-6	22.08.20 08:50	Young Fish Trawl	profile start	79° 10,840' N	011° 45,804' E	364,6	SL: 670m
HE560_17-6	22.08.20 09:11	Young Fish Trawl	profile end	79° 09,875' N	011° 44,246' E	353,6	KL: 700m
HE560_17-7	22.08.20 11:24	Young Fish Trawl	profile start	79° 11,129' N	011° 46,259' E	365,8	SL: 410m
HE560_17-7	22.08.20 11:42	Young Fish Trawl	profile end	79° 10,354' N	011° 44,930' E	354,5	KL: 410m
HE560_17-8	22.08.20 12:53	Young Fish Trawl	profile start	79° 10,213' N	011° 44,220' E	354,5	SL: 200m
HE560_17-8	22.08.20 13:22	Young Fish Trawl	profile end	79° 11,487' N	011° 46,689' E	366,2	KL: 170m
HE560_17-9	22.08.20 14:02	Young Fish Trawl	profile start	79° 12,651' N	011° 51,931' E	285,3	KL: 60m
HE560_17-9	22.08.20 14:17	Young Fish Trawl	profile end	79° 13,022' N	011° 55,244' E	241,5	SL: 40m
HE560_17-10	22.08.20 14:59	Trap (generic)	profile start	79° 14,509' N	011° 57,765' E	74,4	Scientific angling
HE560_18-1	23.08.20 06:16	CTD	max depth	78° 57,623' N	011° 54,261' E	349,5	SL: 341m
HE560_18-2	23.08.20 06:39	Grab	max depth	78° 57,612' N	011° 54,404' E	348,6	SL: 351m
HE560_18-3	23.08.20 07:01	Multi Corer	max depth	78° 57,616' N	011° 54,736' E	347,8	SL: 348m
HE560_18-4	23.08.20 07:32	Bongo Net	max depth	78° 57,260' N	011° 53,680' E	349,5	SL: 340m
HE560_18-5	23.08.20 07:59	Bongo Net	max depth	78° 57,825' N	011° 52,453' E	318,3	SL: 25m
HE560_18-6	23.08.20 08:45	Lander (generic)	max depth	78° 56,416' N	012° 07,893' E	188,6	
HE560_18-7	23.08.20 10:56	Young Fish Trawl	profile start	78° 57,906' N	011° 51,606' E	298,8	KL:450m

HE560_18-7	23.08.20 11:11	Young Fish Trawl	profile end	78° 58,248' N	011° 48,511' E	261,7	
HE560_18-8	23.08.20 12:15	Young Fish Trawl	profile start	78° 58,972' N	011° 47,077' E	288,7	SL: 60m
HE560_18-8	23.08.20 12:37	Young Fish Trawl	profile end	78° 58,191' N	011° 50,532' E	290	
HE560_19-1	24.08.20 06:08	Remote Operated Vehicle	information	78° 55,403' N	012° 10,401' E	60,7	Boot z. W.
HE560_19-2	24.08.20 06:40	CTD	max depth	78° 55,448' N	012° 09,822' E	83,9	SL: 77m
HE560_19-3	24.08.20 06:53	Trap (generic)	profile start	78° 55,440' N	012° 09,538' E	102,4	Scientific Angling
HE560_19-4	24.08.20 10:58	Grab	max depth	78° 55,107' N	012° 14,813' E	106,1	SL: 107 m
HE560_19-5	24.08.20 11:07	Multi Corer	max depth	78° 55,142' N	012° 14,762' E	106,9	SL: 109m
HE560_19-6	24.08.20 12:10	Trap (generic)	profile start	78° 56,047' N	012° 05,485' E	138,9	scientific angling
HE560_19-6	24.08.20 13:20	Trap (generic)	profile end	78° 56,151' N	012° 03,546' E	193,5	
HE560_19-6	24.08.20 13:25	Trap (generic)	station end	78° 56,160' N	012° 03,396' E	202,8	
HE560_20-1	25.08.20 06:10	Young Fish Trawl	station start	78° 56,704' N	011° 58,326' E	291	
HE560_20-1	25.08.20 06:48	Young Fish Trawl	profile start	78° 57,848' N	011° 50,020' E	322,3	SL: 600 m
HE560_20-1	25.08.20 07:04	Young Fish Trawl	profile end	78° 58,245' N	011° 46,536' E	225,3	SL: 540m
HE560_20-2	25.08.20 09:02	Young Fish Trawl	profile start	78° 57,559' N	011° 53,110' E	344,4	SL: 680m
HE560_20-2	25.08.20 09:17	Young Fish Trawl	profile end	78° 57,140' N	011° 56,382' E	345,3	SL: 720m
HE560_20-3	25.08.20 14:19	Lander (generic)	on deck	78° 56,343' N	012° 08,098' E	189	
HE560_21-1	26.08.20 06:35	CTD	max depth	77° 30,006' N	010° 32,930' E	1181,8	SL: 1160m
HE560_21-2	26.08.20 07:21	Grab	max depth	77° 29,997' N	010° 32,820' E	1183,2	SL: 1178m
HE560_21-3	26.08.20 08:33	Multi Corer	max depth	77° 30,121' N	010° 33,628' E	1170,8	SL: 1178m
HE560_21-4	26.08.20 09:16	Bongo Net	max depth	77° 30,220' N	010° 33,759' E	1165,7	SL: 40m
HE560_21-5	26.08.20 09:45	Bongo Net	max depth	77° 29,959' N	010° 37,533' E	1123,2	SL: 400m
HE560_21-6	26.08.20 10:30	CTD	max depth	77° 29,613' N	010° 40,694' E	1085,3	SL: 1000m
HE560_21-7	26.08.20 11:07	Young Fish Trawl	profile start	77° 28,857' N	010° 39,981' E	1114,9	SL: 60m
HE560_21-7	26.08.20 11:23	Young Fish Trawl	on deck	77° 28,139' N	010° 38,749' E	1161,5	
HE560_21-8	26.08.20 12:08	Young Fish Trawl	profile start	77° 25,997' N	010° 35,437' E	1237,7	SL: 760 m
HE560_21-8	26.08.20 12:39	Young Fish Trawl	profile end	77° 24,561' N	010° 34,416' E	1278,2	KL: 770m
HE560_22-1	27.08.20 12:19	Lander (generic)	in the water	78° 38,791' N	016° 27,492' E	55,4	
HE560_22-2	27.08.20 13:15	CTD	max depth	78° 39,480' N	016° 40,691' E	185,4	SL 179 m
HE560_22-3	27.08.20 13:33	Grab	max depth	78° 39,482' N	016° 40,661' E	185,4	SL 183m
HE560_22-4	27.08.20 13:49	Multi Corer	max depth	78° 39,545' N	016° 40,575' E	184,5	SL: 183m
HE560_22-5	27.08.20 14:05	Multi Corer	max depth	78° 39,624' N	016° 40,357' E	181,2	SL: 189 m

HE560_22-6	27.08.20 16:45	Trap (generic)	profile start	78° 32,610' N	016° 28,091' E	85,2	Scientific Angling
HE560_23-1	28.08.20 06:05	Bongo Net	max depth	78° 39,572' N	016° 40,640' E	185	SL: 20m
HE560_23-2	28.08.20 06:19	Bongo Net	max depth	78° 39,725' N	016° 42,390' E	189,4	SL: 170m
HE560_23-3	28.08.20 07:23	Young Fish Trawl	profile start	78° 39,945' N	016° 45,723' E	182,9	SL 340m
HE560_23-3	28.08.20 07:48	Young Fish Trawl	profile end	78° 39,352' N	016° 40,427' E	184,6	SL: 390m
HE560_23-4	28.08.20 08:53	Young Fish Trawl	profile start	78° 38,154' N	016° 35,209' E	147,6	KL: 50m
HE560_23-4	28.08.20 09:08	Young Fish Trawl	profile end	78° 38,708' N	016° 37,290' E	168,9	KL: 60m
HE560_23-5	28.08.20 11:20	Young Fish Trawl	profile start	78° 35,758' N	016° 30,241' E	157,2	KL: 290m
HE560_23-5	28.08.20 11:48	Young Fish Trawl	profile end	78° 34,532' N	016° 27,456' E	151	KL: 220m
HE560_23-6	28.08.20 12:47	Young Fish Trawl	profile start	78° 34,173' N	016° 26,631' E	147,1	KL: 80m
HE560_23-6	28.08.20 13:02	Young Fish Trawl	profile end	78° 34,787' N	016° 28,044' E	154,3	KL: 70m
HE560_23-7	28.08.20 13:46	Young Fish Trawl	profile start	78° 35,476' N	016° 30,020' E	159,2	SL: 220m
HE560_23-7	28.08.20 14:16	Young Fish Trawl	profile end	78° 34,179' N	016° 27,122' E	150,4	KL: 240m
HE560_23-8	28.08.20 16:20	Trap (generic)	profile start	78° 30,014' N	016° 19,602' E	28,8	Scientific Angling
HE560_23-9	28.08.20 18:39	Lander (generic)	on deck	78° 38,734' N	016° 27,242' E	66	
HE560_24-1	29.08.20 06:05	CTD	max depth	77° 45,740' N	015° 07,317' E	100,5	SL: 95m
HE560_24-2	29.08.20 06:16	Grab	max depth	77° 45,839' N	015° 07,563' E	100,5	SL: 103m
HE560_24-3	29.08.20 06:27	Multi Corer	max depth	77° 45,845' N	015° 08,009' E	100,7	SL: 103m
HE560_24-4	29.08.20 06:35	Bongo Net	max depth	77° 45,750' N	015° 08,362' E	100,9	SL: 20m
HE560_24-5	29.08.20 06:45	Bongo Net	max depth	77° 45,462' N	015° 08,513' E	98,9	SL: 90m
HE560_24-6	29.08.20 07:36	Young Fish Trawl	profile start	77° 47,421' N	015° 19,030' E	105,2	KL: 120m
HE560_24-6	29.08.20 07:51	Young Fish Trawl	profile end	77° 46,723' N	015° 18,192' E	103,7	KL: 115m
HE560_24-7	29.08.20 08:36	Young Fish Trawl	profile start	77° 47,038' N	015° 19,114' E	104,2	KL: 190m
HE560_24-7	29.08.20 08:52	Young Fish Trawl	profile end	77° 47,695' N	015° 20,650' E	102,8	
HE560_24-8	29.08.20 11:50	Young Fish Trawl	profile start	77° 49,546' N	016° 24,689' E	58,9	KL: 35m
HE560_24-8	29.08.20 12:11	Young Fish Trawl	profile end	77° 49,573' N	016° 20,119' E	65,1	
HE560_24-9	29.08.20 13:14	CTD	max depth	77° 49,678' N	016° 37,780' E	73,4	SL 71 m
HE560_24-10	29.08.20 14:00	Navlot	profile start	77° 49,716' N	016° 37,536' E	72,8	EK 80 calibration
HE560_24-10	29.08.20 15:00	Navlot	profile end	77° 49,653' N	016° 37,363' E	71,9	
HE560_25-1	30.08.20 06:32	CTD	max depth	76° 59,647' N	016° 25,512' E	120,5	SL: 116m
HE560_25-2	30.08.20 06:44	Grab	max depth	76° 59,756' N	016° 26,077' E	123,3	SL: 125m
HE560_25-3	30.08.20 06:55	Multi Corer	max depth	76° 59,771' N	016° 26,511' E	122,8	SL: 124m

HE560_25-4	30.08.20 08:15	Bongo Net	max depth	76° 59,562' N	016° 00,608' E	102,4	SL: 20m
HE560_25-5	30.08.20 08:25	Bongo Net	max depth	76° 59,699' N	016° 01,794' E	94,8	SL: 90m
HE560_25-6	30.08.20 11:19	CTD	max depth	76° 57,785' N	015° 49,802' E	216,3	SL: 210 m
HE560_25-7	30.08.20 11:37	Grab	max depth	76° 57,794' N	015° 49,910' E	216,5	SL: 222m
HE560_25-8	30.08.20 13:30	Trap (generic)	profile start	76° 57,045' N	015° 48,529' E	59,8	scientific angling
HE560_25-9	30.08.20 16:46	Young Fish Trawl	profile start	76° 59,637' N	016° 25,015' E	123,1	KL: 200m
HE560_25-9	30.08.20 17:01	Young Fish Trawl	profile end	76° 59,425' N	016° 22,118' E	113,3	KL: 180m
HE560_26-1	31.08.20 06:28	Young Fish Trawl	profile start	76° 59,556' N	016° 25,985' E	116	KL: 60m
HE560_26-1	31.08.20 06:43	Young Fish Trawl	profile end	76° 59,444' N	016° 22,618' E	110,7	KL: 55m
HE560_26-2	31.08.20 07:24	Multi Corer	max depth	76° 59,520' N	016° 33,898' E	46	SL: 52 m
HE560_26-3	31.08.20 07:35	CTD	max depth	76° 59,524' N	016° 33,910' E	47,2	SL: 43m

8 Data and Sample Storage and Availability

Evaluation, analysis and publication of research data from this cruise is still ongoing. Some of the data have already been published (cf. 12.2), most of the data have been made available on PANGAEA, but in part are still under embargo (cf. table 8.1). Analysis of fisheries data is still being carried out and will result in a publication of joint datasets from the earlier cruises in this time series (HE408, HE451.1 and HE519 to Svalbard), which will then be made available on PANGAEA as well.

Table 8.1 Overview of data availability

Type	Database	Available	Free Access	Contact
Master track of HE 560	PANGAEA	2020	2020	https://doi.org/10.1594/PANGAEA.925314
Mastertrack HE 560, alternative resolutions	PANGAEA	2020	2020	https://doi.org/10.1594/PANGAEA.925313
Physical oceanography, raw data CTD	PANGAEA	2021	2021	https://doi.org/10.1594/PANGAEA.928667
Continuous thermosalinograph oceanography	PANGAEA	2021	2021	https://doi.org/10.1594/PANGAEA.932286
Lead 210 and caesium 137 based age model of sediment core HE560_26-2	PANGAEA	2022	2024	https://doi.pangaea.de/10.1594/PANGAEA.945922
Total organic carbon bulk radiocarbon data of sediment core HE560_26-2	PANGAEA	2022	2024	https://doi.pangaea.de/10.1594/PANGAEA.945892
Total organic carbon concentrations and bulk δ13C data of sediment core HE560_26-2	PANGAEA	2022	2024	https://doi.pangaea.de/10.1594/PANGAEA.945885
Petrogenic OC used for biosynthesis of sediment core HE560_26-2	PANGAEA	2022	2024	https://doi.pangaea.de/10.1594/PANGAEA.946017
Compound specific radiocarbon data of IPL-FAs of sediment core HE560_26-2	PANGAEA	2022	2024	https://doi.pangaea.de/10.1594/PANGAEA.946008
Full fisheries data		2022	2024	fmark@awi.de

9 Acknowledgements

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11 Abbreviations

n.a.

12 Appendices

12.1 Selected Pictures of Samples

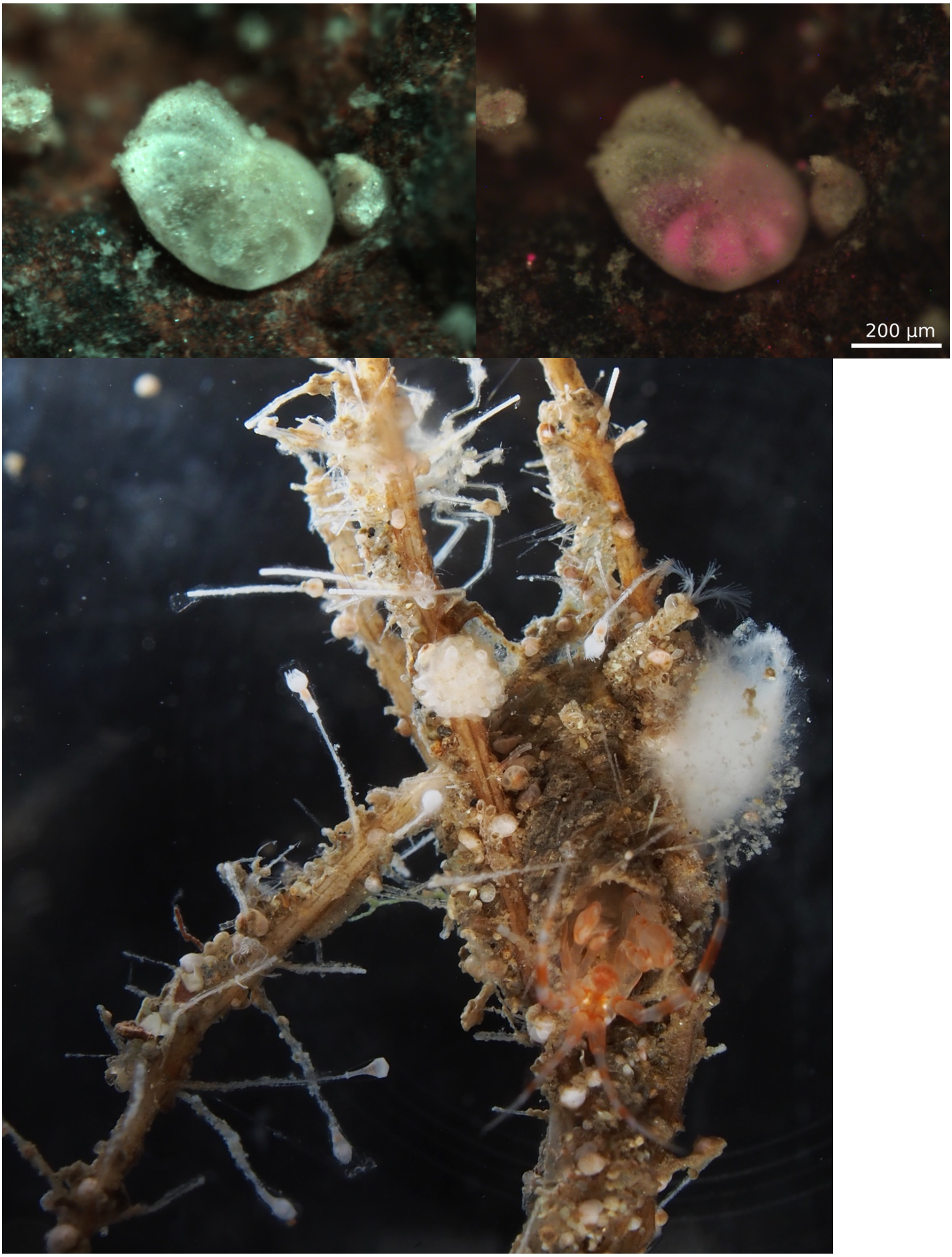

Figure 12.1.1: Pictures of live foraminiferans and live epifauna on sediment transported back alive to AWI. Upper panel: *Elphidium subantarcticum* from Hinlopen (station HE560_004) under normal light (left) and UV light (right). Chloropholl from ingested algae shows pink fluorescence. Lower panel: alive epifauna on a stone from Yermak plateau (station HE560_012) (photographies taken by Julia Wukovits, University of Vienna).

12.2 Selected Publications, Theses and Conference contributions referring to HE560

Article
Spotowitz, L., Johansen, T. , Hansen, A. , Berg, E. , Stransky, C. and Fischer, P. (2022)
New evidence for the establishment of coastal cod *Gadus morhua* in Svalbard fjords ,
Marine Ecology Progress Series, 696 , pp. 119-133 .
doi:10.3354/meps14126 , hdl:10013/epic.1502ad64-b698-4d73-a533-87147e9031b2

Book Chapter
Dischereit, A. , Havermans, C. and Murray, A. (2022)
Arctic vs sub-Arctic pelagic amphipods in the face of climate change: Insights into the genetic connectivity and diet spectrum of Themisto libellula and T. abyssorum. In: POLAR REGIONS, CLIMATE CHANGE AND SOCIETY, 28TH INTERNATIONAL POLAR CONFERENCE, POTSDAM, 01 – 05 MAY 2022. / Kassens, H. , Damaske, D. , Diekmann, B. , Flisker, F. , Heinemann, G. , Herrle, J. O. , Karsten, U. , Koglin, N. , Kruse, F. , Lehmann, R. , Lüdecke, C. , Mayer, C. , Sattler, B. , Scheinert, M. , Spiegel-Behnke, C. and Tiedemann, R. (editors) , Bremerhaven, AWI, Berichte zur Polar- und Meeresforschung = Reports on polar and marine research, 158 p.
doi:10.57738/BzPM_0762_2022 , hdl:10013/epic.037fecb6-c6f9-4eb4-a799-067adc51658f

Thesis -Master
Neven, C. J. (2021)
Hypoxia tolerance and exercise of an Arctic key stone species the Polar cod Boreogadus saida under global change scenarios ,Master thesis, Universität Bremen, hdl:10013/epic.45b23387-fae2-440a-8712-d5f42a14fab0

Thesis -Master
Kuchenmüller, L. L. (2021): Usage of Internal Heart Rate Bio-Loggers in Arctic Fish, Master thesis, Universität Bremen. hdl:10013/epic.45618b26-8472-471c-a384-e03aade26da8

Thesis -Bachelor
Withelm, C. (2022): Genotyping of Atlantic cod (Gadus morhua) by pantophysin I marker (Pan I), Bachelor thesis, Johannes Gutenberg Universität Mainz.

Thesis -Master
Steiner, N. (2022)
Range expansions of scyphozoan jellyfish - the case study of Periphylla periphylla and Cyanea capillata ,
Master thesis, University of Bremen. hdl:10013/epic.7b188b16-16a1-4a70-a45f-9e20f9549902 Item availablity restricted.

Conference -Invited keynote
Mark, F. C. (2022) Integrative Ecophysiology in the Anthropocene: classic approaches, current achievements & future challenges , 32nd ESCPB Congress, Naples, Italy, 28 August 2022 - 31 August 2022.
hdl:10013/epic.5710de2b-77d0-4852-9cbe-24116b049781

Conference -Talk
Mark, F. C., Kempf, S., Neven, C. J. and Claireaux, G. (2021)
Can Polar fish get out of breath? Hypoxia tolerance and aerobic scope of Polar cod, Boreogadus saida ,
SEB Annual Main Meeting, Online, 29 June 2021 - 8 July 2021 .
hdl:10013/epic.bd945e3d-1642-4aa7-916d-c9e1b6f6603f

Conference -Talk
Kempf, S. and Mark, F. C. (2021)
Can polar fish get out of breath? Hypoxia tolerance and aerobic scope of polar cod, Boreogadus saida ,
Open hardware and software for aquatic respirometry workshop, Thünen Institute for Fisheries Ecology (Bremerhaven), 28 October 2021 - 28 October 2021 .
hdl:10013/epic.6861ddcb-da42-44f2-a7c5-4ec2a523ed9c Item availablity restricted.

Conference -Talk
Jucker, M. N. and Havermans, C. (2022)
The phylogeography of two Beroe species in the Arctic Ocean based on one mitochondrial and one ribosomal marker , ICYMARE International Conference for Young Marine Researchers, Bremerhaven, 13 September 2022 - 16 September 2022. hdl:10013/epic.cf178033-f3ec-4fea-a3d1-b2a84799cf7c

Conference -Talk
Steiner, N. , Murray, A. and Havermans, C. (2022)
Range expansions of scyphozoan jellyfish – the case study of Periphylla periphylla and Cyanea capillata , ICYMARE International Conference for Young Marine Researchers, Bremerhaven, 13 September 2022 - 16 September 2022 . hdl:10013/epic.8456b017-d46b-4941-92a1-59d16bf9ece9

Conference -Keynote
Havermans, C. (2022)
Zooplankton in an ocean of change: evaluating the likelihood and consequences of poleward range expansions for pelagic ecosystems ,
Polar Genomics Workshop, Bielefeld, Germany, 15 May 2022 - 18 May 2022 .
hdl:10013/epic.3db54b3d-75b4-4126-a3a4-dd1bc69ed1ba

Conference -Poster
Murray, A. and Havermans, C. (2021)
Arctic vs sub-Arctic pelagic amphipods: DNA reveals a different history and a different future in the face of climate change , Arctic Science Summit Week 2021, Online, Portugal, 19 March 2021 - 26 March 2021 .
hdl:10013/epic.5915204b-61dc-416b-8139-fdce38f6628e

Conference -Invited talk
Havermans, C. , Dischereit, A. , Eschbach, A. , Murray, A. , Pantiukhin, D. and Verhaegen, G. (2021)
Atlantification equals jellification? Exploring the role of jellyfish in Tomorrow's Arctic Ocean ,
LTER-D Jahrestagung, Online, 17 March 2021 - 19 March 2021.
hdl:10013/epic.810f3e7f-a52e-4c5e-99ff-6782bc952cf0

Conference -Talk
Havermans, C. , Dischereit, A. , Eschbach, A. , Murray, A. , Pantiukhin, D. and Verhaegen, G. (2021)
The Arctic Jellies (ARJEL) project: Investigating the impact of gelatinous zooplankton communities on changing Arctic ecosystems , Arctic Frontiers 2021, Online, Tromsoe, Norway, 1 February 2021 - 4 February 2021 .
hdl:10013/epic.21922439-911e-485e-b013-b366860ebd37

Conference -Talk
Murray, A. and Havermans, C. (2021)
Arctic vs sub-Arctic pelagic amphipods: DNA reveals a different history and a different future in the face of climate change , Arctic Frontiers 2021, Online, Tromsoe, Norway, 1 February 2021 - 4 February 2021 .
hdl:10013/epic.e6a8fb3d-c667-4d56-9365-884610cd9b72