EXPEDITION REPORT

2022

AMUNDSEN SCIENCE

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2022 Expedition Report

The 2022 Expedition Report is a collection of all the participating research teams' Cruise Reports provided to the Chief Scientists at the end of each Leg of the 2022 CCGS *Amundsen* Expedition. The 2022 Expedition Report is divided into two parts:

Part I gives an overview of the expedition, shows the cruise track and the stations visited and provides a synopsis of operations conducted during each of the two legs.

Part II contains the reports submitted by participating science teams or researchers, with details on the specific objectives of their project, the field operations conducted and methodology used, and in some cases, preliminary results. When results are presented, they show the data as they were submitted at the end of the legs in 2022. The data presented in this report are illustrative only and have not been quality checked, thus parties interested in the results should contact the project leader, the researchers who collected the data or Amundsen Science's Data Coordinator (amundsen.data@as.ulaval.ca).

The four Appendices provide information about the location, date, time and type of sampling performed at each station visited by the ship, as well as a list of science participants on board during each leg.

The core oceanographic data generated by the CTD-Rosette operations, as well as meteorological information (AVOS) and data collected using the Moving Vessel Profiler (MVP), the ship-mounted current meter (SM-ADCP) and the thermosalinograph (TSG) are available in the Polar Data Catalogue (PDC) at www.polardata.ca.

Following Amundsen Science's data policy, research teams must submit their metadata to the PDC and insure that their data are archived on the long-term. It is not mandatory to use the PDC as a long-term archive, as long as a link to the data is provided in the metadata (see http://www.amundsenscience.ulaval.ca/data/data-policy for more details on data policy).

Part I – Overview and Synopsis of Operations

0 Overview of the 2022 *Amundsen* Expedition

0.1 **Introduction**

Arctic ecosystems and the communities they support are changing rapidly under the triple pressure of climate warming, modernization, and industrialization. In 2003, a consortium of Canadian universities jump-started Canada's research effort in the Arctic by mobilizing the icebreaker CCGS *Amundsen* for science. Equipped with leading-edge scientific instrumentation, the ship enabled no less than 32 large-scale national and international research initiatives that mustered 112 teams of scientists from academia, the North and public and private sectors. In two decades of operations for science, the *Amundsen* propelled Canada in the leading pack of nations studying the changing Arctic Ocean. The ship's annual presence in the North, its contribution to the International Polar Year and to the Network of Centres of Excellence ArcticNet, and its support of major environmental assessments has bolstered Canada's international stature in the study and stewardship of the Arctic.

Beyond the contribution to Canada's Arctic research effort, the *Amundsen* is part of the International Arctic Research Icebreaker Consortium (ARICE) and substantiates Canada's contribution to the 2018 Agreement on Enhancing International Arctic Scientific Cooperation by directly supporting collaborations with other Arctic countries in the multinational study of the Arctic Ocean. This cooperation takes place through diverse projects that inventory and document Arctic marine biodiversity and ecosystems, monitor their response to climate change, provide vital information on seafloor bathymetry and marine hazards, and assess the risks of increased maritime traffic and resource exploitation.

On 9 September, the Canadian research icebreaker CCGS *Amundsen* departed from Quebec City for its 19th annual mission to the Arctic Ocean. The multidisciplinary expedition lasted until 19 October, accommodating 71 participants from national and international research teams on board, enabling them to study the marine and coastal environments of the Canadian and Greenlandic Arctic. Programs on board included the Integrated Studies in the Coastal Labrador Ecosystem (ISICLE), the ArcticNet annual marine-based research program and the Knowledge and Ecosystem-Based Approach in Baffin Bay (KEBABB) program. From aquatic microorganisms to seabirds to melting glaciers and seabed mapping, numerous aspects of the northern marine environment were studied during this 40-day expedition.

0.2 **Regional settings**

0.2.1 *Labrador Sea*

Between Labrador and Greenland lies the Labrador Sea, a key region that is home to the Labrador Current system. This strong current carry cold water down from Baffin Bay to offshore Newfoundland and, therefore, strongly influences the oceanographic conditions on the Atlantic Canadian Shelf and on a global scale. Indeed, the deep ocean exchanges carbon dioxide, oxygen and heat with the atmosphere in the Labrador Sea. The area also acts as a corridor for southward drifting icebergs and ice islands, inducing risks for activities and operations conducted offshore Newfoundland. Additionally, the Labrador Sea hosts a great variety of sensitive habitats, some of which are protected and closed to bottom-contact activities. From this perspective, gathering scientific knowledge about the area is of particular importance to inform decision makers and federal departments about the risks associated with the exploitation of natural resources (fisheries, oil and gas, etc.) and ways to insure protection of the marine ecosystem.

0.2.2 *Baffin Bay*

Baffin Bay is located between Baffin Island and Greenland and connects the Arctic Ocean to the Northwest Atlantic. Warm and salty waters from the Labrador Sea exchange heat, salt, and ice with the southward Baffin Island Current in an anti-clockwise circulation. Baffin Island Current brings the colder and fresher waters of the Arctic Ocean in Baffin Bay through three narrow passages of the Canadian Arctic Archipelago (CAA): Nares Strait, Jones Sound and Lancaster Sound.

In Nares Strait, between Ellesmere Island and Greenland, ice arches typically form each winter at both its northern and southern end. The formation of ice arches in Nares Strait, the resulting cessation of ice transport and the input and upwelling of warm and salty Atlantic waters all contribute to the formation of the North Water (NOW) polynya. This year-round expanse of open waters in Smith Sound and northern Baffin Bay is the largest and most productive of its kind, on which depend many species of marine mammal and birds. The thinning of the Arctic sea-ice is already negatively affecting the stability and variability of these ice arches, which results in an increased southward ice flux through Nares Strait and an acceleration in the loss of multi-year ice from the Arctic. This process could affect the NOW polynya ecosystem.

Over the last years, the CCGS *Amundsen* frequently visited Baffin Bay and Northern Baffin Bay for scientific sampling activities, in particular to monitor seawater physics, nutrients chemistry, contaminants, and the biodiversity present along well established historical transects.

0.3 **2022 Expedition Plan**

0.3.1 *General schedule*

During winter and spring 2022, the CCGS *Amundsen* underwent significant improvements of its systems during the Vessel Life Extension refit. The ship was in dry dock and unavailable to conduct science operations until the end of summer. Based on the scientific objectives, the regions of interest and the time constraints, the Arctic expedition was divided in two legs. Leg 1 took the *Amundsen* in the Labrador Sea for the Integrated Studies in the Coastal Labrador Ecosystem (ISICLE). The KEBABB project took place in Baffin Bay and Lancaster Sound during Leg 2, in addition to the ArcticNet marine program and the deployment of acoustic moorings for the ITTAQ Heritage and Research Centre near Clyde River.

0.3.2 *Leg 1 – ISICLE – 9 to 22 September – Labrador Sea*

The first Leg of the 2022 Expedition used ASTRID the new Remotely Operated Vehicle (ROV) to study key coral habitats and seabed seep features in the Labrador Sea and Baffin Bay. This program is conducted in partnership with universities, ministries and local governments, and supports the Imappivut marine planning initiative. This year, an emphasis was placed on promoting Inuit-focused research, knowledge co-production, and Inuit community participation. In addition, oceanographic moorings recoveries and deployments took place at 5 locations.

0.3.3 *Leg 2 – KEBABB & ArcticNet – 22 September to 19 October – Baffin Bay*

Leg 2 of the 2022 Expedition took place in Baffin Bay, with operations in coastal and offshore environments, in the NOW polynya, in Lancaster Sound, in Greenland waters and in Hudson Strait. The Knowledge and Ecosystem Based Approach in Baffin Bay (KEBABB) program sampled various components of the ecosystem along four transects in the Southern Baffin Bay area. A synergy was in place with the ArcticNet program, which also studies the marine ecosystem along historical transects in Hudson Strait, in the Davis Strait and in Northern Baffin Bay. Scientific operations were also undertaken near Clyde River for the deployment of acoustic moorings in two locations.

1 Leg 1 – 9 to 22 September 2022 – Labrador Sea

Chief Scientist: David Coté[1] (david.cote@dfo-mpo.gc.ca)

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Science Participants: D. Amirault, M. Armstrong, M. Atkinson, J.B. Bennett, L. Broom, C. Carrier-Belleau, T. Carson, H.P. Clark, D. Coté, E. de Froe, J. Desforges, A. Desmarais, T. DeZutter, R. Dove, W. England, R. Forbes, H. Geizer, M. P. Hannaford, V. Wareham-Hayes, C. Hubert, E. Jacobsen, M. Ji, S. Meredyk, S. Morisset, C. Morrissey, B.M. Neves, G. Nickoloff, C. Pamak, S. Roul, B. Sandland, M. Saunders, H. Sharpe, T. Shepherd, J. Sutton, K. Wallace

1.1 Introduction and Objectives

Leg 1 of the 2022 *Amundsen* program was designed to build on previous multi-disciplinary missions (Integrated Studies and Ecosystem Characterization of the Labrador Sea Deep Ocean - ISECOLD, Integrated Studies in the Coastal Labrador Ecosystem – ISICLE, and Hidden Biodiversity – HiBio projects) to the Labrador Sea and Baffin Bay that targeted benthic biodiversity in Canada's northern oceans, sensitive habitats from the coast to the deep ocean, and characterization of demersal and pelagic faunal communities. Supporting Inuit-led initiatives including the Imappivut marine planning initiative (Nunatsiavut, DFO, Parks Canada, NRCan, Memorial) was a focus of scientific operations in 2022.

The primary scientific objectives of 2022 were to 1) further study recently located biodiversity hotspots (e.g. vulnerable marine ecosystems) and investigate new potential hotspots along the Labrador Coast with the guidance of local Nunatsiavut knowledge (Imappivut, ISICLE, DFO), 2) improve knowledge of pelagic fish and plankton communities along data-poor areas of the Labrador coast and shelf, 3) map and sample potential submarine landslides along the Labrador Coast (Imappivut, NRCan), and 4) extend ISECOLD multi-year oceanographic and pelagic data time series by recovering and redeploying oceanographic moorings in Hatton Basin and Hopedale Saddle (ISECOLD, DFO, Memorial, U of New Brunswick - UNB, U of Edinburgh - UofE). Secondary opportunistic objectives included sampling biological communities at newly discovered hydrocarbon seeps at Saglek Bank (DFO, Calgary), bioturbation studies in soft sediments (DFO, Laval), benthic carbon mineralization (Dalhousie), and epifauna sampling (Memorial, DFO, UofE, Nunatsiavut).

In addition to the scientific objectives, a heavy emphasis of this mission was placed on promoting Inuit-focused research, knowledge co-production, and Inuit community participation. Planned visits by local community members from Makkovik and Nain did not happen due to weather and a grounded helicopter. However, two Nunatsiavut Government staff (Carla Pamak and Michelle Saunders) participated in the expedition and conducted daily katimaks (Inuktitut word for meetings), highlighting best practices for conducting research in Nunatsiavut, providing information on Nunatsiavut culture and language, sharing histories of nearby communities on the coast, and conducting facilitated discussions with the science team. The highlight was a shore visit to the resettled community of Hebron where the family of one expedition member (Carla Pamak) hosted an *Amundsen* shore party made up of scientists and crew, and provided a tour of this culturally significant site.

The following mission report includes multidisciplinary contributions from each team that participated in Leg 1. Each contribution identifies team-specific objectives, methods employed, and samples collected, and in some cases preliminary results, and recommendations for future missions. These data will be the basis of many collaborative scientific papers, help shape management of these study areas, and form the foundation on which future *Amundsen* missions are constructed in the Labrador Sea.

Figure 1-1: The CCGS *Amundsen* in the Labrador Sea during Leg 1. An Isaacs's Kidd midwater trawl (IKMT) is deployed with the A-Frame.

1.2 **Synopsis of operations**

The Leg 1 mission faced numerous challenges including a delayed departure, inclement weather, a medevac of a crew member, limited daylight, and a Covid-19 outbreak. These challenges required adaptations to the mission plan, limiting capacity to achieve some objectives but also providing opportunities to enhance others. For example, more time was spent in fjord environments than planned due to storm events, which came at the cost of collections in exposed environments. This change provided an opportunity to enhance data collection in fjords. On average across all sampling activities, ~96% of planned operations were conducted successfully, but these were conducted at only 6 of 11 planned stations. The stations missed in 2022 include previously visited stations (e.g. Makkovik Hanging Gardens, Okak Fjard, Saglek Fjord, and Saglek Bank hydrocarbon seep) and one previously unexplored station (the Sentinel). The visited stations included new sites such as Joey's Gully and Hopedale Saddle and previously visited sites in Nachvak and Hebron fjords as well as two stations on Saglek Bank.

Over this 12-day Leg, the following operations were conducted:

- 11 CTD-Rosettes
- 3 phytoplankton nets
- 3 Tucker nets
- 9 Hydrobios
- 2 IKMTs
- 2 beam trawls
- 1 AUV deployment
- 6 ROV dives
- 3 mooring deployments and 2 recoveries
- 10 drop cameras
- 2 baited cameras
- 10 box cores
- 3 gravity cores

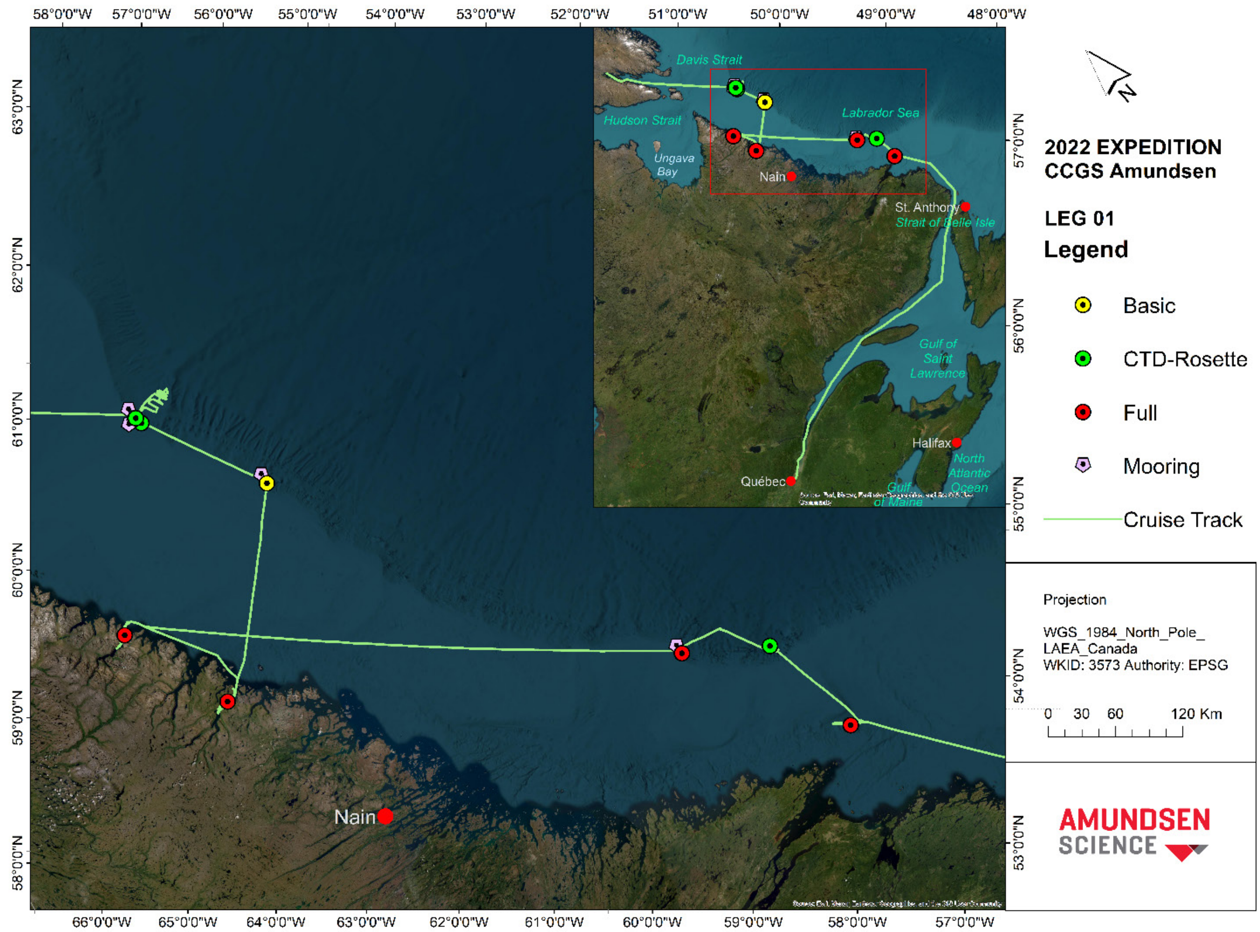

Figure 1-2. Ship track and location of stations sampled by the CCGS *Amundsen* during Leg 1 of the 2022 Expedition.

2 Leg 2 – 22 September to 19 October 2022 – Baffin Bay

Chief Scientist: Maxime Geoffroy[1] (Maxime.Geoffroy@mi.mun.ca)

[1] Marine Institute of Memorial University of Newfoundland. 155 Ridge Road, St. John's, NL, A1C 5R3, Canada

Principal Investigators: Mathieu Ardyna, Philippe Archambault, David Capelle, Ian Church, Luke Copland, Jay Cullen, Brent Else, Shari Fox, Maxime Geoffroy, Kevin Hedges, Liisa Jantunen, Zou Zou Kuzyk, Patrick Lajeunesse, Audrey Limoges, Christine Michel, Jean-Carlos Montero Serrano, Alexandre Normandeau, Katleen Robert, André Rochon, Owen Sherwood, Philippe Tortell, Jean-Éric Tremblay

Science participants: D. Amirault, T. Anderlini, E. Cracquart, C. Brice, D. Capelle, G. A. Christie, S. Ciastek, G. Deslongchamps, L. P. Fernandes, J. Gagnon, M. Geoffroy, P. Guillot, D. Hammett, J. Herbig, E. Jacobsen, K. Koerner, C. Marcil, A. McPherson, S. Meredyk, C. Morrisey, C. Nakashuk, G. Nickoloff, A. Oates, M. Pearson, M. Pierrejean, Y. Sezginer, G. Soetaert, L. Vandenbyllaardt, V. Villeneuve, J. Vogt, J. T. Yu.

2.1 Introduction and Objectives

Thirty-two scientists participated in leg 2 of the 2022 CCGS *Amundsen* scientific cruise between 22 September and 19 October. This scientific cruise was supporting i) the KEBABB project, led by Fisheries and Oceans Canada; ii) a mooring project in collaboration with Ittaq Heritage and Research Centre and the community of Clyde River; and iii) six ArcticNet projects (NTRAIN, ArcticSeafloor, ArcticFish, Contaminants, Biochemistry, ArcticKelp). Seventeen different operations were conducted on a total of 180 occasions and at 57 stations (Figure 2-1) spanning from Nares Strait to Hudson Strait. In addition, bottom mapping operations were conducted over 4000 nm. The original sampling plan did not include contingency time, hence 12 stations and 76 operations had to be cancelled due to delays caused by five storms, one medevac, and heavier than average sea ice cover (Figure 2-2). Compared to the initial mission plan, the completion rate of each operation varied between 0% and 100%, for an overall completion rate of 67% (

Table 1-2). When including the 6 opportunistic stations and 26 opportunistic deployments, this ratio reaches 78%. This report details the rationale, sampling methods, preliminary results, recommendations, and user experience of each sampling team.

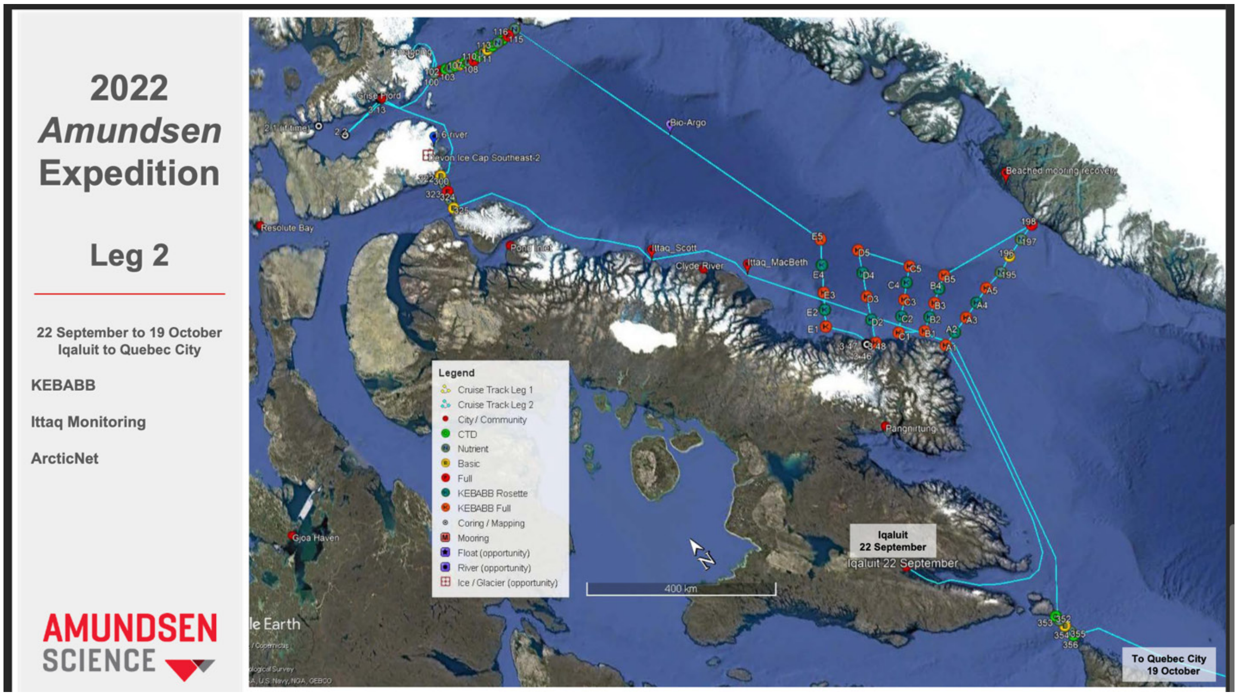

Figure 2-1. Planned cruise track of the 2022 CCGS *Amundsen* expedition, leg 2. Note that the initial plan was modified due to bad weather and heavy sea ice conditions

Table 1-1. Ratios of stations sampled during leg 2

Planned	Completed	Opportunistic	Total	Ratio planned (%)	Ratio total (%)
63	51	6	57	85	90

Table 1-2. Ratios of sampling operations completed during leg 2

Operations	Planned	Completed	Opportunistic	Total	Ratio planned (%)	Ratio total (%)
CTD Rosette	59	48	5	53	81	90
Baited camera	3	2	0	2	67	67
Beam trawl	8	6	1	7	75	88
Bongo net	22	13	3	16	59	73
Box core	26	14	4	18	54	69
Gravity core	3	0	2	2	0	67
Hydrobios	19	14	0	14	74	74
IKMT	13	9	0	9	69	69
Monster	1	1	4	5	100	500
Trace Metals Rosette	32	21	4	25	66	78
Tucker	26	17	1	18	65	69
Van Veen grab	0	0	2	2	100	200
Zodiac trace metals	8	2	0	2	25	25
Zodiac contaminants	2	1	0	1	50	50
MVP	1	1	0	1	100	100
CPR	1	1	0	1	100	100
Mooring recovery	2	0	0	0	0	0
Mooring deployments	2	2	0	2	100	100
Bio-Argo deployments	2	2	0	0	100	100
TOTAL	**230**	**154**	**26**	**180**	**67**	**78**

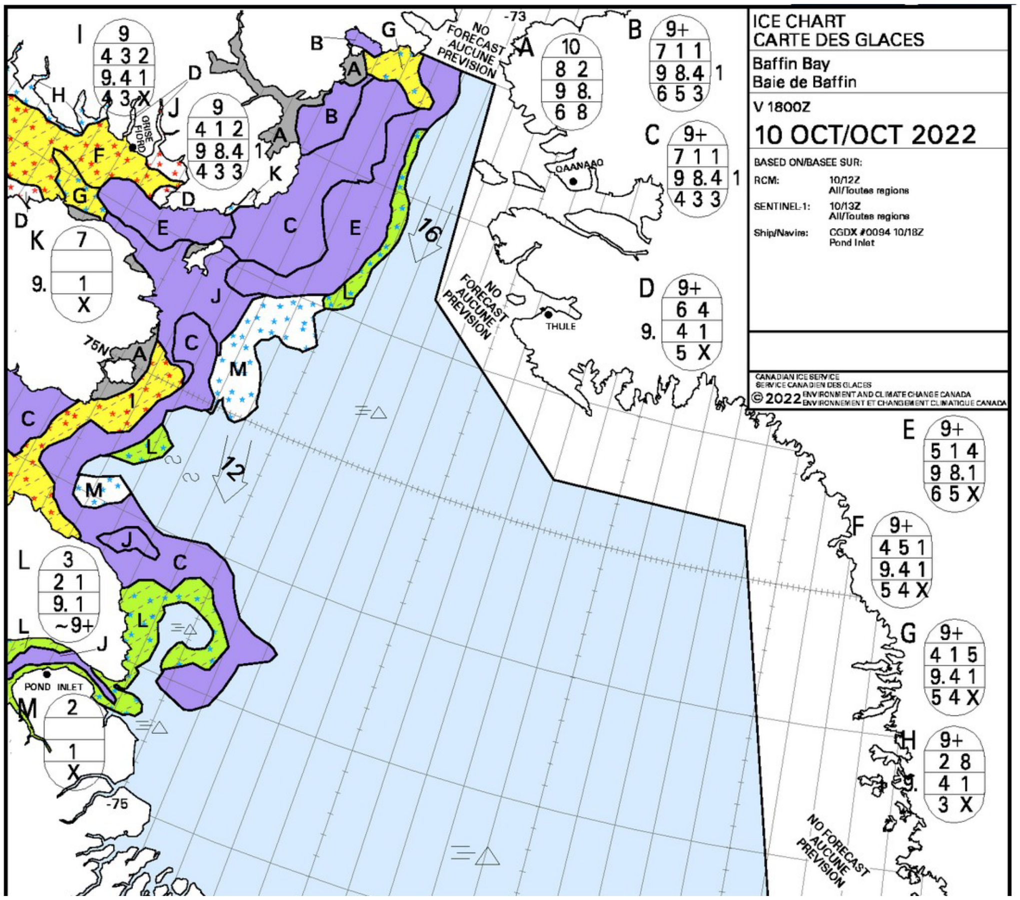

Figure 2-2. Sea ice coverage in the study area on 10 October 2022 (source: Canadian Ice Service)

Over this 27-day Leg, the following operations were conducted:

- 2 zodiac deployments
- 53 CTD-Rosette
- 25 Trace metals casts
- 16 phytoplankton nets
- 19 Tucker nets
- 5 Monster nets
- 13 Hydrobios
- 9 Isaacs-Kidd midwater trawls (IKMT)
- 7 beam trawls
- 7 Continuous Plankton Recorder (CPR)
- 6 Moving Vessel Profiler (MVP) casts
- 1 Bio-Argo floats deployment
- 2 mooring deployments
- 2 baited cameras
- 2 Van Veen grabs
- 18 box cores
- 2 gravity cores

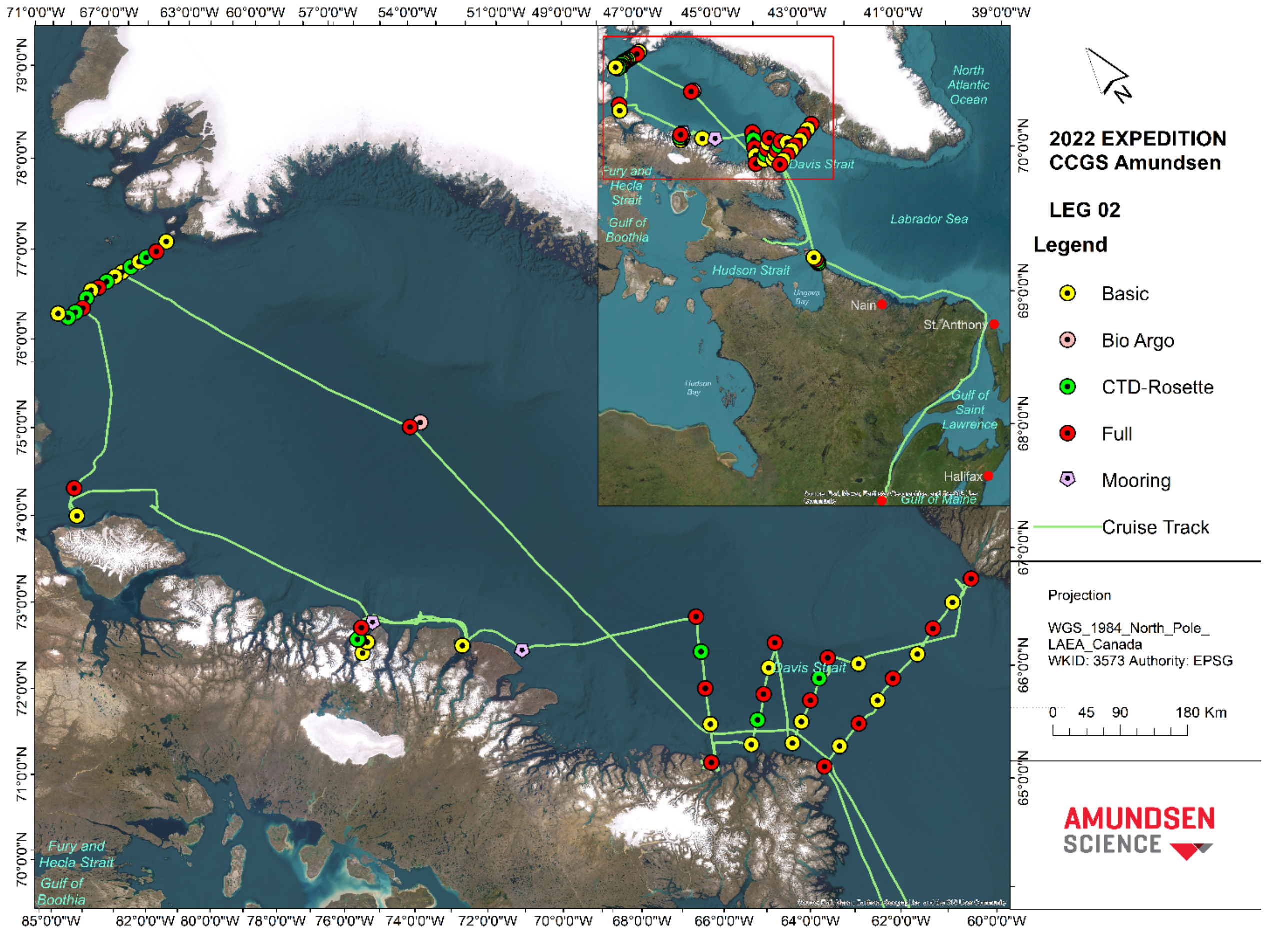

Figure 2-3. Ship track and location of stations sampled by the CCGS *Amundsen* during Leg 2 of the 2022 Expedition.

Part II – Project reports

1 Nunatsiavut Community Engagement, Inclusion and Participation

Principal Leads: Michelle Saunders[1] (Michelle.Saunders@nunatsiavut.com), Carla Pamak[1] (Carla.Pamak@nunatsiavut.com)

Cruise Participants : Full Leg 1 science team.

[1]Nunatsiavut Government, Nain, NL.

1.1 Introduction and objectives

Nunatsiavut (Our Beautiful Land in Inuktitut) is the homeland of the Labrador Inuit. The Labrador Inuit Land Claims Agreement (LILCA) was ratified in 2005 establishing the Nunatsiavut Government, the first Inuit region in Canada to achieve self-government. Nunatsiavut comprises 5 communities: Nain, Hopedale, Makkovik, Postville and Rigolet and is home to over 1,400 Inuit (Stats Can). Along with the 72,520 km^2 of land rights set out in LILCA, Nunatsiavut also have special rights along the coast to 48,690 km^2 of sea.

Labrador Inuit depend on the land, sea ice, and marine areas for their way of life. From food security to health to cultural preservation, the ability to access and use Nunatsiavut land and waters is paramount. In 2017, the Nunatsiavut Government began to develop Imappivut (Our Oceans) – the Nunatsiavut Marine Plan to fully implement Chapter 6 of the LILCA which sets out to develop a co-management plan out to the 200-mile Exclusive Economic Zone. Imappivut will cover the full extent of the coastal and marine areas included in LILCA representing species, habitats and community interests of importance to Labrador Inuit. Imappivut ensures that Labrador Inuit have self-determination in research and decisions that affect their environment and way of life. By utilizing Inuit and scientific knowledge, Imappivut guides research activities within our waters to address community priorities and ensure that Inuit can continue to access, use and enjoy a healthy marine environment.

The Nunatsiavut Government and Nunatsiavut Research Centre contributed to the development of the National Inuit Strategy on Research (NISR). The NISR describes 5 priorities for ensuring effective, impactful and meaningful research for Inuit: 1) Advance Inuit governance in research, 2) Enhance the ethical conduct in research, 3) Align funding with Inuit research priorities, 4) Ensure Inuit access, ownership and control over data and information and 5) Build capacity for Inuit Nunangat research.

With the guiding priorities of Imappivut and the NISR, the Nunatsiavut Government partnered with *Amundsen* participants to complete Leg 1 of the *Amundsen* 2022 expedition to help further understand our marine environment. The Nunatsiavut Government sent two Research Centre employees on the Leg to provide input in scientific operations and sampling, enhance and build capacity in research and to educate and guide participants on appropriate research process in Nunatsiavut. The Nunatsiavut Government team completed 5 activities during their time aboard:

1. eDNA sampling: sediment samples were taken from box cores at 1. Joey's Gully, 2. Hopedale Saddle, 3. Nachvak, 4. Hebron for eDNA analysis. eDNA sediment sampling has not been completed by the NG until now due to lack of equipment. This additional sampling will help us better complete the eDNA analysis along with surface and bottom eDNA water samples.

2. DNA library sampling: Organisms were opportunistically collected to analyze their DNA to better understand eDNA results. Various organisms from pelagic species to benthic species were identified, collected and labeled for DNA analysis. Organisms were collected in 1. Joey's Gully 2. Hopedale Saddle, 3. Nachvak, and 4. Hebron through box cores, beam trawls and IKMT nets.

3. Nunatsiavut katimak (meeting in Inuktitut): Presentations were held after each science meetings ranging from research process in Nunatsiavut, introductory Inuktitut lessons, knowing the region you're working in and the history of Hebron. These presentations were held to educate the *Amundsen* scientists about Nunatsiavut and the importance of ongoing work in the Labrador Sea and coastal Nunatsiavut.

4. Hebron Site Visit: Scientists and *Amundsen* personnel travelled to Hebron to learn about the history of the site and the importance of it to Labrador Inuit (Figure 2-1). Hebron was settled by the Moravian Missionaries in the 1700's providing services to Inuit in the surrounding areas. The Hudson Bay Company also established a store there where Inuit were able to trade for goods. In 1959, the Government of Newfoundland forcefully relocated all Inuit living in Hebron to other communities in the South. This had a devastating effect on Inuit that still lingers today. Hebron is one story of colonization that the Labrador Inuit endured. The site visit had a profound impact on many of the scientists who voiced their appreciation for invitation into Labrador Inuit lands and gave perspective on the importance of the work on this Leg.

5. Facilitated Discussion/Focus Group: A facilitated discussion was held by NG to hear feedback from scientists about Nunatsiavut participation. Three questions were asked: What are you impressions of the Nunatsiavut and the Labrador Sea? How do you think your research can benefit Nunatsiavut? How will this experience on the ship change the way you do research? The responses from this discussion were noted by NG staff and will be used to formulate a social science research project (pending NGRAC approval) to understand how Inuit participation impacts Western science institutions. After leaving the ship, all participants will be contacted for a follow up one-on-one interview to understand the impacts NG representation had on the ship, how this may change the way they do research and how they can collaborate better with Indigenous organizations.

1.2 **Recommendations:**

- Continue making opportunities to include Inuit leadership in mission planning and consider establishing an Inuit steering committee for scientific activities (NISR Priority Area 1: Advance Inuit governance in research);

- Continue to look for opportunities to increase Inuit participation in *Amundsen* programs to further capacity building and training (NISR Priority Area 5: Build capacity in Inuit Nunangat research);

- Continue to make efforts to visit Inuit communities to share knowledge between scientific community and Inuit; and

- Continue to promote multidisciplinary mission teams to fully implement the Inuit holistic approach to research. For example, since the multidisciplinary approach has worked so well for natural scientists, additional benefits will likely be achieved by the inclusion of artists, social scientists, and/or health researchers/practitioners on research missions.

Figure 1-1: *Amundsen* shore party hosted by Nunatsiavut residents at the Hebron Mission National Historic Site, Hebron Fjord, Nunatsiavut

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2 ROV Deep-water benthic habitat Remotely Operated Vehicle (ROV) surveys

Project leaders: Bárbara de Moura Neves[1] (barbara.neves@dfo-mpo.gc.ca), Vonda Wareham Hayes (vonda.hayes@dfo-mpo.gc.ca), Paul Snelgrove[2] (psnelgrove@mun.ca), Chris Algar[3] (chris.algar@dal.ca), David Coté[1] (David.cote@dfo-mpo.gc.ca).

Cruise participants – Leg 1 : Bárbara de Moura Neves, Vonda Wareham Hayes, Rachelle Dove, Maria Armstrong, Haley Geizer, David Coté.

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[2] Memorial University, St. John's NL, Canada

[3] Dalhousie University, Halifax, NS, Canada

2.1 Introduction and Objectives

Remotely Operated Vehicle (ROV) operations in 2022 aimed to complement the suite of operations planned as part of the ISICLE program. ROV surveys play a crucial role in the investigation of sensitive benthic communities, and aimed to contribute to data collection related to existing or planned area-based marine conservation initiatives and to still unidentified areas of high ecological significance. ROV surveys have particular importance when surveying areas of complex relief where other equipment have limited access and to conduct specialized operations such as targeted biological sampling and sediment push-coring.

Specifically, ROV dives were meant to contribute to objective 1 of the cruise proposal: to further study previously located biodiversity hotspots (e.g. vulnerable marine ecosystems) and investigate new potential hotspots along the Labrador Coast, in addition to sampling biological communities at newly discovered hydrocarbon seeps at Saglek Bank (DFO, Calgary), bioturbation studies in soft sediments (DFO, Laval), benthic carbon mineralization (Dalhousie), echinoderm form and function studies (Memorial), demersal fish and shrimp sampling (Memorial, DFO), and sponge sampling (UoE).

2.2 Methodology

A total of 5 ROV dives were conducted at 3 sites (Figure 2-1). HD video as well as 38 biological, sediment, and seawater samples were collected during the dives (Table 1-1). Sediment samples from Joey's Gully (Dive 30) were processed by the Algar team (Maria Armstrong and Haley Geizer) for biogeochemical purposes (described in Section 8). Sediment samples from Hebron Fjord (Dive 32) were pre-processed by the Algar team and further processed by the Neves team aboard for infauna biodiversity analyses. This processing consisted of slicing the sediment into three layers: 0-2 cm, 3-5 cm, and 5-10 cm and preserving them in 10% formalin. Samples were going to be sieved but due to time limitations, sediment was directly preserved in formalin.

Seawater samples were used for sediment incubations or to keep biological samples fresh. Biological samples were photographed, subsampled for DNA analysis (preserved in 100% ethanol) and the remaining of samples were frozen at -20 °C. Samples for Poppy Clark are described in Section 4.

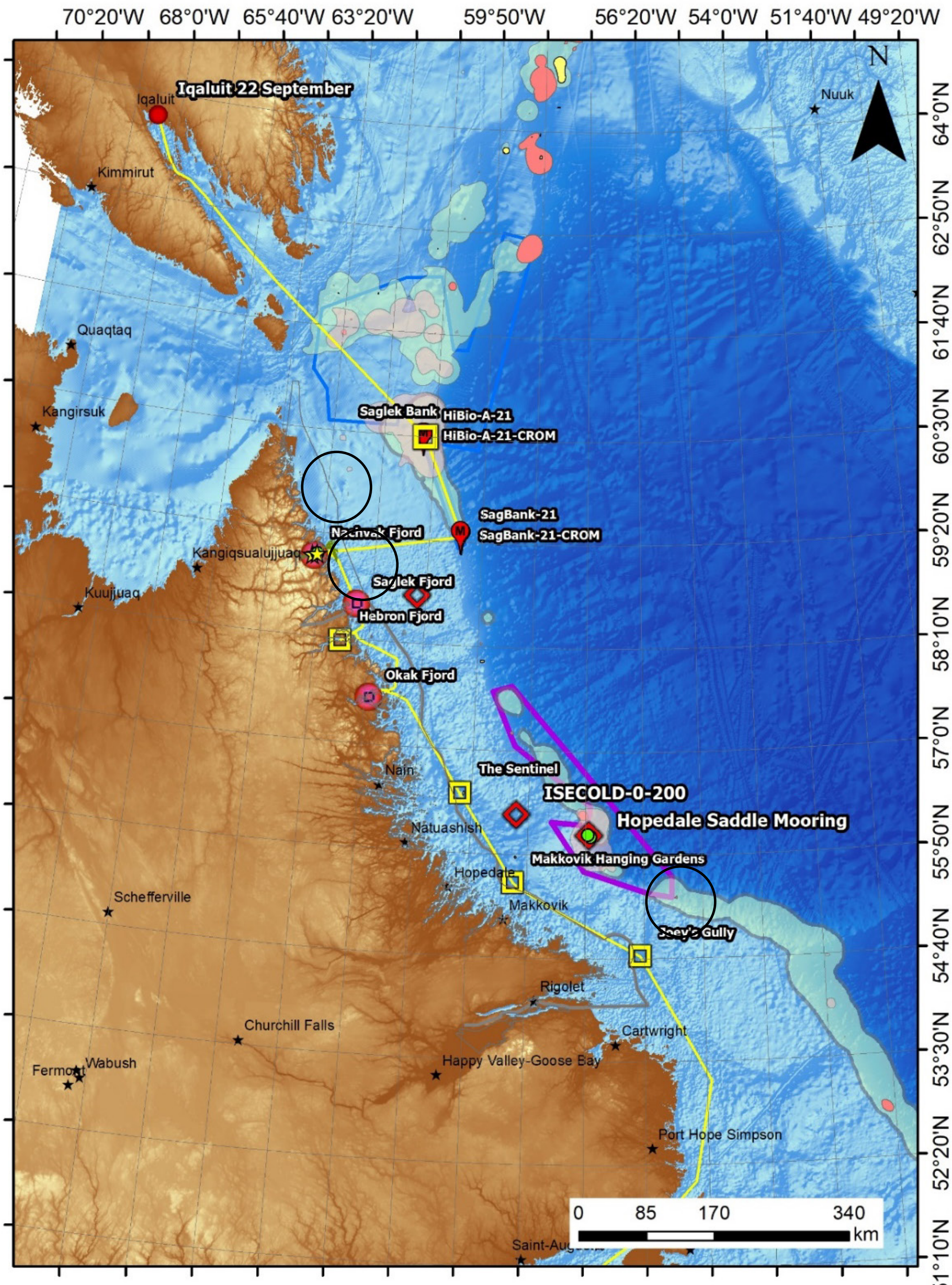

Figure 2-1: Map of general area surveyed during the 2022 *Amundsen* expedition. Accomplished ROV dives are circled

Table 2-1: List of ROV samples collected during Leg 1 of the 2022 *Amundsen* expedition

Time	Number	Identifier	Method	Latitude	Longitude	Depth
9/12/2022 19:48	R30-1	sediment	push core	N54° 37.3116′	W56° 27.1656′	381.2
9/12/2022 19:52	R30-2	sediment	push core	N54° 37.3128′	W56° 27.1662′	381.2
9/12/2022 20:00	R30-3	sediment	push core	N54° 37.3116′	W56° 27.1656′	381.2
9/12/2022 20:05	R30-4	sediment	push core	N54° 37.3116′	W56° 27.1662′	381.3
9/12/2022 20:17	R30-5	sediment	push core	N54° 37.3116′	W56° 27.1686′	381.4
9/12/2022 20:21	R30-6	sediment	push core	N54° 37.3128′	W56° 27.1662′	381.4
9/12/2022 20:32	R30-7	seawater	Niskin	N54° 37.3152′	W56° 27.147′	383.2
9/12/2022 20:34	R30-8	seawater	Niskin	N54° 37.314′	W56° 27.1536′	383
9/12/2022 22:19	R30-9	Sponge	arm	N54° 37.2726′	W56° 26.9724′	428
9/16/2022 19:51	R31-1	Sponge	arm	N59° 4.4628′	W63° 29.04′	160.2
9/16/2022 20:18	R31-2	Sponge	arm	N59° 4.4298′	W63° 29.0322′	118.4
9/17/2022 14:29	R32-1	seawater	Niskin	N58° 8.919′	W62° 47.3652′	245.9
9/17/2022 14:36	R32-2	sediment	push core	N58° 8.9208′	W62° 47.37′	245.7

9/17/2022 14:39	R32-3	sediment	push core	N58° 8.9208′	W62° 47.37′	245.7
9/17/2022 14:42	R32-4	sediment	push core	N58° 8.9208′	W62° 47.37′	245.8
9/17/2022 14:45	R32-5	sediment	push core	N58° 8.9202′	W62° 47.37′	245.8
9/17/2022 14:47	R32-6	sediment	push core	N58° 8.919′	W62° 47.367′	245.9
9/17/2022 14:51	R32-7	sediment	push core	N58° 8.9184′	W62° 47.3694′	245.8
9/17/2022 15:00	R32-8	sediment	push core	N58° 8.9178′	W62° 47.3694′	245.7
9/17/2022 15:03	R32-9	sediment	push core	N58° 8.9196′	W62° 47.3676′	245.8
9/17/2022 15:04	R32-10	sediment	push core	N58° 8.9196′	W62° 47.3682′	245.9
9/17/2022 15:10	R32-11	sediment	push core	N58° 8.9178′	W62° 47.3676′	245.8
9/17/2022 15:14	R32-12	sediment	push core	N58° 8.9196′	W62° 47.3706′	245.8
9/17/2022 15:27	R32-13	cerianthid	arm	N58° 8.916′	W62° 47.3676′	246
9/17/2022 15:31	R32-14	cerianthid	scoop	N58° 8.9172′	W62° 47.3676′	246
9/17/2022 20:17	R33-1	seawater	Niskin	N58° 9.1014′	W62° 48.063′	243
9/17/2022 20:19	R33-2	seawater	Niskin	N58° 9.1038′	W62° 48.0732′	242.6

9/17/2022 20:25	R33-3	sediment	push core	N58° 9.105′	W62° 48.0744′	243.1
9/17/2022 20:27	R33-4	sediment	push core	N58° 9.1062′	W62° 48.0744′	243
9/17/2022 20:30	R33-5	sediment	push core	N58° 9.1062′	W62° 48.0732′	243
9/17/2022 20:32	R33-6	sediment	push core	N58° 9.1056′	W62° 48.0744′	243
9/17/2022 20:35	R33-7	sediment	push core	N58° 9.1062′	W62° 48.0726′	243
9/17/2022 20:37	R33-8	sediment	push core	N58° 9.1056′	W62° 48.0726′	243
9/17/2022 20:43	R33-9	sediment	push core	N58° 9.1056′	W62° 48.0744′	243
9/17/2022 20:48	R33-10	sediment	push core	N58° 9.1056′	W62° 48.0714′	243
9/17/2022 20:51	R33-11	sediment	push core	N58° 9.1062′	W62° 48.0714′	243
9/17/2022 20:54	R33-12	sediment	push core	N58° 9.108′	W62° 48.0756′	243
9/17/2022 20:58	R33-13	sediment	push core	N58° 9.1074′	W62° 48.0714′	243

2.3 **Preliminary Results**

<u>Dive 30. Joey's Gully (September 12th 2022)</u>

This was the first dive of the expedition (Leg 1) and it lasted ~4:20 hours (Figure 2-2, Figure 2-3). The dive was concluded one hour before the allocated end time in order to give room for additional operations. The dive started at 379 meters in a soft sediment area (~100 m from the planned vertical wall), and sediment push-coring started as soon as the ROV was stable. A total of six push-cores were collected for Maria Armstrong and Haley Geizer (Algar lab team aboard) for sediment geochemistry studies and will be described separately Section 8. A sponge was also collected (*Mycale* (*Mycale*) cf. *lingua*) for Poppy Clark's PhD project (DeClippelle lab, Section 4).

For most of the dive the ROV video-surveyed a vertical wall, which had been identified from the multibeam bathymetry (Figure 2-2). Most of the benthic fauna on the walls consisted of sea anemones, Nephtheidae soft corals (likely *Duva florida* and *Drifa* sp.), and encrusting sponges. Some soft corals seemed larger than usual (e.g., the size of a cod fish) and were abundant and conspicuous, but no gorgonian corals or sea pens were observed during this dive.

Many species of Demospongiae sponges were observed during the dive, including *Mycale* (*Mycale*) cf. *lingua*, several species of *Polymastia* sponges, the carnivorous sponge *Cladorhiza* sp., vase sponges, fan sponges and encrusting sponges.

Other benthic fauna included shrimp (glass shrimp and stripped shrimp), sea stars (*Hippasteria* cf. phygiana, *Henricia* sp., *Gorgonocephalus* sp., *Icasterias* cf. *panolpa*, and Ophiuridae brittle stars), several species of bryozoans, and the solitarian hydrozoan (likely *Corymorpha* sp.) was also observed at a few instances. Sea anemones were at occasionally seen in very high densities, mostly on one side of the wall, providing a vibrant display of colours (Figure 2-3). and were also very abundant in the IKMT nets deployed later that day at this station (see Section 6). Shrimp were also very common in the nets. Overall, the area seemed like a very productive environment and the ROV performed well, with the only setback being the CTD not recording data for this dive.

The ROV dives at Hopedale Saddle (scheduled for September 14th 2022) and Makkovik were both cancelled due to weather complications. While on station on September 14th (at Hopedale Saddle) the captain and ROV team assessed that wind conditions would make operations too challenging and the dive was cancelled. All operations at the Makkovik station were cancelled because of a weather system that made us to head straight to Nachvak fjord for protection.

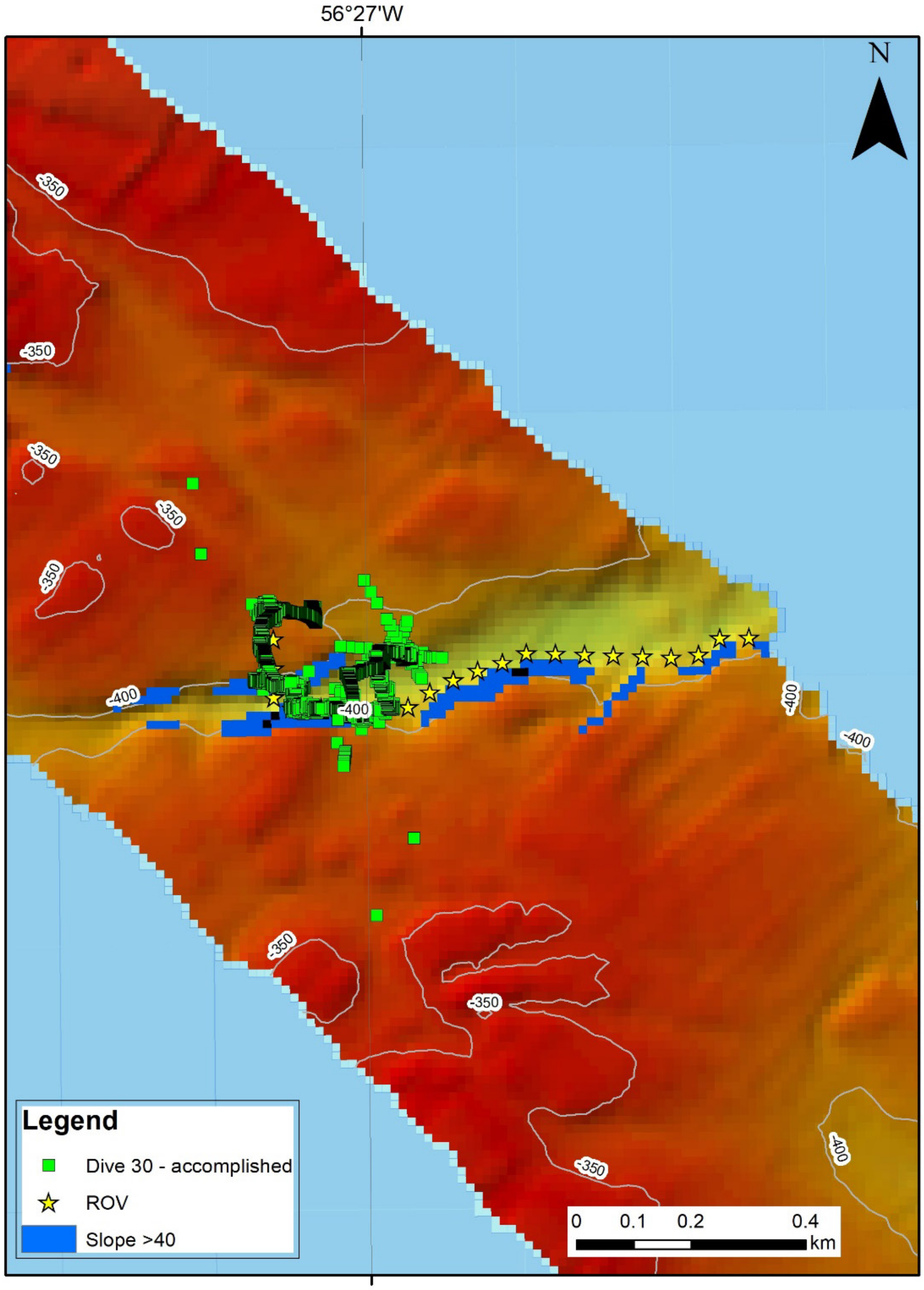

Figure 2-2: Map showing path of ROV Dive 30 at Joey's Gully. Outliers will be filtered out during data processing. Stars show proposed dive path.

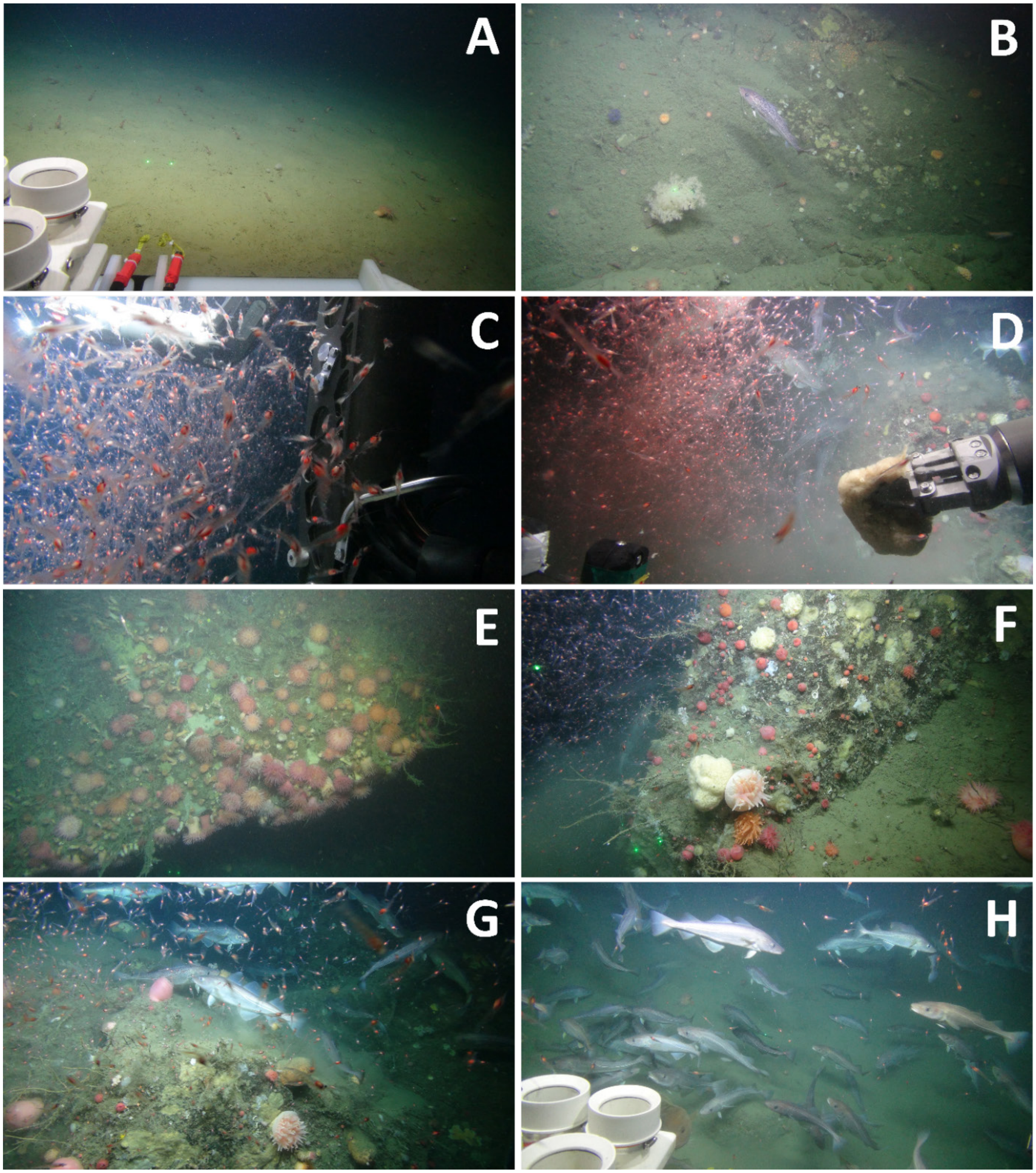

Figure 2-3: Seafloor images at Joey's Gully. A) Start of dive and location where push-cores were taken, B) large soft coral (*Nephtheidae*) and cod, C) abundance of crustaceans in the water column, D) sample sponge in ROV arm being brought to sample drawers, E) cluster of sea anemones on wall, F) additional sea anemones and sponge shown in D, G-H) school of cod

Dive 31. Nachvak Fjord (September 16th 2022)

This dive had not been initially planned and it was added as a result of the same weather system that made us to cancel the Hopedale Saddle and Makkovik ROV dives. The dive was planned to survey an area close to the area where a baited camera had been deployed the day before. That area had been selected based on the position of a shark captured as longline bycatch, as part of an Exploratory Turbot survey (Torngat Wildlife Plants and Fisheries Secretariat) in 2012. Dive 31 lasted ~3:50 hours.

The location of the dive was chosen based on the results of two drop camera deployments, the location of one of them being based on gillnet bycatch of the bamboo coral *Acanella arbuscula*, also as part of the Exploratory Turbot survey described above. A beam trawl deployed the night before the dive indicated the presence of abundant cerianthids nearby. The dive aimed to collect sediment push-cores in a similar way to that planned for the Hebron Fjord, based on habitat types (Figure 2-4). This dive started at ~207 m. Sediment was very fine and water was very turbid, making it difficult to even see the seafloor (Figure 2-5). We opted for doing the transect line at a slow speed for ¼ of the planned transect line and then re-evaluate survey plan. Sea anemones were commonly observed, but no obvious cerianthids were noted. Half way through the transect (total transect planned at 1.5 km) we decided to accelerate to reach the high slope area. Once depth started to decrease and the bottom type to change to less fine sediment and bedrock, visibility improved. Sea anemones were still some of the most common organisms observed. Dark cerianthids were also observed at this part of the dive, but not in high densities. Sponges were not uncommon, and two individuals were collected for P. Clark's study (see Section 4 for details on processing). One of the sponges was a *Mycale* (*Mycale*) cf. *lingua*, but the second one remains unidentified at present (possible *Iophon* sp.). Subsamples of both sponges were also collected for taxonomy and DNA analysis. One of the dive objectives was to collect sediment push-cores, if we had encountered fields of cerianthids. However, since that was not the case, no push-cores were collected during this dive. The bamboo coral *Acanella arbuscula* was also not observed despite knowledge of its presence in the area.

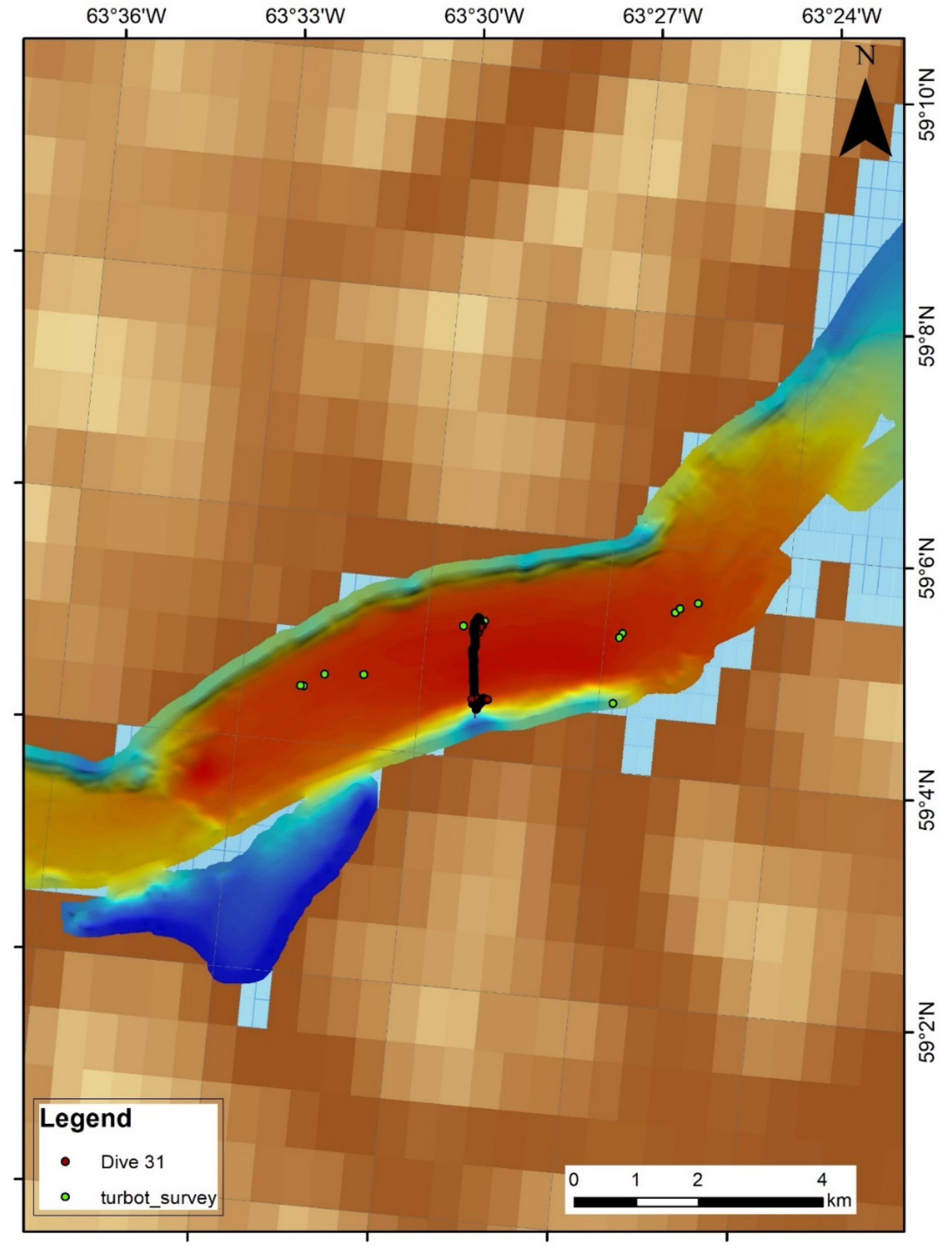

Figure 2-4: Map showing the ROV Dive 31 at Nachvak Fjord.

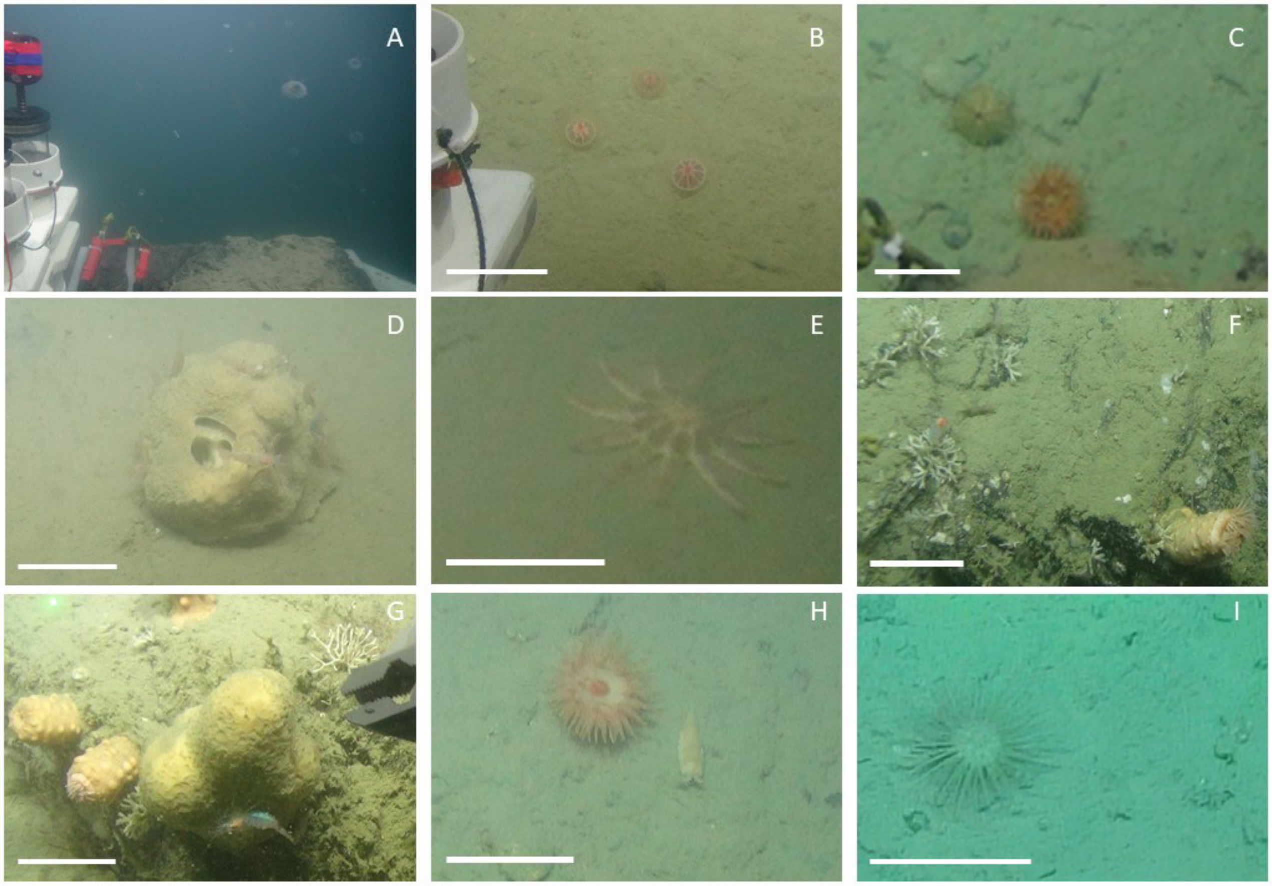

Figure 2-5: A) pelagic jellyfish observed during ROV descend, B) benthic jellyfish, C) sea urchin and sea anemone sp. 1, D) *Demospongiae* sp., E) sea star *Crossaster* sp. , F) bryozoans and sea anemone sp. 2, G) *Mycale* (*Mycale*) cf. lingua with shrimp, sea anemones sp. 2, and white bryozoans, H) sea anemone with large isopod *Saduria* sp., I) ceranthid on slope wall

Dive 32. Hebron Fjord (September 17th 2022, Morning) – Cerianthid field.

The main objective of the ROV dive at this site was to collect sediment push-cores to investigate the potential influence of cerianthid fields on sediment macrofauna diversity and for geochemical studies of sediment on fjords (Figure 2-6).

Dive time was ~2:50 hours, with time on bottom ~2 hours. The seafloor was flat, composed of soft sediment, but visibility was good (Figure 2-7). The seafloor was dominated by polychaete tubes, with sparse ophiuroids, sea anemones and cerianthids (Figure 2-7). As we moved to the planned start position, cerianthid fields started to be observed. A total of 11 push-cores were collected in the cerianthid field area (Figure 2-7), at 246 m. Six push-cores were collected for geochemical analyses (3 for flux, 2 for porewater, and 1 for oxygen microsensors, described in Section 8) and five for macrofauna. We likely crossed the path of the beam trawl deployed nearby at this site (beam trawl 1; see Figure 2-7 H).

Push-core samples were quickly processed by the two teams to allow the cores to be reused during Dive 33, only ~3 hours after the ROV had been recovered.

Dive 33. Hebron Fjord (September 17th 2022, Afternoon) – Non-cerianthid field.

This dive was a continuation of Dive 32, this time aiming to sample sediment push-cores at a non-cerianthid site (Figure 2-6). Distance between cerianthid and non-cerianthid sampling was 0.8 km, and depth was very similar (246 m for Dive 32 and 243 m for this dive) (Figure 2-6). The seafloor was comparable to that observed during Dive 32, but the area chosen to sample had no cerianthids (Figure 2-7). Like in the cerianthid area, a total of six push-cores were collected for biogeochemical analyses (3 for flux, 2 for porewater, and 1 for oxygen microsensors, described in Section 8) and five for macrofauna. A short video survey taken after sampling (towards west) did not reveal cerianthid fields, corroborating the choice of this site. Dive time was 2 hours, of which one was spent on the seafloor.

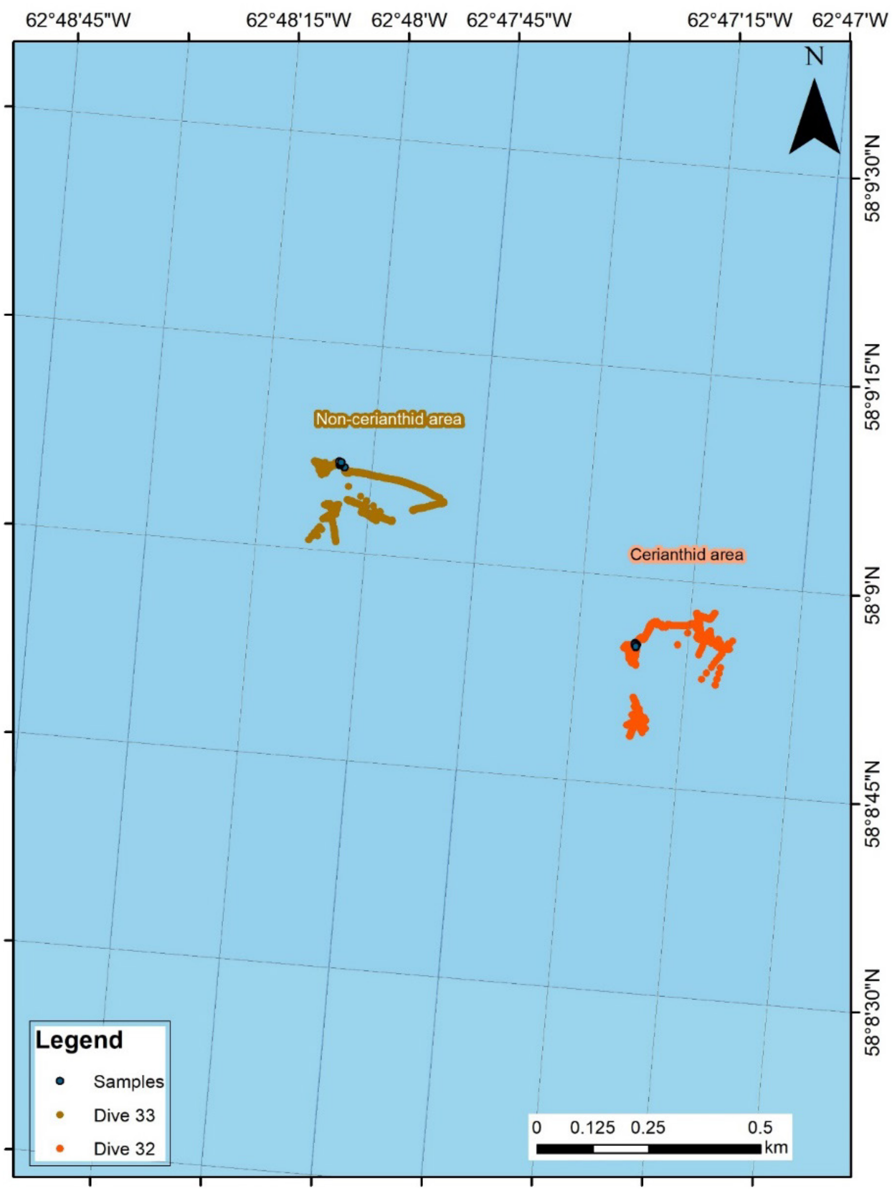

Figure 2-6: Map showing path of ROV dives 32 and 33 at Hebron Fjord and location of samples.

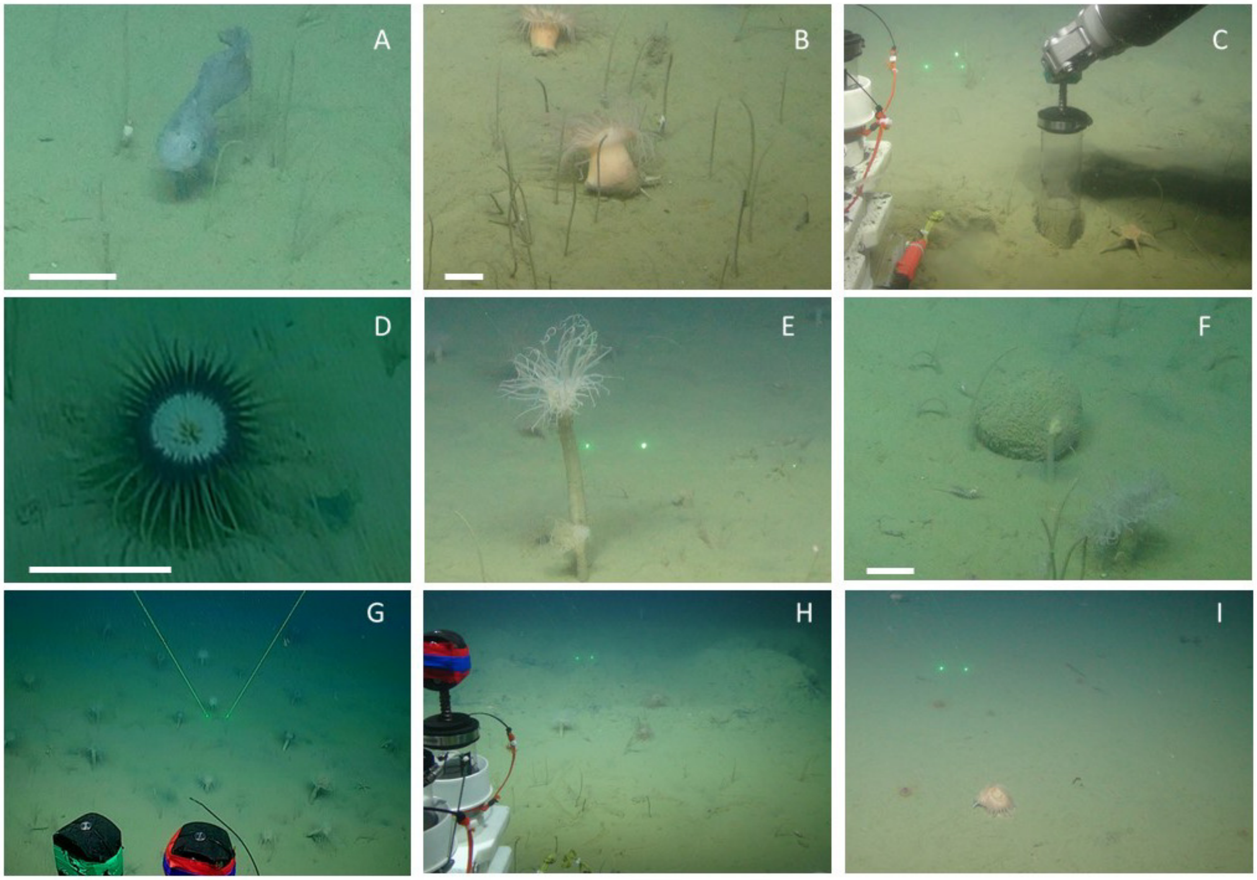

Figure 2-7: A) snailfish *Liparidae* sp., B) large sea anemone sp. 1 attached to whelk, surrounded by polychaete tubes, C) ROV push core with brittle star next to it, D-E) two different cerianthids with dark and light morphologies, F) *Demospongiae* sp. with cerianthids and shrimp, G) cerianthid field, H) large sediment disturbance noted, potentially from beam trawl deployed the day before, I) sea anemone sp. 1 attached to whelk, surrounded by benthic jellyfish. Note photos A-H) from cerianthid site, and photo I) from non-cerianthid site

Dive 34. Hebron Fjord (September 18th 2022, Morning) – Ceriantthid area + video survey.

This dive was a last minute addition to the plan, and the result of available time for extra operations at Hebron Fjord. The plan was to start the dive at waypoint 5 identified during dive 32 to collect additional push-cores in the cerianthid area, but with cerianthids inside the cores, as well as to video-survey a line ~1.3 km in length. Unfortunately, strong winds prevented the dive to be completed and we aborted it not long after reaching the seafloor, as the ship was having difficulties holding position.

General notes

For every station where ROV dives took place, the ROV performed well and the specific objectives were met. The Hopedale Saddle, Makkovik, and Saglek Bank sites could not be surveyed with the ROV due to weather challenges (Makkovik was not surveyed at all during this expedition). Despite that, we were able to perform four successful dives and to collect 28 sediment push-cores, three sponges, and two cerianthids (note only 1 sample was retained in the sample box for DNA), in addition to bottom seawater from all stations where the ROV was deployed (used for push-core incubations). Biological sampling was less intensive than expected because the areas where we expected to sample the most were not surveyed (i.e., Hopedale Saddle, Makkovik, and Saglek Bank). Sampling of cerianthids could not be accomplished using the ROV arms, since these organisms are extremely delicate and exhibit a withdrawing behavior that requires a different sampling method. However, one cerianthid was collected using the ROV scoop.

2.4 Recommendations

Recommendations listed here have been briefly discussed with the ROV team, and are listed for consideration.

1) ROV push-core holsters are currently not straightforward for the science team to use. The science team would be more than happy to discuss with Amundsen Science (C. Morrissey) about potential solutions to facilitate this process.
2) Having additional push-core holsters available (and tubes, plungers, etc.) could facilitate instances where back-to-back dives might be requested in order to intensify push-core collection. Processing of push-cores by the science team might not occur as fast as desired, and having a full second set of cores available (i.e., for 11 cores) is of great interest.
3) Push-core plungers available in the current pool of push-core parts are not all easy to pass through the holster tubes. Assessing which ones are problematic and potentially shaving theirs sides would facilitate extracting liners from them without risking sediment integrity.
4) The RayFin camera is problematic in many aspects. We encourage the ROV team to explore solutions related to improving it, or replacing it with a more reliable camera.
5) An ROV suction sampler is still highly recommended, and it will facilitate the collection of delicate specimens like the cerianthids video-surveyed in Hebron Fjord.

6) Continued access to IRLS during future expeditions is also highly recommended, as it greatly facilitates our work.

7) Better quality of video shown in CCTV system would be a great bonus, although we realize that it might not be possible. In instances where scientists might be prevented from accessing the ROV room during a dive, this would be beneficial. Potentially even a sound system where live narration of dives could be listened to by scientists outside of the ROV room.

8) DP system integration will greatly improve navigation precision, and it will be quite important during future repeat video-surveys (i.e., redoing a video-survey conducted in a previous year). Although it was not available this year, we would like to emphasize the benefits of having it for the next surveys. Also consider an INS to assist with precise positioning.

9) The sediment autosiever worked very well, and the team is pleased with it.

3 Knowledge and Ecosystem-Based Approach in Baffin Bay (KEBABB)

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Program Coordinator: Monika Pućko[1]

Cruise participants – Leg 2: David Capelle[1], Vincent Villeneuve[1], Elizabeth Kitching[1], Lenore Vandenbyllaardt[1], Catherine Marcil[1], Stephen Ciastek[2], Devin Hammett[2], Marie Pierrejean[5], Sikulia (Charlie) Nakashuk[1]

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3.1 Introduction and objectives

Stock assessment surveys are conducted by Fisheries and Oceans Canada (DFO) in the Eastern Canadian Arctic for major commercial fisheries - Greenland Halibut (*Reinhardtius hippoglossoides*) and Northern and Striped Shrimp (*Pandalus borealis* and *P. montagui*, respectively). However, an ecosystem-based approach to fisheries management requires additional collection of oceanographic data in the region to contribute to the interpretation of changes in major stocks' abundance, dynamics, and distribution The Knowledge and Ecosystem-Based Approach in Baffin Bay (KEBABB) program, developed by DFO in 2019 in collaboration with university partners, will provide crucial oceanographic data for the development and application of the ecosystem-based approach to fisheries management, as well as for an overall Arctic marine ecosystem monitoring program of Baffin Bay. The general objective of KEBABB is to characterize the variability and trends in physical, chemical, and biological oceanographic conditions in order to evaluate their influence on fisheries resources of western Baffin Bay. Five main components of KEBABB are: 1) physical and chemical oceanographic conditions; 2) abundance and composition of phytoplankton and microbial communities; 3) abundance and composition of zooplankton; 4) benthic communities and biogeochemistry; and 5) ecosystem health and interactions.

3.2 **Methodology**

The KEBABB program in 2022 was carried out during Leg 2 of the CCGS *Amundsen* 2022 expedition by four teams:

1. Filtration team – Vincent and Elizabeth (Rosette sampling, filtrations, chlorophyll readings and operating the Fast-Repetition Rate Fluorometer (FRRF)),

2. Zooplankton team – Lenore and Charlie (zooplankton nets deployments and taxonomy samples preservation), and Catherine (zooplankton sorting for fatty acid analysis and nets deployment),

3. Sediments team – Stephen, Devin and Marie – deploying the box core, taking push cores and doing incubations for oxygen consumption (Marie),

4. Benthos team – Marie – helping with deployments of Beam Trawl, and identifying epifauna to the lowest taxonomic level possible.

The KEBABB program consists of 5 transects (A, B, C, D, and E) located east of Qikiqtarjuaq, each composed of 5 stations, and are designed to cover a coastal – offshore gradient. In 2021, locations of stations A2, A3, A4, and A5 were moved north when compared to 2019, to align with the NTRAIN program's extension of KEBABB's line A, stretching across Davis Strait. These new stations coordinates were also used for the 2022 expedition. KEBABB lines A to D were sampled between September 24th and October 3rd, 2022, a different timing when compared to the 2019 and 2021 sampling periods (2019: August 22nd – August 31st; 2021: August 17th – August 29st). This difference in the 2022 sampling period was due to the fact that the *Amundsen* vessel was undergoing important repairs until the end of August, 2022. However, the entire line E had to be cancelled in 2022, mainly due to bad weather and lack of contingency in the original expedition plan.

The KEBABB filtration team also sampled on most of the NTRAIN basic and full stations, on the NOW transect, in Lancaster Sound, and at some opportunistic stations in Broughton Trough, Scott Inlet and Clyde River to collect data such as chlorophyll *a* concentration, bacteria and protist abundance and phytoplankton taxonomic composition, and filtered water for POC/PN analyses for the NTRAIN team. Some NTRAIN nutrient stations were sampled for a limited suite of biochemical parameters.

The KEBABB zooplankton team also sampled on KEBABB station, at NTRAIN stations 196 and 198, at station 323 in Lancaster Sound, as well as station 354 in Hudson Strait. Even if samples were not collected on any other stations than the ones identified before, the zooplankton team helped to deploy the different nets and to process the samples for Maxime Geoffroy's team.

The KEBABB sediment and benthos team sampled on KEBABB stations, NTRAIN stations 198 and 196, NOW stations 111 and 115, station 323 in Lancaster Sound and at some opportunistic stations in Scott Inlet, Clyde River and Broughton Trough. General sampling schedule is summarized in Table 1.

Water from the CTD-Rosette was collected at multiple depths depending on the station depth. Sampled depths and the analyses performed at each of them are listed in Table 2 for KEBABB, and Table 3 for other non-KEBABB stations. Fractionated chlorophyll *a* (total and > 5 µm) concentrations were measured on board the ship, using a Turner Design fluorometer (model 10-AU), following Parsons *et al* (1984). All other water samples will be analyzed later, at the Freshwater Institute (DFO, Winnipeg), or will be sent to collaborators/contractors for analysis. Particulate Organic Carbon/Particulate Nitrogen POC/PN and Fatty Acid (FA) samples were filtered and kept frozen, at -80 °C until further analysis. For taxonomy (two types: lugol and buffered formaldehyde), water was subsampled and kept at 4°C. For cell abundance, flow cytometry, water was subsampled and kept at -80°C. Surface water was sampled at the Rosette for nanoparticles analyzes (Gigault team, Takuvik).

Meso and macrozooplankton were sampled for taxonomic composition using a 3-Net Vertical Sampler (3NVS) "*Monster*" net (200, 200 and 50 µm mesh size, 1 m^2 collection area), throughout the entire water column (integrated vertical tow, from 10-20 m over the ocean floor to the surface) and were preserved in HDPE jars in 4 % v/v borate-buffered formaldehyde solution until further taxonomic analysis. Zooplankton for stratified taxonomic composition was sampled using a "*Hydrobios*" closing net MultiNet Type Maxi (200 µm mesh size, 0.5 m^2 collection area, 9 nets). Depths of the strata were decided in station in order to maximize the mesopelagic vertical definition. Samples were preserved using the same method as for the integrated vertical tow samples. Zooplankton for fatty acid biomarker analysis were collected using a Double Square Net (DSN) "*Tucker"* net (500, 500 and auxiliary 50 µm mesh size, 1 m^2 collection area), sampling the upper 100 m of the water column in an oblique V-shaped tow. When sampling in very shallow depths (station 198), a W-shaped tow was undertaken in order to ensure that sufficient material was sampled. The actual depth of the *Tucker* net during deployment was monitored using a Kongsberg Maritime HiPAP MiniS34 cNODE acoustic transponder system (S/N# 17570) attached to the cable just over the net. After collection, zooplankton were sorted and counted into abundant taxonomic groups down to the lowest taxonomic level possible (species or genus for most specimens and class for more difficult individuals): *Clione limacina*, *limacina helicina*, *Calanus hyperboreus*, *Calanus finmarchicus/glacialis*, *Metridia* sp., *Themisto libellula*, *Themisto abyssorum*, *Parasagitta elegans*, *Eukrohnia hamata*, *Paraeuchaeta* sp., *Aglantha* sp., *Thysanoessa* sp., *Ostracoda*, *Tunicata* sp., *Oikopleura* sp., *Onisimus littoralis*, *Meganyctiphanes norvegica*, *Hyperia galba*, *Heterorhabdus norvegicus*, Polychaeta, Cnidaria, *Hyperoche medusarum*, , Decapoda; using a dissecting stereomicroscope, and kept frozen at -80 °C in glass cryovials. Subsamples of the *Tuckey* 500 µm and *Monster* 200 µm nets were given to the Contaminants team (Gary Stern, CEOS, Winnipeg), J. Gigault/CNRS-Takuvik and Tanya Brown team. All samples preserved in formalin were sent to Maxime Geoffroy's team for taxonomic analysis after the cruise.

Box core deployments (table 6) starting from station 198 were deployed with a Kongsberg Maritime HiPAP MiniS34 cNODE acoustic transponder system (S/N# 17570) attached to the winch cable in order to ensure that any issues with the cable counter due to excess grease or freezing water would not result in operational failures. Push cores of 10 cm diameter were collected from the box core sampler and stored at 4 °C. They were then sectioned in layers (Table 4) within 12 hours after collection and individually bagged. Sectioned samples were kept at -20 °C until further analysis. Analyses that will be performed on these layers include sedimentation rate, radioisotope dating, porosity, total mercury concentration, PAH, n-alkanes, PCBs, total carbon, total inorganic carbon, and C/N isotopes. Bulk surface samples were collected at box core sites and kept at 4 °C for archival purposes.

Subcores of sediments were collected for sediment pigment content, organic matter, compound specific isotope analysis (SIA) and biomarkers (HBIs). Sediment pigments were frozen at -80°C, and SIA and HBIs samples were frozen at -20°C. All samples will be transported off the ship for analyses at the Université Laval at Québec. Sediment cores (3) were collected using sub sampling of box cores to examine sediment remineralization. Overlaying water was added in each core with bottom water (2 m above seafloor) from the CTD Rosette. Flux incubations were conducted for a period of 48 hours in a ~4°C cold room at the dark. Oxygen measurements were made every ~4 hours and dissolved nutrient samples (NO_x^-, NH_4^+, PO_4^{3-}, SiO_2) were collected at the beginning, after 24h and at the end of the incubations then frozen at -80°C. To relate sediment biogeochemical processes to macrofauna, cores were sieved on a 2 mm mesh sieve and organisms were preserved at -20°C for later compound specific isotope analysis at the Université Laval at Québec.

The Beam trawl was operated by Maxime Geoffroy’s teams (table 5) and provided a lot of benthic individuals such as decapods, amphipods, echinoderms, and cnidarians. Species from the beam trawl were sorted, identified, counted, weighted. Specimen were frozen at -20°C for compound specific isotope analysis and biomarkers (HBIs). Moreover, 3 specimens of decapods species were frozen at -20°C for later DNA analyses at Maurice Lamontagne Institute. The benthos team also provided individuals and surface sediment to other teams for nanoparticles (Gigault team, Takuvik) and contaminant analyses (Jantunen/Stern teams).

Table 3-1: General sampling schedule conducted by the KEBABB team during leg 2 of the 2022 CCGS *Amundsen* expedition.

Station name	Latitude	Longitude	Cast	Date	Water column biochemistry[1]	Zooplankton integrated taxonomy	Zooplankton stratified taxonomy	Zooplankton oblique tow fatty acids	Zooplankton oblique tow taxonomy	Sediment characterization	Benthic epifauna
A1	66.60666	-61.18852	001	24-09-2022	X[1]		X	X			B
A2	66.6694	-60.4756	002	24-09-2022	X[1]						
A3	66.73082	-59.608	003	25-09-2022	X[1]		X	X[4]		C,S,P,I	
A4	66.79768	-58.73792	004	25-09-2022	X[1]					C,S,P	
A5	66.87664	-57.95712	005	25-09-2022	X[1]		X	X		C,S	
195	66.88712	-56.93088	006	26-09-2022	X[1]					C,S	
196	66.98324	-56.06718	007	26-09-2022	X[2]		X		X	Cancelle d	B
197	67.04428	-55.09574	008	27-09-2022	X[3]					V	
198	67.08512	-54.2036	009	27-09-2022	X[2]		Cancel led		X	V,C,S	B
B6	67.28522	-58.43684	010	28-09-2022						C,S,P	
B5	67.58724	-59.02384	011	28-09-2022	X[1]		X	X	X		
B4	67.46662	-59.63544	012	28-09-2022	X[1]						
B3	67.32946	-60.27714	013	28-09-2022	X[1]		X	X	X	C,S,P,I	
B2	67.19518	-60.89636	014	29-09-2022	X[1]						
B1	67.06014	-61.50838	015	29-09-2022	X[1]		Cancel led	X	X		B
C5	68.14592	-59.9731	016	29-09-2022	X[1]		X	X	X		
C4	67.9579	-60.62494	017	30-09-2022	X[1]					C,S,P,I	
C3	67.74784	-61.26864	018	30-09-2022	X[1]		Cancel led	X[5]	X[5]	C,S,P	
C2	67.54752	-61.90764	019	30-09-2022	X[1]						
C1	67.34838	-62.53066	020	30-09-2022	X[1]		X	X	X		Cancelled

Station name	Latitude	Longitude	Cast	Date	Water column biochemistry[1]	Zooplankton integrated taxonomy	Zooplankton stratified taxonomy	Zooplankton oblique tow fatty acids	Zooplankton oblique tow taxonomy	Sediment characterization	Benthic epifauna
Broughton Trough/D1*	67.39604	-63.84868	021	01-10-2022	X[1]					C,S	
D1	67.47434	-63.68532	022	02-10-2022	X[1]	X		X	X		B
D2	67.85626	-63.1448	023	02-10-2022	X[1]						
D3	68.2449	-62.59526	024	02-10-2022	X[1]	X		X	X	C,S,P,I	
D4	68.62838	-61.98124	025	03-10-2022	X[1]						
D5	69.00236	-61.4055	026	03-10-2022			X	X	X		
E1				Cancelled due to bad weather							
E2											
E3											
E4											
E5											
Clyde river	70.34794	-68.45464	027	04-10-2022	X[1]						
Scott Inlet sill	71.15394	-71.26854	028	05-10-2022	X[1]					C,S,I	B
Clark_fjord	71.05054	-71.59096	029	05-10-2022					X		
SI_coring 2	70.96496	-71.3233	030	05-10-2022							
SI_coring 3	70.87536	-71.66164	031	06-10-2022							
325				Cancelled due to ice							
324_south	73.8251	-79.60446	032	08-10-2022	X[2]						
323_east	74.15138	-79.30468	033	08-10-2022	X[2]		X		Cancelled	C,S,P,I	
300				Cancelled due to ice							
322											
100											

Station name	Latitude	Longitude	Cast	Date	Water column biochemistry[1]	Zooplankton integrated taxonomy	Zooplankton stratified taxonomy	Zooplankton oblique tow fatty acids	Zooplankton oblique tow taxonomy	Sediment characterization	Benthic epifauna
101				Cancelled due to ice							
102_south	76.17866	-76.9801	034	09-10-2022	X[2]						
103_south	76.08736	-76.59422	035	09-10-2022							
104_south	76.11012	-76.16374	036	09-10-2022							
105_south	76.1222	-75.76466	037	09-10-2022	X[2]				X		
106_south	76.20942	-75.37534	038	09-10-2022							
107	76.27246	-74.99742	039	09-10-2022							
108	76.26452	-74.61174	040	09-10-2022	X[2]				X		B
109	76.28758	-74.10964	041	10-10-2022							
110	76.29722	-73.61706	042	10-10-2022							
115	76.33378	-71.20374	043	10-10-2022	X[2]				X	C,S,P,I	
116	76.38166	-70.51848	044	10-10-2022	X[2]						
114	76.32732	-71.79374	045	11-10-2022							
113	76.32284	-72.20088	046	11-10-2022							
112	76.31514	-72.69986	047	11-10-2022							
111	76.30568	-73.20742	048	11-10-2022	X[2]				Cancelled	C,S,P,I	
Stn 138				Cancelled due to bad weather							
Stn 54											
Bio-Argo_2022	72.89636	-65.60316	049	12-10-2022	X[2]						
353	61.154	-64.78216	050	14-10-2022	X[2]						
354	61.00472	-64.72826	051	14-10-2022	X[2]	X			X		
355	60.85378	-64.71846	052	15-10-2022	X[2]						

Station name	Latitude	Longitude	Cast	Date	Water column biochemistry[1]	Zooplankton integrated taxonomy	Zooplankton stratified taxonomy	Zooplankton oblique tow fatty acids	Zooplankton oblique tow taxonomy	Sediment characterization	Benthic epifauna
356	60.7407	-64.71442	053	15-10-2022	X[2]						

[1] DIC/TA, Salinity, del^{18}O, flow cytometry (FC), DAPI, chlorophyll a concentration, Phytoplankton taxonomy (lugol and formol), Phyto-plankton fatty acid (FA) composition, POC/PON, Frrf

[2] Flow cytometry (FC), chlorophyll a concentration, Phytoplankton taxonomy (lugol and formol), POC/PON, Frrf

[3] DIC/TA, Salinity and del18O

[4] Winch miscounted the cable length

[5] Sampling depth not reliable, problem with HIPAP beacon

* Alternate station

B = Beam Trawl, V = Van Veen, C = Box Core, S = Bulk Surface, P = Push Core, I = Benthic Incubations

Table 3-2: Sampling details for water column biochemistry sampled by the KEBABB filtration team during leg 2 of the 2022 CCGS *Amundsen* at KEBABB and NTRAIN stations; 1x – single sample collected, 2x – duplicates collected, 3x – triplicates collected

Depth (m)	**DIC/TA**	**Salinity**	**$\delta^{18}O$**	**Flow cytometry**		**DAPI**	**Chlorophyll *a***		**Phyto taxonomy**	**Phyto fatty acid**	**POC/PN**	**FRRF**
				Bacteria	**Protist**		**Total**	**>5µm**				
5	1x	1x	1x	2x	2x	2x	2x	2x	2x*	2x		1x
10		1x	1x				2x	2x				
20	1x	1x	1x	2x	2x		2x	2x				
30		1x	1x				2x	2x				
SCM	1x	1x	1x	2x	2x	2x	2x	2x	2x*	2x	3x	1x
40	1x	1x	1x	2x	2x		2x	2x				
50		1x	1x				2x	2x				
60	1x	1x	1x	2x	2x		2x	2x				
80	1x	1x	1x	2x	2x		2x	2x				
100	3x	1x	1x	2x	2x							
150		1x	1x									
200	1x	1x	1x									
250		1x	1x									
300		1x	1x									
500	1x	1x	1x									
750	1x	1x	1x									
1000	1x	1x	1x									
Bottom	1x	1x	1x								3x	

* one sample preserved with formalin, and one with Lugol's acidic solution

Table 3-3: Sampling details for biochemical characterization of water column sampled by the KEBABB filtration team during leg 2 of the 2022 CCGS *Amundsen* at stations other than KEBABB and NTRAIN; 1x – single sample collected, 2x – duplicates collected, 3x – triplicates collected

Depth (m)	DIC/TA	Salinity	$\delta^{18}O$	Flow cytometry		DAPI	Chlorophyll *a*		Phyto taxonomy	Phyto fatty acid	POC/PN	FRRF
				Bacteria	Protist		Total	> 5µm				
5	1x	1x	1x	2x	2x		2x	2x	2x*	2x		1x
10							2x	2x				
20	1x	1x	1x	2x	2x		2x	2x				
30							2x	2x				
SCM	1x	1x	1x	2x	2x		2x	2x	2x*	2x	3x	1x
40				2x	2x		2x	2x				
50	1x	1x	1x				2x	2x				
60				2x	2x		2x	2x				
80				2x	2x		2x	2x				
100	3x	1x	1x	2x	2x							
150	1x	1x	1x									
200	1x	1x	1x									
Bottom	1x	1x	1x								3x**	

* one sample preserved with formalin, and one with Lugol's acidic solution

** During the NOW transect, triplicates collected only on stations where a boxcore was also done. Otherwise, triplicates done at each other stations sampled during the cruise

Table 3-4: Thickness of layers sectioned from push cores according to their depth in the core

Section (cm)	Layer thickness (cm)
0-10	1
10-20	2
20-Bot	5

Table 3-5: General information on Beam Trawl deployment rationale and degree of success on KEBABB stations and some NTRAIN stations. Cable length is 2.5 times the depth.

Station	Depth (m)	Cable length and wire angle (m)	Number of taxa saved for SIA	Comments
A1	112	NA	20	Successful
196	130	325	18	Successful
198	75	185	28	Successful
B1	107	270	5	Successful but few organism in the net, barely touch the bottom.
C1				Cancelled due to bad weather
D1	455	1075	23	Successful
E1				Cancelled to avoid falling behind schedule.
Scott Inlet	459	1150	32	Successful
108	445	1112	34	Successful

Table 3-6: General information on Box Core sampler deployment rationale and degree of success on KEBABB stations and some NTRAIN/Anet stations.

Station	Depth (m)	Comments / Push core recovery[1]
A3	872.18	Successful, Push Core 26 cm. 3 push core for benthic incubation (Sediment oxygen consumption)
A4	902.68	Successful, core tube was cracked due to an abundance of gravel deeper in the core but the push core (28 cm) was able to be recovered
A5	812.00	Seal failed, disturbing the surface, Bulk surface was taken.
195	655.19	Hit a rock, surface water drained too quickly, disturbing the surface of the core, Bulk Surface was taken. Winch had a counting error starting after this we started using the HiPAP as an additional depth check.
196	~130	Skipped, sub bottom had a low sediment response.
197	67.39	Van Veen came up with only shell fragments, no box was deployed.
198	73.84	Van Veen showed broken shells and sediments, box was deployed but failed to create a good seal. Bulk surface was collected
B6	1133.83	Fishing boat in planned location alternate station was chosen. Successful, Push Core 38 cm.
B3	1073.93	Successful, Push Core 33.5 cm. fishing vessel in the area. 3 push core for benthic incubation (Sediment oxygen consumption and nutrient fluxes)
C4	1592.41	Successful, Push Core 38.5 cm. Core tube was inserted at a slight angle. Iceberg was on station, had to move slightly. 3 push core for benthic incubation (Sediment oxygen consumption and nutrient fluxes)
C3	1557.79	Successful, Push Core 44 cm. Box hit side of ship multiple times causing the surface to become suspended.
Broughton Trough/D1*	463.93	Successful, surface sample was taken.
D3	1540.34	Successful, Push Core 40 cm. 3 push core for benthic incubation (Sediment oxygen consumption and nutrient fluxes)
E3	~1296	Cancelled to avoid falling behind schedule.
E5	~1976	Cancelled to avoid falling behind schedule.
Scott Inlet sill	459.22	Successful, surface sample was taken. 3 push core for benthic incubation (Sediment oxygen consumption and nutrient fluxes)
325	~706	Cancelled due to ice.
323_east	788.04	Successful, Push Core 38.5cm. 3 push core for benthic incubation (Sediment oxygen consumption and nutrient fluxes). Station was east of ice edge.
322	~666	Cancelled due to ice.
101	~353	Cancelled due to ice.
115	652.40	Successful, Push Core 33.5 cm. 3 push core for benthic incubation (Sediment oxygen consumption and nutrient fluxes)
111	589.20	Successful, Push Core 40 cm. 3 push core for benthic incubation (Sediment oxygen consumption and nutrient fluxes).
Stn 138	~1079	Cancelled to avoid falling behind schedule.
Stn 54	~1079	Cancelled to avoid falling behind schedule.

[1] All push cores have bulk surface samples taken as well.

3.3 **Preliminary results**

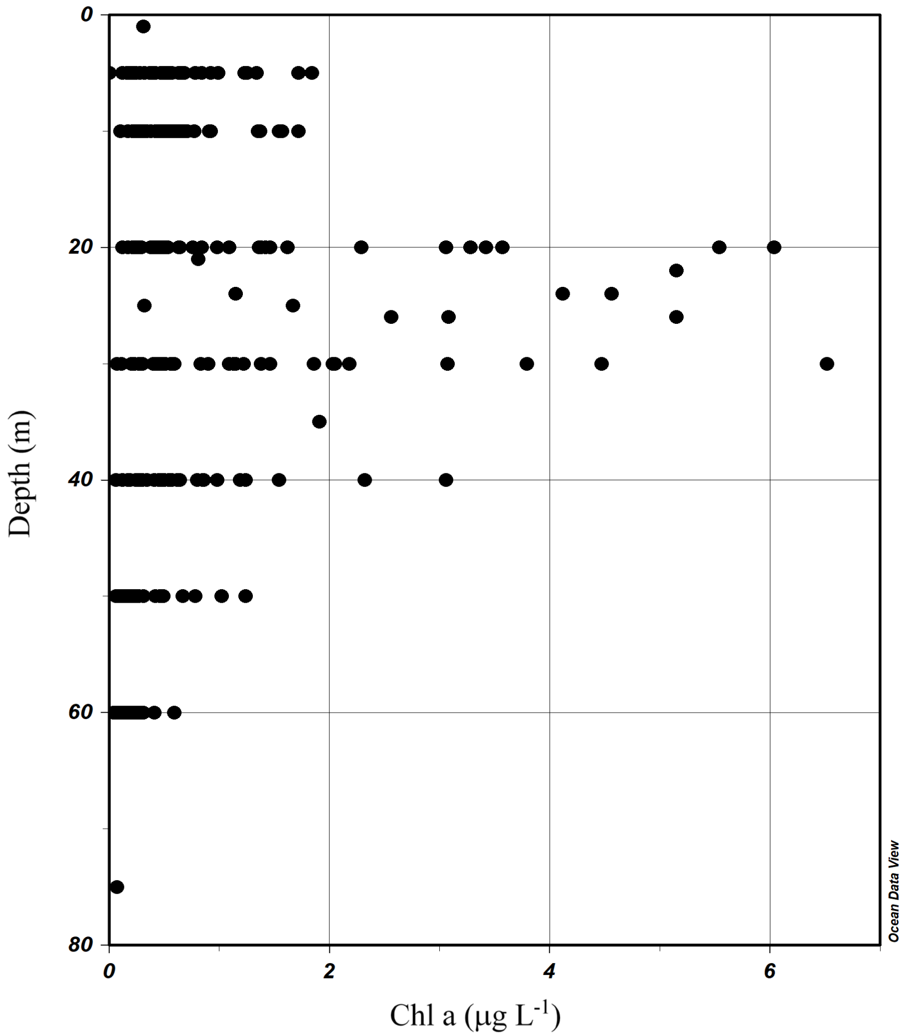

Figure 3-1: Chlorophyll a concentration according depth for all stations sampled during Leg2. SCM was mostly between 20 and 30 m in all stations.

3.4 **Recommendations**

- Due to the Agassiz Trawl incident during the 2021 mission, the Agassiz was not used again this year. However, it would be interesting to deploy it again especially in the deepest stations (>600 m) where the beam trawl cannot be deployed. Indeed, the use of the beam trawl strongly restricts the knowledge on benthic organisms in the deepest stations, where the Agassiz can be deployed. For the use of the Agassiz and to avoid any damage to it, it would be preferable to have people trained or familiar with the deployment of the trawl. It is also necessary to ask the deck several times about the depths to avoid any losses or damage.

- During the leg, we noted the presence of smokers at the autosiever. Cigarette particles and smoke can greatly damage the samples during the sieving and sorting process. It would be best to get the word out to the crew and to post a "no smoking" sign.

- During Box Core deployment on station 195, the winch cable read out was off by ~250 m. The box core almost hit the top of the A Frame as a result. A Kongsberg Maritime HiPAP MiniS34 cNODE acoustic transponder system (S/N# 17570) was later attached to monitor the depth of the Box Core. During Box Core deployment D3 and 115 the winch was off by ~100 m and 30 m respectively. Use of the HiPAP system would be prudent as grease build up from the cable during deep deployments and the build-up of ice during below freezing conditions can cause the cable to pull in and not get counted by the cable counter.

- Offset in the 500 HP winch counting pulley and/or HIPAP beacon also occurred on net sampling at stations A3 and C3, but no damage or incident happened.

- Several Hydrobios deployments were cancelled or sample lost/incomplete due to net damage (stations A3, C5, C3, C1). The Monster net replaced the planned Hydrobios casts at stations D1 and D3 while Maxime Geoffroy's team tried to repair it. The net should undergo maintenance before being deployed again.

- Two Hydrobios casts were also cancelled because the depths were considered too shallow for an Hydrobios (stations 198 and B1). It would be preferable to plan a Monster net cast at these stations in the future.

- Some nets deployments were done in very marginal conditions (wind over 30 Kn) at stations C1 and 354. This seems to become more frequent with time, as the conditions considered too risky to deploy, for the equipment integrity and for the teams' safety, are not properly defined. Sampling in very windy condition can induce equipment failing and breaking, samples not representative (since we cannot properly rinse the nets, causing a fraction of the sample to be lost) and physical harm to the team (as nets are very hard to stabilize). We recommend that the deployment should be reassessed when winds are over 25 Kn and that no net should be deployed when steady winds are over 30 Kn.

3.5 References

Parsons, T.R., Maita, Y., Lalli, C.M. (1984) A manual of chemical and biological methods for seawater analysis. Pergamon, Oxford.

4 Sponge sampling

Project leaders: Laurence De Clippele[1] (laurence.de.clippele@ed.ac.uk)

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4.1 **Introduction and Objectives**

My PhD project is investigating changes in competition between the deep-sea sponge, *Mycale lingua* and cold-water coral*, Lophelia pertusa*, at the Tisler reef in the northeast Atlantic Ocean. Sampling during the *Amundsen* expedition was completed to enhance my current investigations and facilitate new research into the global chemical ecology of *M. lingua*.

Sponges provide a multitude of ecosystem services to deep-sea environments, from nutrient cycling to habitat generation. They are also excellent sources of natural products with pharmaceutical potential. The difficulties and expenses associated with deep-sea observation and sample collection has limited investigation of these sponges, meaning their chemical ecology is still poorly understood. Additionally, the shifting dynamics between corals and sponges on deep-sea reefs with climate change are currently unpredictable.

During the expedition, we collected sponge samples as intended using the ASTRID ROV, but also opportunistically from box cores and beam trawls (Table 4-1). These samples will be used to investigate three separate concepts.

1. Investigating sampling method effects

Sponges can dynamically shift their secondary metabolite production, and microbiome composition in response to external factors. Therefore, destructive sampling, like trawling, may induce more significant stress/wound responses in sponge metabolomes and microbiomes than ROV sampling. ROV sampling during this expedition will allow direct metabolome and microbiome comparisons to previously trawled *M. lingua* from the same area. ROV sampling requires access to valuable machinery, a qualified ROV pilot and calm ocean conditions. By comparison, trawl sampling is cheaper, easier, and less dependent on ocean conditions. Thus, current knowledge of sponge metabolomes and microbiomes are largely based on trawl samples; potential sampling effects may mean these are not representative of sponges *in situ*. Understanding shifts in sponge metabolomes and microbiomes caused by trawling will also provide insight into the sponges left in these environments. This may allow us to rationalise the changes we are seeing on reefs partially destroyed by trawling. For example, shifts in sponge metabolite production may be facilitating their spatial competition.

2. Geographical and functional differences

M. lingua samples from this expedition will allow the first characterisation of the secondary metabolite profile and associated microbiome of this sponge in the northwest Atlantic Ocean. As sponge metabolomes and microbiomes vary with geographical location and depth, these results should be distinct from my northeast Atlantic Tisler samples. Additionally, the sites we sampled during this expedition did not contain *Lophelia* reefs. Therefore, comparing *Amundsen* and Tisler reef samples may highlight the secondary metabolites facilitating *M. lingua* overgrowth of Tisler coral colonies. This will also allow evaluation of *M. lingua*'s ecological role under different environmental conditions and in different ecosystems.

3. Secondary metabolite distribution analyses

Despite lacking distinct morphological tissues, sponges exhibit differential distribution of some secondary metabolites, that may relate to their functional roles. The internal distribution of these secondary metabolites in the *Amundsen M. lingua* samples will be investigated, using specialised mass spectrometry (MALDI-TOF). Evaluating the purpose of secondary metabolites in conjunction with their distribution may elucidate the interactions between *M. lingua* and its environment.

Investigation adaptations: For conclusive results sponge metabolome and microbiome investigations should be completed in at least triplicate for each condition. Unfortunately, COVID interference and difficult ocean conditions limited ROV deployment. We are also unsure at this time exactly how many of the sponge samples are *Mycale lingua* (

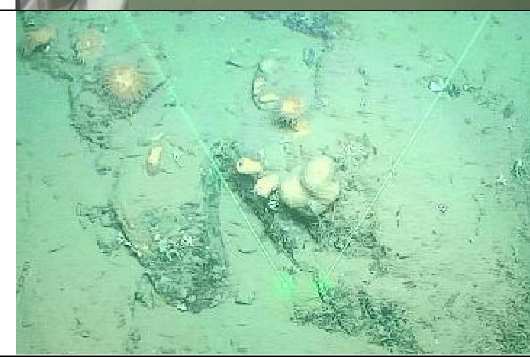
Table 4-2). The number samples collected is only sufficient for tentative sampling method comparisons. Therefore, the samples will mainly be utilised in valuable research into geographical and functional differences exhibited by *M. lingua*, as described above.

4.2 **Methodology**

Table 4-1: Data associated with samples taken

Site	Date	Sample method	Sample ID	Coordinates	Depth / m	BW temp / °C	Time sampled	Time sample left the water	Time from collection to end of processing	Sample size / cm
Joey's Gully (JG)	12/09/22	ROV	Sample 1: R30-9_JG_12-09-22_1	N54° 37.2726' W56°26.9724	428	CTD non-functional. ST = 10	18:19	19:11	2 hours	17x10
Hopedale Saddle (HS)	14/09/22	Box core	Sample 2: BC_HS_14-09-22_2	Lat 56.00661 Long -57.4608	273	~6	17:59	18:08	3 hours	5.5x5
Hopedale Saddle (HS)	14/09/22	Box core	Sample 3: BC_HS_14-09-22_3	Lat 56.00661 Long -57.4608	273	~6	17:59	18:08	3 hours	2x3
Nachvak Fjord (NF)	16/09/22	ROV	Sample 4: RV_NF_16-09-22_4	N59°4.4628' W63°29.04'	160.3	-1.785	15:59	16:48	1 hour	28x18
Nachvak Fjord (NF)	16/09/22	ROV	Sample 5: RV_NF_16-09-22_5	N59°4.4298' W63°29.0322'	118.4	-1.776	16:18	16:48	1 hour	14x12
Hebron Fjord (HF)	17/09/22	Beam trawl	Sample 6: TW_HB_17-09-22_6	Lat 58.15423 Long -62.74393	262.9	4.62	06:13	06:34	6 hours	(3x4) x3

Table 4-2: Additional notes

Sample	Notes	Image
1	Appeared adjoined to an anemone. Broke in half during sampling. Original size 227 cm^2 (18cmx14cm) - difference between sampled and in situ is the depth of sponge.	
4	Alone on sediment. Many shrimp on surface. Not *Mycale* too dense.	
5	On rock next to bryozoan. Definitely *Mycale*. Tore in half during sampling. Brittle star on underside.	
6	Sponges were incredibly dirty. Found three very soft pieces suspected to be from one *M. lingua* individual.	

Samples were processed according to the following workflow:

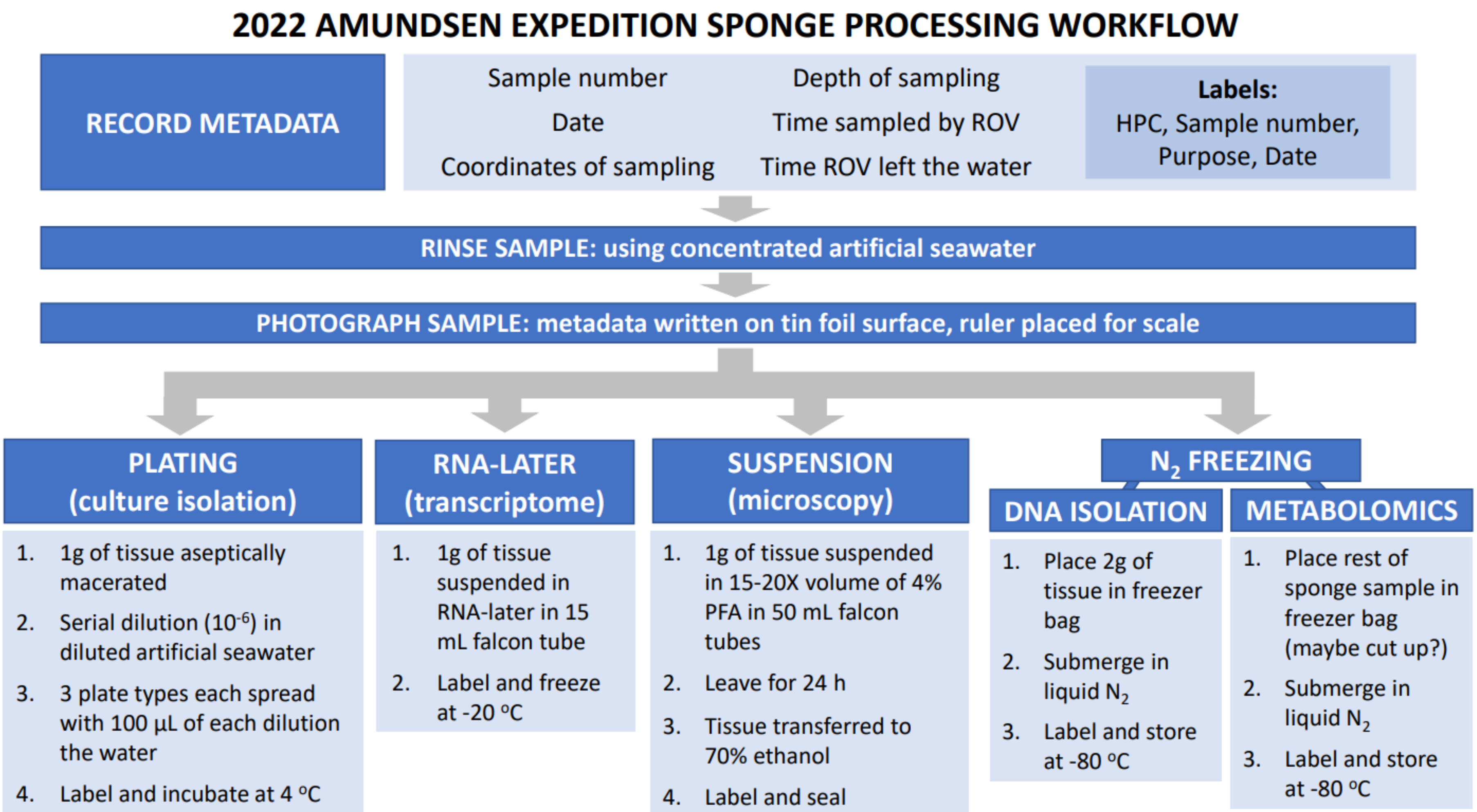


Figure 4-1. Workflow for sample processing

4.3 1.3 Preliminary Results

No results to present currently. Objectives were met through sampling.

4.4 1.4 Recommendations

No recommendations at this time.

5 Seabed Mapping and Multibeam Calibration

Principal Investigator: Amundsen Science

Cruise participants – Leg 1: Daniel Amirault[1], Bjorn Sandland[2]

Cruise participants – Leg 2: Daniel Amirault[1], Graham Christie[3]

Report Author: Daniel Amirault[1]

[1]: Amundsen Science

[2]: Kongsberg Maritime

[3]: University of New Brunswick

5.1 **Introduction & Objectives**

The 2022 *Amundsen* Leg 1 began in Quebec City on the 8th of September and finished at Iqaluit on 22nd September. Following the CCGS *Amundsen's* 2022 dry-dock the newly installed Kongsberg EM304 multibeam echosounder (Figure 5-1) required a full range of tests and calibration in order to assure the system is fully functional and performs within specification. Bjorn Sandland from Kongsberg Maritime attended Leg 1 to complete the Hardware Acceptance Test (Dan Klamas from Kongsberg Maritime included in HAT during dry-dock) and a Sea Acceptance Test of the EM304, involving a range of operations (most notably a patch test calibration and control survey). The Leg also featured a number of opportunistic and dedicated multibeam surveys in support of various projects.

The 2022 *Amundsen* Leg 2 began in Iqaluit on the 22nd of September and finished in Quebec City on October 19th. Following the CCGS *Amundsen*'s 2022 dry-dock the newly installed Kongsberg EM304 multibeam echosounder required a full range of tests and calibration in order to assure the system is fully functional and performs within specification. After completing the calibration and testing of the EM304 during Leg 1, technicians on board Leg 2 continued to monitor the system. The Leg featured a number of opportunistic bathymetric surveys, dedicated surveys, and an array of sub-bottom surveys to identify the seabed type for coring teams.

In total, 4000 nautical miles of multibeam was collected, resulting in approximately 14 100 km² of coverage for Leg 2.

5.2 **Material & Methods**

5.2.1 **Kongsberg EM304 Multibeam Sonar**

The CCGS *Amundsen* is equipped with a newly installed Kongsberg EM304 multibeam echosounder (MBES) operated through the system's proprietary acquisition software, Seafloor Information System (SIS) version 5.9.3. The Applanix POS-MV V5 integrates attitude and position data to the multibeam to georeferenced acquired points along the seafloor. Position accuracies in planimetry and altimetry were approximatively < 0.6m and < 0.9m respectively, with rotational accuracy from the Inertial Measurement Unit (IMU) of 0.02. A Mini *Sound Velocity Sensor* is used for beam forming at the transducer head.

Figure 5-1: EM304 installed on the hull of the CCGS *Amundsen*

5.2.2 *Knudsen 3260 CHIRP Sub-bottom Profiler*

A Knudsen 3260 deck unit has been installed on board the *Amundsen* with a 3.5kHz transducer which is operated from the previous multibeam PC (since 2022). The Knudsen sub-bottom profiler is used to analyse sediments and geological materials as much as 50m below the ocean floor. Coordinates obtained by the CNAV 3050 and attitude data provided by the POSMV's IMU are integrated to the sub-bottom profiler in order to correctly georeferenced recorded data.

5.3 **Results**

All the data acquired during the cruise is post-processed in real-time using the *CARIS HIPS & SIPS 11.3* software. This post-processing phase is essential to rapid detection of any anomalies in the data collection as well as the evaluation of acquired data. Vertical measurements reference Mean Sea Level (MSL) through the integration of Bedford Institute of Oceanography's Webtide Model. Sound Velocity profiles are created from CTD Rosette casts, XSV casts, and profiles retrieved from the World Ocean Atlas Model (WOA13).

Leg 2's program focused primarily on transects which did not include multibeam surveys; therefore, most multibeam data was collected opportunistically. Many stations required an evaluation of historical or real-time sub-bottom data, these were planned with the scientists on board.

5.3.1 *Opportunistic data acquisition*

The EM304 MBES and Knudsen 3260 CHIRP Sub-bottom profiler acquired data throughout most of Leg 1 and throughout the entirety of Leg 2 in order extend the spatial coverage of Amundsen Science's Arctic bathymetric database. As testing was occurring throughout Leg 1, the system was shut off periodically. Outside the scope of dedicated mapping operations, opportunistic data acquisition focuses on systematically surveying outside the extents of the Canadian Hydrographic Service's (CHS) compilation of bathymetric data; collected by Canada's fleet of Coast Guard vessels and additional sources. Amundsen Science will share acquired datasets with the CHS to update their database and marine charts. These may also be useful for future work with Amundsen Science.

Sites mapped opportunistically during Leg 1 include Nachvak Fjord, Hebron Fjord, and other locations. See an example below of the Hebron Fjord opportunistic survey (Figure 5-2), which focused on extending the coastal coverage acquired by CHS.

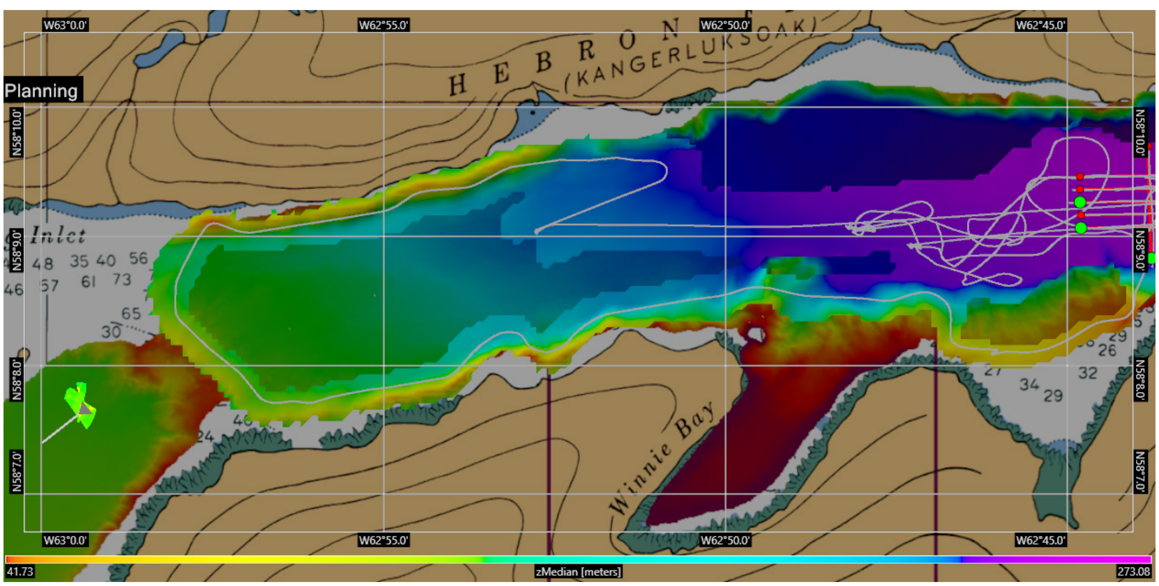


Figure 5-2: Hebron Fjord opportunistic survey

5.3.2 *Opportunistic mapping*

During Leg 2, the *Amundsen* had extra time in Qikiqtarjuaq as the ship needed to wait out a storm, the ship covered unsurveyed patches with the multibeam. Figure 5-3 displays the area where coverage was extended.

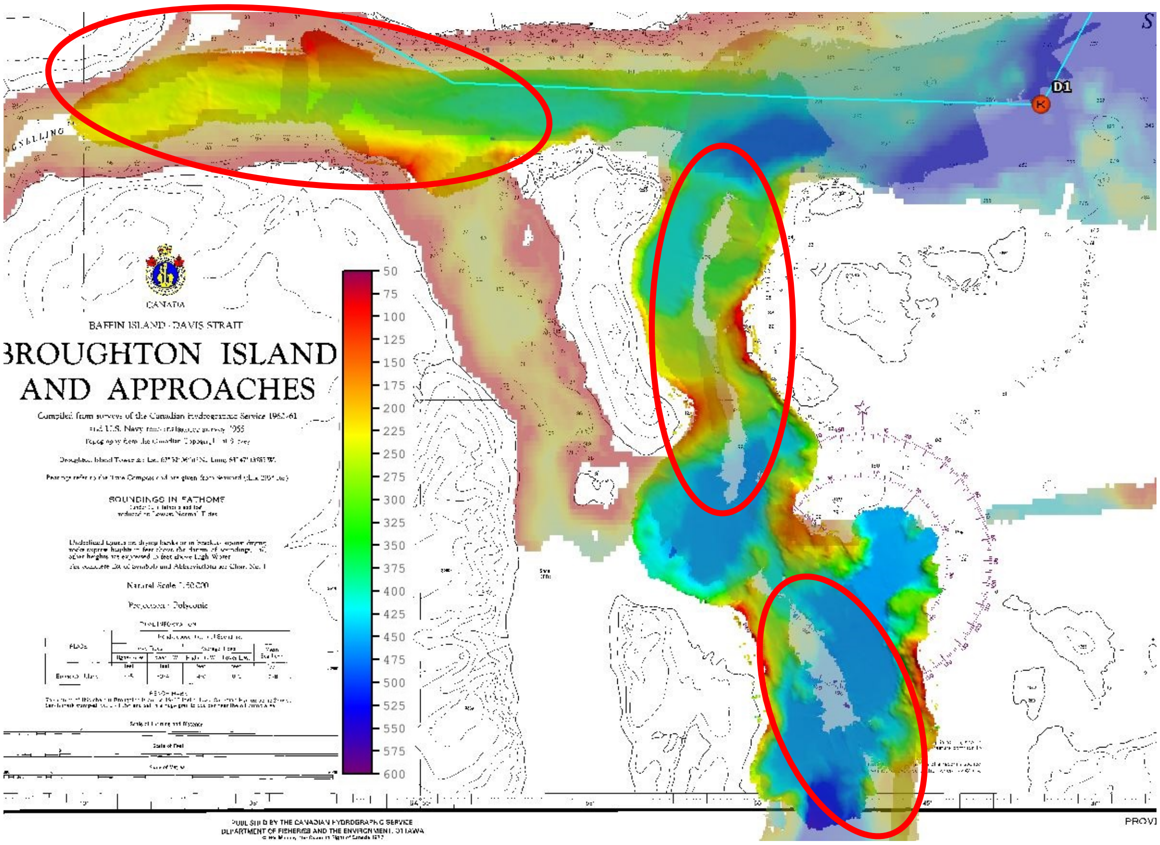


Figure 5-3. Qikiqtarjuaq extended coverage

On October 5th 2022, the *Amundsen* hid itself in Scott Inlet in order to wait for a storm in Baffin Bay to pass. Many stations were planned, including some opportunistic mapping to patch up unmapped areas. Figure 5-4 depicts new coverage obtained around the Scott Inlet stations.

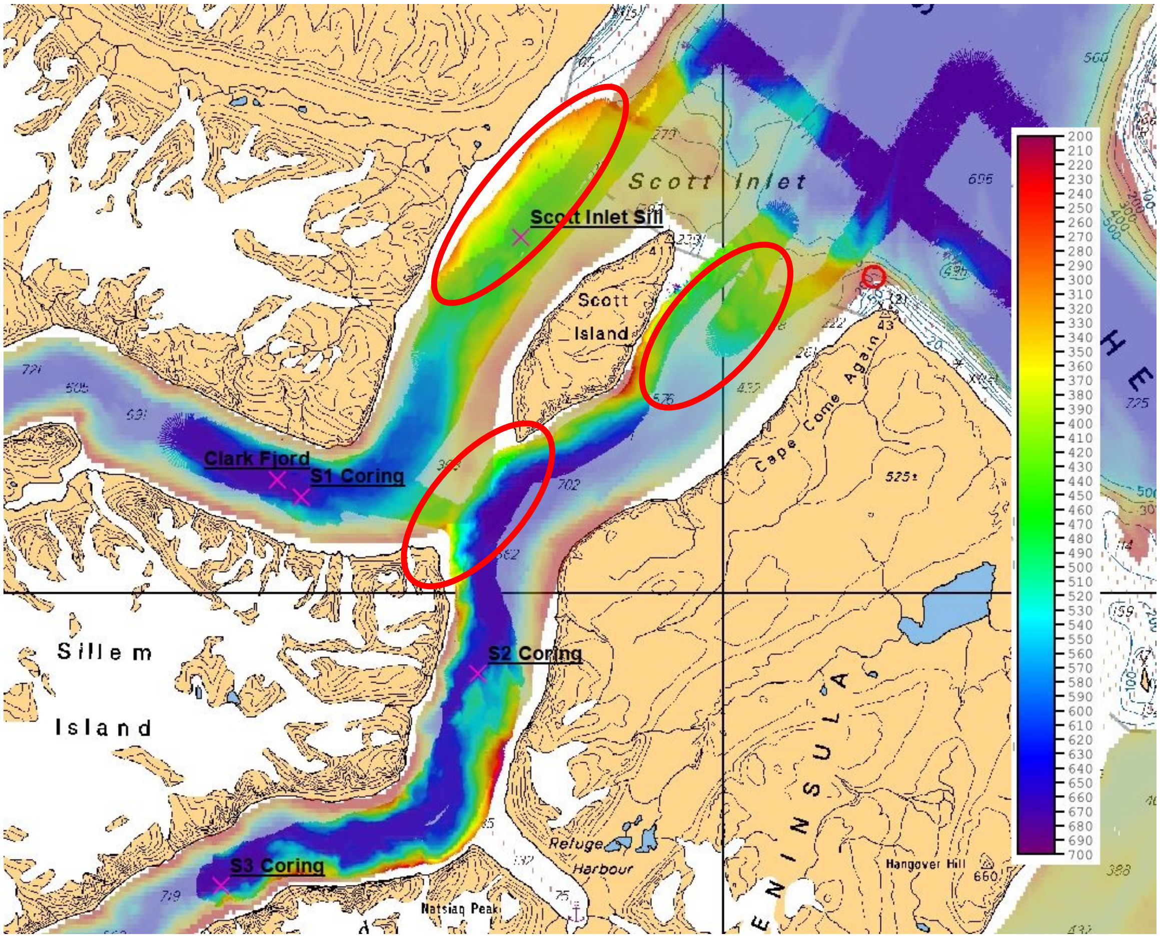


Figure 5-4. Scott Inlet extended multibeam coverage

5.3.3 *Dedicated Mapping Operations*

Dedicated mapping operations focused primarily on collecting data in conjunction to the EM304 SAT. During Leg 1, three separate survey sites were utilized; Hopedale Saddle, Hebron Fjord, and Saglek Bank.

Dedicated mapping operations also served to determine future DFO ROV sites in Joey's Gully, Nachvak Fjord, and Hopedale Saddle. Resulting offsets from the calibration survey (seen below) must be applied to the data before displaying results from these surveys.

Moorings

Moorings were deployed and mapped in both Macbeth and outside Scott Inlet, the team passed over them in order to confirm the location. It served as a good test for the EM304 to prove it can execute the operation similarly to the previous EM302 on the *Amundsen*. SIS preferences were created to quickly set up the screen for mooring visualisation. The following picture displays the Macbeth mooring from the EM304's water column display.

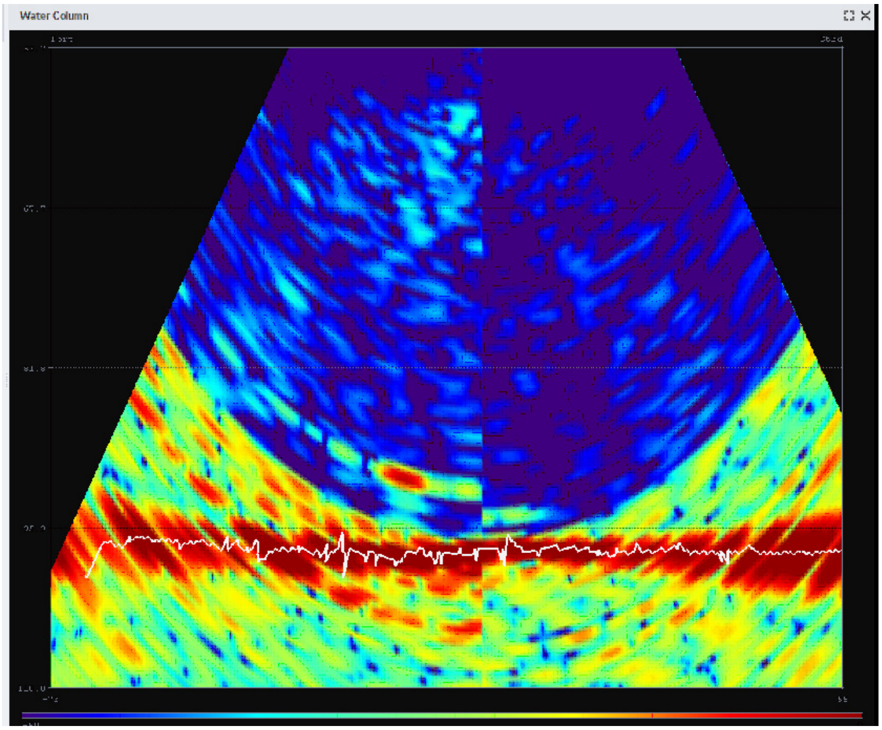


Figure 5-5. EM304 Water column data - locating mooring in Macbeth

While arriving to the Macbeth site, the mooring team requested a 45-minute multibeam survey as almost no *Amundsen* or NONNA data existed in the area. Within the allotted time, six survey lines were achieved. Increasing available data surrounding the mooring location will assist future recoveries and deployments on this site.

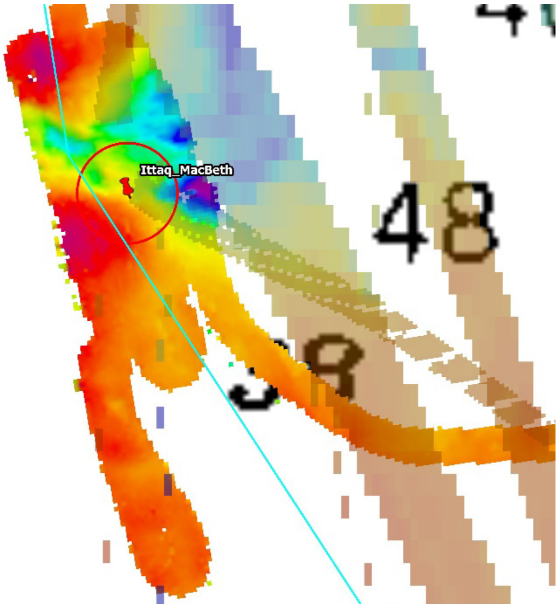


Figure 5-6. Macbeth mulitbeam survey

Coring operations

Coring teams required an evaluation of sub-bottom data in order to identify the bottom type before the use of a gravity core, box core, or van veen grab. In areas such as Scott Inlet, coring sites were selected shortly before arriving on site. Most sites were located in areas with previous sub-bottom coverage, allowing the team to evaluate the seafloor before arriving to stations. An example of a site chosen in Scott Inlet can be found below.

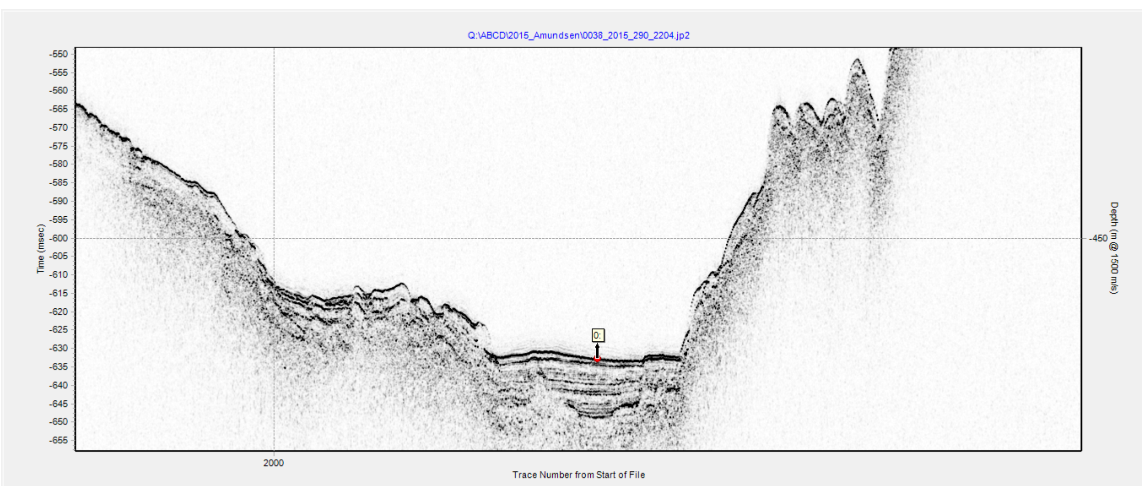


Figure 5-7. Scott Inlet Sill station - sub-bottom profile

5.3.4 *Hopedale Saddle Calibration Survey:*

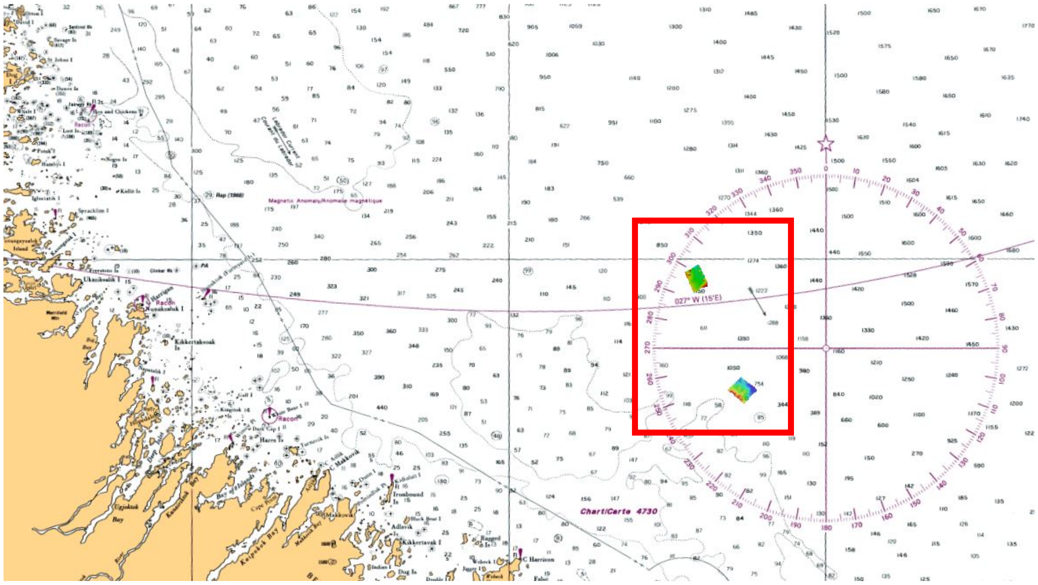


Figure 5-8: Hopedale Saddle Deep Water Patch Test Calibration Site

Calibration lines were run in Hopedale Saddle (Figure 5-8), operations lasted from 2022/09/13 23:46 UTC until 2022/09/14 08:00 UTC. Collected data was not optimal as waves passing under the hull interfered with acoustic pulses. Lines could not be redone due to time constraints of the survey, data was analysed as is. Nonetheless, the survey was completed successfully and the multibeam's rotational offset with the IMU was adjusted. Values determined for the offset adjustments were the following:

- Roll: -0.07°

- Pitch: 0.00°

- Heading: 0.15°

5.3.5 *Hebron Fjord Shallow Water Control Survey and Calibration:*

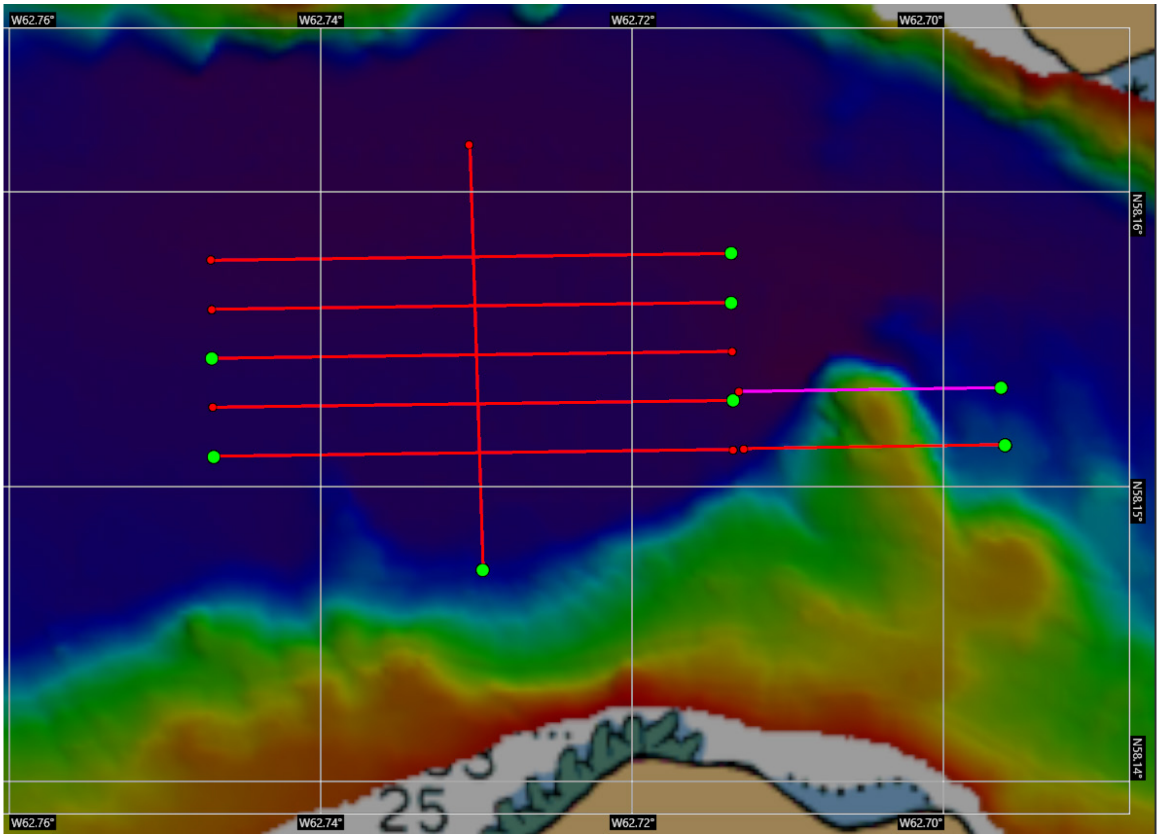


Figure 5-9: Hebron Fjord Shallow Control Survey lines

The Hebron Control Survey (Figure 5-9), conducted from 2022/09/19 09:30 UTC to 14:20 UTC, included a sequence of lines to be compared in post processing for data uncertainty, as well as additional calibration lines to compare offset values with the previous calibration. The site was selected opportunistically as the ship had to stay sheltered in Hebron for over 70 hours. The site's depth was less optimal than required for a proper control survey, but the data was collected in case the schedule did not allow an opportunity to conduct a control survey in deep water.

Results from the survey were positive, confirming most of the offset values determined during the calibration, as well as a small adjustment to the Roll calibration value of 0.02°.

5.3.6 *Saglek Bank Deep Water Control Survey:*

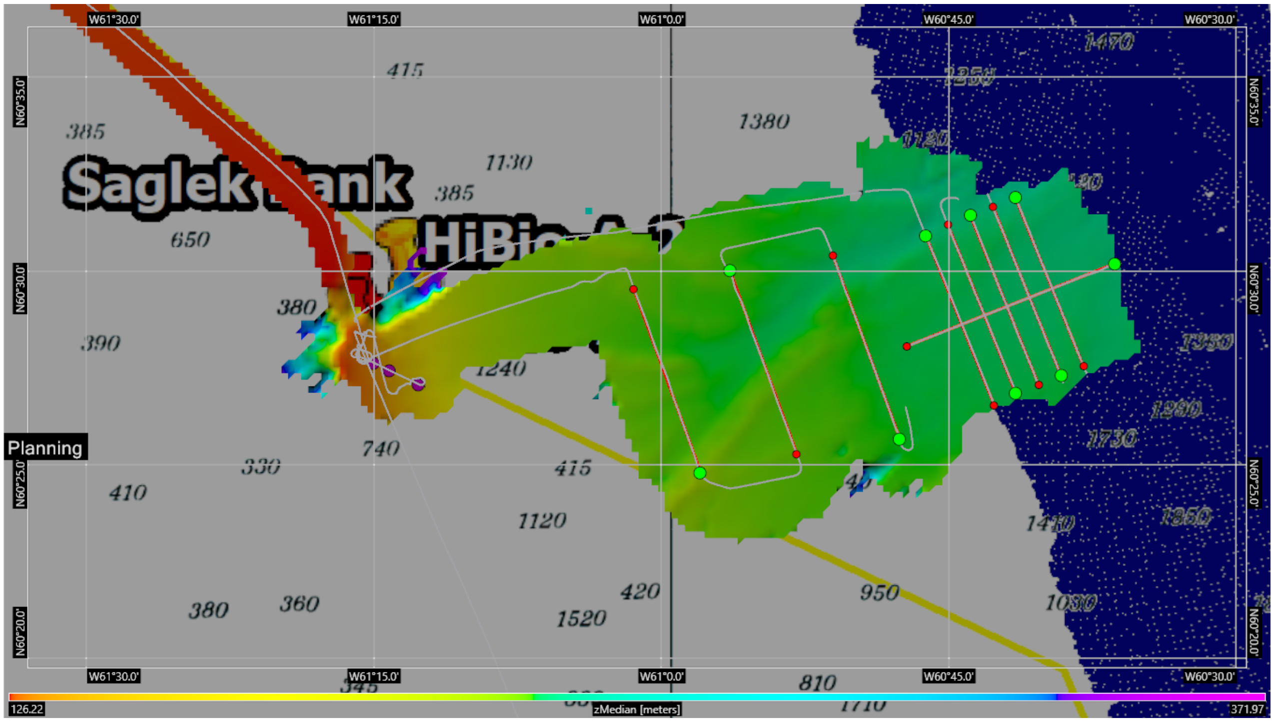


Figure 5-10: Saglek Bank Deep Water Control Survey Lines

The Saglek Bank survey (Figure 5-10), conducted from 21/09/2022 00:05 UTC to 10:35 UTC, focused on collecting data for a deep-water control survey. The main objective of this survey was to validate offset values of the calibration survey and to confirm uncertainties are within specification of the system. Survey conditions were favorable for the most part; however, the absence of the night shift crew on the *Amundsen* meant a sound velocity cast did not support the survey within the desired time or area. The absence of a sound velocity profile caused high levels of error in the outer beams.

Despite the downfalls of sound velocity data, the team was still able to assess the accuracy of the system and could confirm the system was performing within specification. Values for IMU offsets were concluded at the following:

Roll: 0.023° - 0.05°

Pitch: 0.951° + 0.00°

Heading: 0.298° + 0.15°

5.3.7 *Miscellaneous*

Trimble RTX

Leg 2 featured opportunistic testing of the Trimble RTX real time corrections service for marine applications in partnership with Trimble and the University of New Brunswick Ocean Mapping Group. Prior to being enabled for Leg 2, the still in development service had never been trialed in the north. It was enabled in the POSMV inertial navigation unit used as the primary position source of the vessel for the EM304 multibeam and other systems on September 27th, off the coast of Greenland. The service would run continuously after that point until arrival in Quebec City on the 19th of October.

The effect of the corrections was to increase the accuracy of the real-time vessel position from approximately 0.5m to 0.035m. As expected given the location of the satellite broadcasting the corrections, the service dropped out when the vessel was in fiords, and suffered periodic dropouts at the northernmost reaches of the Leg, both due to the low elevation angle of the satellite.

Though detailed analysis of the results has yet to be conducted, the test is considered a success. Additionally. a mutually beneficial relationship has been established which will likely lead to further testing of the RTX service by Trimble on board future expeditions, aiding in Trimble's testing efforts, and improving the positioning of the vessel at no cost.

SIS Projection Issue

SIS 5.9.3 is the latest release of acquisition software for Kongsberg's EM304. Despite the improved stability of the software since its release, program bugs hinder the functionality of the software. Amongst the list of bugs, the most notable one is the geographical view's use of projections. Geotiffs exported from ArcMap are periodically projected incorrectly in SIS. This issue was mentioned to Kongsberg technician Bjorn Sandland who was present for Leg 1's calibration, a solution is in the works.

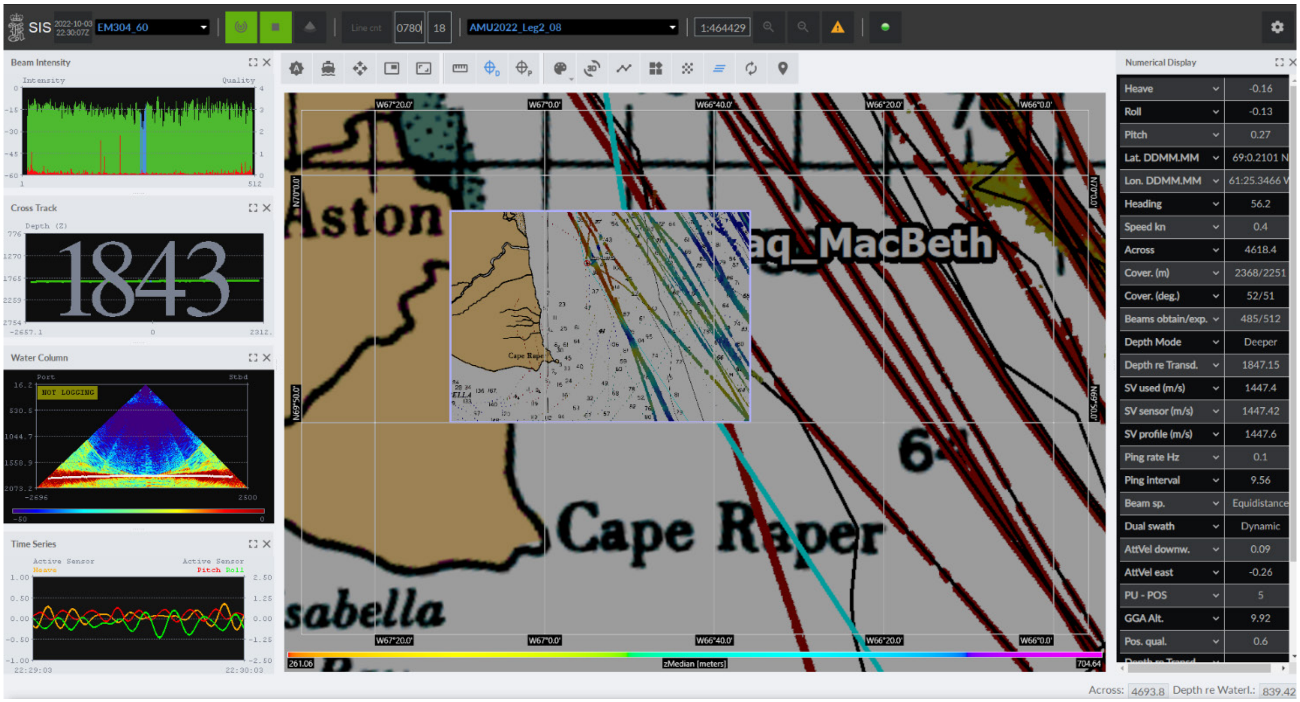


Figure 5-11. SIS projection issue

POSMV Logging

Every Leg Amundsen Science logs POSMV POSPac data to store positions, attitude accuracies, etc. from the POSMV. During Leg 2 technicians noticed logging will stop every 2-3 days. The POSView software itself indicates “Ethernet Log” is active even when the logging is faulty. A workaround for this issue was discovered, however the reason for this has not yet been determined.

6 Pelagic Fish and Plankton

Principal Investigators: Maxime Geoffroy[1] (Maxime.Geoffroy@mi.mun.ca), David Cote[2] (David.cote@dfo-mpo.gc.ca)

Cruise Participants – Leg 1: Eugenie Jacobsen[1], Evert de Froe[1], Rachel Forbes[1], and Jordan Sutton[2]

Cruise participants – Leg 2: Ashley Oates[1], Eugenie Jacobsen[1], Jennifer Herbig[1], Maxime Geoffroy[1]

[1]Marine Institute of Memorial University, St. John's, NL.

[2]Fisheries and Oceans Canada, Northwest Atlantic Fisheries Centre, St. John's, NL.

6.1 Introduction

Mesopelagic and zooplankton communities in the Labrador Sea have been poorly documented with their true diversity and abundance in the region remaining unclear. Mesopelagic organisms, who form dense mid-water aggregations across the global ocean known as deep sound scattering layers (DSLs), are presumed to be responsible for the largest biomass aggregations of animal life on the planet and provide a crucial energy link to the deep ocean (Proud et al. 2017). However, this midwater scattering may be biased by traditional net sampling techniques, which introduce selectivity bias based on avoidance behavior and size. In many cases, gelatinous zooplankton and fast-swimming meso-zooplankton avoid capture and thus may be underestimated.

Furthermore, commercial fisheries for Greenland halibut (*Reinhardtius hippoglossoides*) and shrimp (*Pandalus spp.*) in Baffin Bay and Davis Strait are a critical part of the Northern economy, worth more than $50 million per year since 2011. However, the Canadian Arctic Ocean is rapidly changing, as waters warm and sea ice declines. In addition, warming temperatures have resulted in a northward expansion of non-native species (Harwood et al. 2015; Falardeau et al. 2017), which could shift energetic pathways as competitive and predatory pressures increase for native species (Pedro et al. 2020). The effects of these changes on commercial fisheries remain unclear and the successful management of these fisheries will require robust biological data (Niemi et al. 2019). However, for many Arctic species, information about life history characteristics, abundance, and distribution remain unknown (Hollowed et al. 2013). While the demersal ecosystem has received increased attention, critical knowledge gaps remain on how marine pelagic ecosystems of the Canadian Arctic are evolving under the current warming regime.

In this study, to account for the uncertainty, we combine high-resolution acoustic imaging (hull mounted EK80 and a moored AZFP) with traditional midwater trawls (Isaac-Kidd Midwater Trawl –IKMT), depth-stratified plankton net sampling (Hydrobios plankton net) to better understand the biodiversity and distribution of mesopelagic organisms along the continental shelf in the Labrador Sea. CTD profiling combined with net trawls, hydroacoustics, and eDNA sampling (Section 12) will allow us to better comprehend how mesopelagic fish are distributed along the continental slope and fjords in the Labrador Sea (Figure 6-2, Table 6-1).

Secondly, the overarching objective of this research is to document how ongoing changes in the Arctic pelagic ecosystem impact fisheries productivity. This ‘ArcticFish’ project supported by ArcticNet relies on multiple research platforms and technologies to fill in these knowledge gaps and to shed light on the distribution and ecology of key pelagic species in Arctic marine food webs. Aboard the *CCGS Amundsen* during Leg 2 in 2022, our specific objectives are to (1) establish baseline knowledge on the current occurrence and distribution of pelagic fish species in the Canadian Arctic/subarctic; (2) document inter-annual and seasonal variation in fish and zooplankton and identify the biological and environmental drivers of these variations; (3) coordinate the collection and sharing of fish and invertebrate samples with other research groups to compliment and extend their sampling; and (4) refine the ecological importance of the North Water for fisheries resources (like Northern shrimp), marine mammals and seabirds.

6.2 **Methodology**

6.2.1 *Hydroacoustics*

The CCGS *Amundsen* was equipped with a hull-mounted EK80 broadband echosounder operating at 38, 120 and 200 kHz. The EK80 was continuously operated in narrowband mode during transit to monitor the distribution and abundance of pelagic fish and zooplankton. It was turned to broadband mode on stations, while deploying the IKMT. The broadband data will be used to compare the frequency-response curve of single targets with the community composition of fish and zooplankton captured in the IKMT. In addition to the hull-mounted echosounder, an Acoustic Zooplankton and Fish Profiler (AZFP) moored at station HiBio-A in 2021 was successfully recovered and redeployed at the same station on September 21st, 2022. The upward-looking AZFP was deployed at 420 m depth and continuously monitored the water column a 38, 125, 255 and 455 kHz with a resolution of 1 ping x 15sec-1. Once analyzed, this unique acoustic dataset will provide information on the seasonal variation in abundance and vertical distribution of mesopelagic fish and zooplankton.

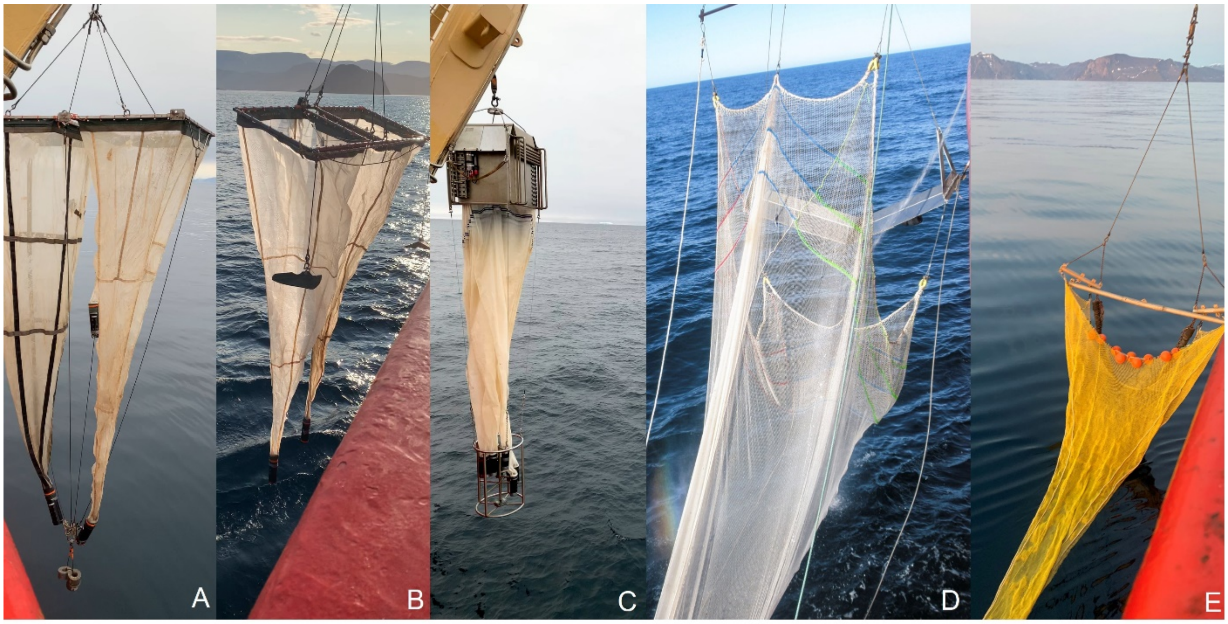


Figure 6-1. The V-Tow net(A), the O-Tow net (B), the hydrobios net (C), the IKMT net (D), and the beam trawl net (E) which were used to sample the fish and zooplankton communities.

6.2.2 *Multi-net plankton sampler (Hydrobios)*

Meso-zooplankton was sampled with a Hydrobios multi-net plankton sampler (Figure 6-1c). The net was equipped with nine 200 µm mesh nets (opening 0.5 m^2) allowing for depth-specific sampling of the water column. The Hydrobios is also equipped with a CTD to record temperature and salinity while collecting biological samples. The multinet is deployed vertically from 1000 m (or 25-60 m off the bottom in depths shallower than 1000 m) to the surface. The nets open and close one by one while the net is pulled up through the water column. The depth at which the different nets open and close is programmed before deployment and the depths programmed are based on bottom depth. Once retrieved, the zooplankton samples are preserved in 10% formalin solution and stored for further taxonomic identification at Laval University.

6.2.3 *Isaac-Kidd Midwater Trawl (IKMT)*

The IKMT sampled pelagic fish and macro-zooplankton (Figure 6-1d). The rectangular net has a 13.5 m^2 (4.5 m x 3 m) mouth aperture and mesh size of 11 mm in the first section and 5 mm in the last section. The net was lowered at a target depth, which was determined by the echosounder EK-80 signal and towed at that depth for 20-30 minutes at a speed of 3 knots. At one night station, a ‘double-dip’ (Hatton Sill at 100 m and 390 m) was conducted, where a shallower layer was sampled first and then a deeper layer was sampled to assess which species conduct diel vertical migration and are distributed shallower at night than during daytime. All samples were sorted by species, counted and weighed before being frozen for further analyses, including compound specific isotope analysis of amino acids.

6.2.4 *Beam Trawl*

Demersal and benthic adult fish were sampled with a benthic beam trawl (headline = 4.27 m, footrope= 4.27 m, 9.5 mm codend mesh) (Figure 6-1e). The net was lowered using the 500T cable winch to the bottom depth. Two times the bottom depth of cable was provided to ensure that the beam trawl was securely on the bottom. The nets were deployed from the vessel at two knots and then were trawled along the bottom at the same speed for 20-30 min. All fish samples were sorted at minimum by family, if species identification could not be made. Once identified, the samples were stored in a -80°C freezer until further analysis.

6.2.5 *Double Square Net (DSN or Tucker)*

Icythyoplankton were sampled using a double square net (DSN or Tucker net) carrying two 1 m^2 aperture nets (mesh size 500 and 750 µm) and one small net (50 µm) was deployed obliquely at maximum sampling depths of 100 m with a ship speed of two knots (Figure 6-1b). The duration of the Tucker vertical tow averaged 25 min from surface to surface. If caught, fish larvae were sorted out and individually preserved in 95% ethanol while the rest of the contents in the net were stored in 10% formalin. The predominant larval species caught in the Tucker net was Atlantic cod and *Liparis* s

6.2.6 *V-Tow (Monster Net) (2 × 200 µm, 1 × 50 µm)*

Zooplankton were sampled with a vertically towed net (V-Tow), also called a monster net (Figure 6-1a). This net was made up of two 1 m^2 frames attached together and rigged with two 4.5 m long, conical-square plankton nets with 200 µm mesh, and an external 10 cm diameter, 50 µm mesh net. Each of the 200 µm nets was equipped with a KC Denmark ® flowmeter and a control flowmeter was attached in the center of the frame, for a total of three flowmeters. The V-Tow was deployed vertically, 10-70 m off the bottom to the surface. In the lab, the 50 µm mesh nets were preserved in a 4% formaldehyde solution for taxonomy and abundance measurements. One 200 µm mesh net was given to Fisheries and Oceans Canada (DFO) team (PI: Christine Michel) for the KEBABB project. At select stations, the other 200 µm mesh net sample was divided and given to the Petroleum Environmental Research Laboratory team (PETRL lab; PI Gary Stern) for contaminant analysis, and the Environment Canada team (PI Liisa Jantunen) for contaminant and microplastics analyses.

6.2.7 *Continuous Plankton Recorder (CPR)*

The plankton community and microplastics in the upper water column (~5 m) were sampled in Leg 2 with the continuous plankton recorder (CPR) (Figure 6-5). The torpedo-shaped steel body (85 kg) with a 1.6 cm^2 aperture delivered seawater to a 270-micron collection silk net was towed behind the ship during transit. As the CPR was towed, a propeller drove the advancement of the collection silk and a cover silk within an internal mechanical cassette. Both silks were spooled into a collection area for analyses of plankton samples and microplastics at known locations along the tow route. The CPR was attached to the ship with a braided steel CPR cable attached to the port side mooring winch on the upper level. The CPR was lowered to the water via the Moving Vertical Profiler lifting arm and winch where the CPR cable assumed all load. The CPR worked well at speeds above 6 knots, so it could be deployed during transits and mapping operations. In the laboratory, CPR silks were preserved in a 4% formalin solution and packaged for transportation to project partners at the Marine Biological Association of the United Kingdom for analyses of species compositions and abundances.

6.2.8 *Baited remote underwater video (BRUV) camera*

To characterize the benthic fish and invertebrate communities, a SubC Imaging Inc. (Clarenville, NL, Canada) high resolution ‘Rayfin’ camera system was deployed for 6 to 8 hours on the seafloor to record high-definition video continuously (Figure 6-4). The camera system with battery, LED and laser was mounted on a 20 kg aluminum frame. The Frame was equipped with a baited arm, on which bait (Squid, both frozen and thawed) were attached. Metal chain weight anchored the frame to the sea floor, and a rope and floats connected the system to the surface. The camera system was deployed via the A-frame and 500 HP winch using both the winch cable and capstan winch to deploy/retrieve the 9/26” nylon rope.

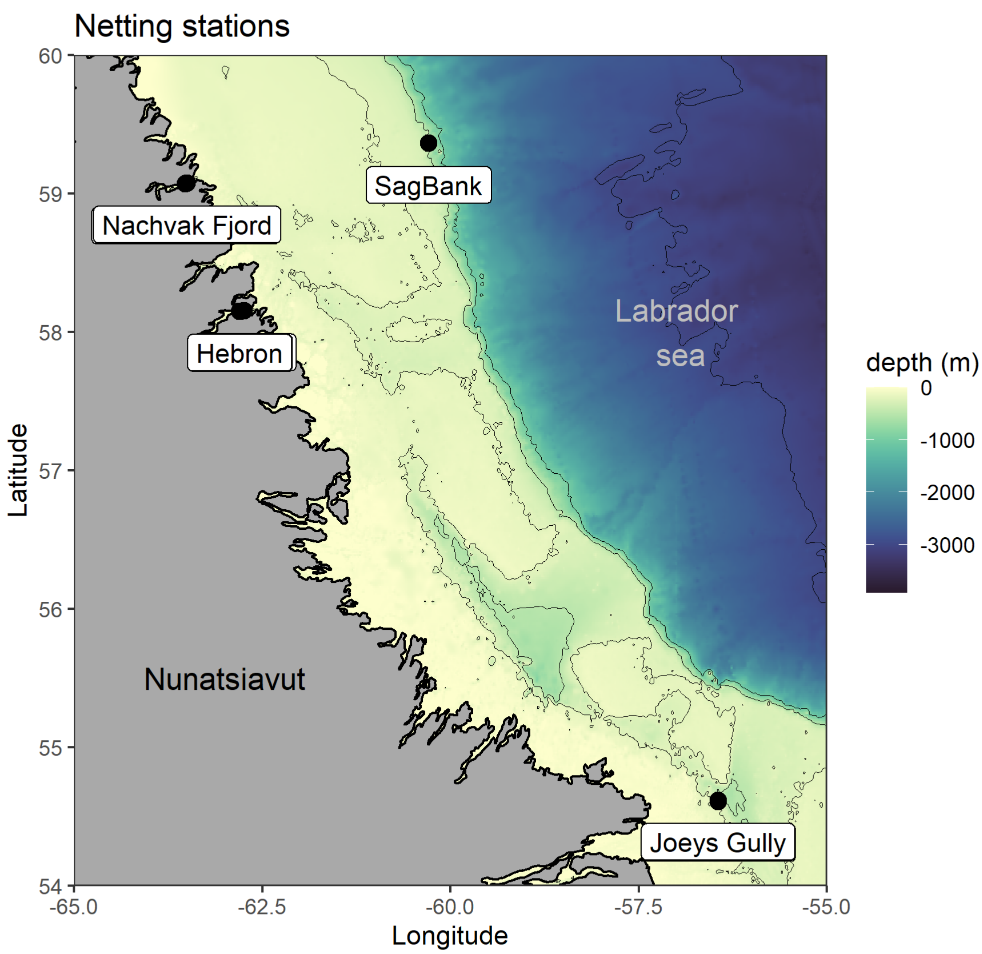


Figure 6-2: Map of the sample stations in the Labrador Sea during Leg 1 of the CCGS *Amundsen* research expedition.

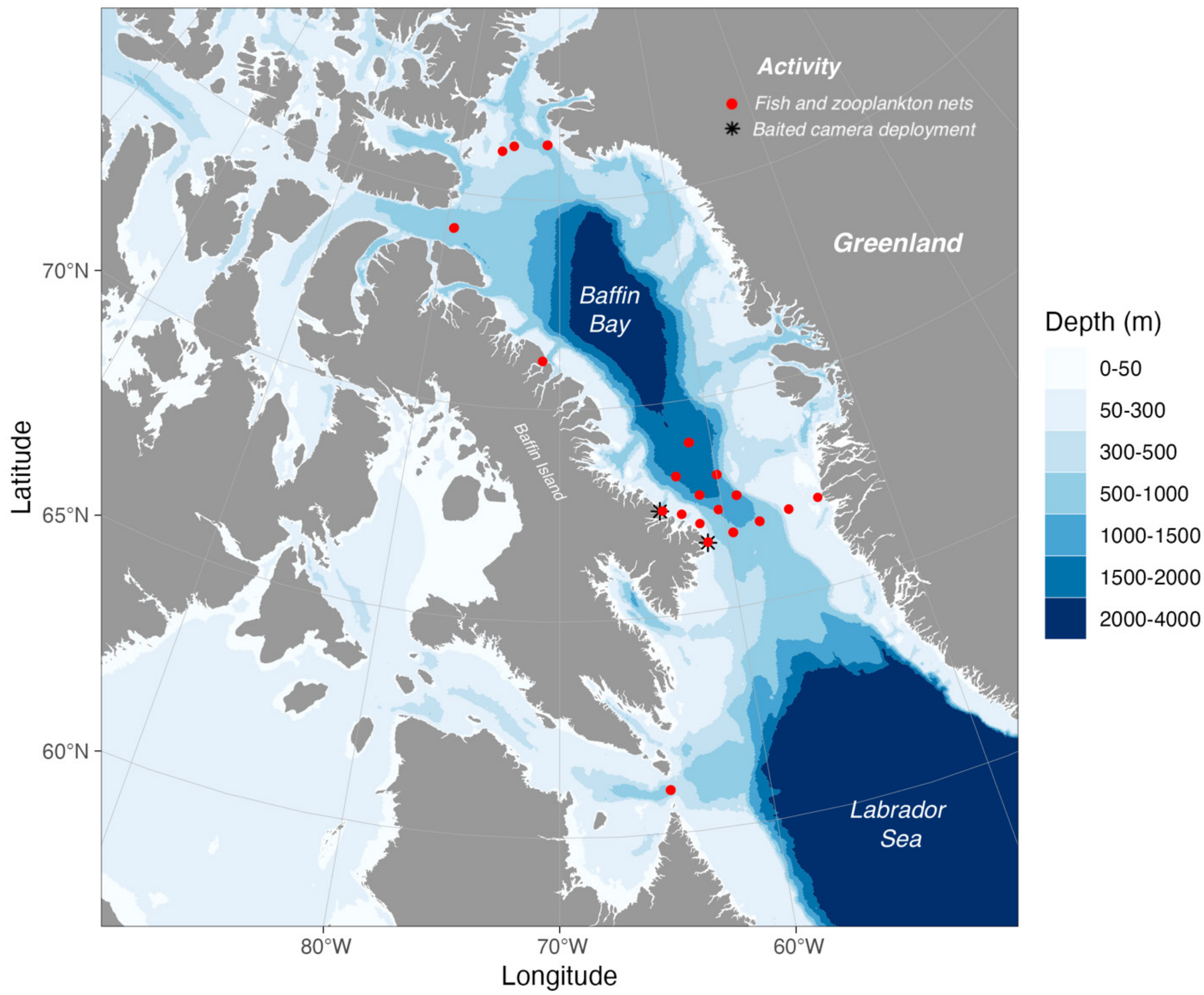


Figure 6-3. The location of the net and camera deployments during Leg 2.

Table 6-1: Sampling stations with number of nets deployed during Leg 1

Station	Sampling dates	Latitude	Longitude	Depth (m)	Hydrobios	Tucker	Beam trawl	IKMT	Monster
Joey's Gully	9/13/2022	54.61764	-56.4461	357	1	1	0	1	0
Nachvak	9/16/2022	59.07974	-63.511	200	1	1	1	0	0
Hebron	9/17/2022	58.15055	-62.8022	248	5	1	1	0	0
Saglek Bank	9/20/2022	59.3623	-60.2898	412	0	0	0	1	0

Table 6-2. Net deployment summary for Leg 2, deployment of a net indicated by an “X.”

Station ID	Date	Latitude	Longitude	Monster	Tucker	Hydrobios	Beam Trawl	IKMT
KEBABB A1	9/24/2022	66.61059	-61.1868		X	X	X	X
KEBABB A3	9/25/2022	66.73791	-59.6238		X	X		X
KEBABB A5	9/26/2022	66.87336	-57.9409		X	X		X
196	9/27/2022	66.99325	-56.0873		X	X	X	
198	9/27/2022	67.08506	-54.199		X		X	
KEBABB B5	9/28/2022	67.58232	-58.9975		X	X		X
KEBABB B3	9/29/2022	67.32454	-60.2558		X	X		
KEBABB B1	9/29/2022	67.06825	-61.5001		X		X	
KEBABB C5	9/30/2022	67.73445	-61.249		X	X		X
KEBABB C3	9/30/2022	68.1412	-59.9805		X			X
KEBABB C1	10/1/2022	67.34582	-62.5201		X	X		X
KEBBAB D1	10/2/2022	67.4777	-63.6789	X	X		X	
KEBABB D3	10/3/2022	68.24003	-62.568	X	X			X
KEBABB D5	10/3/2022	69.00179	-61.4147		X	X		
KEBABB D5	10/4/2022	68.98633	-61.4445					X
Scott Inlet Sill	10/5/2022	71.15113	-71.2416	X	X		X	
323_east	10/8/2022	74.14274	-79.3222			X		X
105_south	10/9/2022	76.12042	-75.756	X	X			
108	10/10/2022	76.25963	-74.6224		X	X	X	
115	10/10/2022	76.33212	-71.2405		X	X		X
354	10/14/2022	61.0185	-64.7405	X	X			
			Total	**5**	**19**	**12**	**7**	**9**

6.3 **Preliminary Results**

6.3.1 *Hydroacoustics*

On September 13th 2021, we observed a large aggregation of adult Atlantic cod using the Remotely Operated Vehicle (ROV) which coincided with a high level of backscatter found in the trough at 265 m using the EK80 broadband echosounder at 38kHz (Figure 6-5). We deployed the IKMT above the backscatter layer (with the Atlantic cod) and caught mostly *Meganyctiphanes norvegica* (prey) and larvae fish (Atlantic cod). This indicates that there might be size segregation throughout the water column with prey and larvae avoiding large predators.

6.3.2 *Nets*

During Leg 1, the IKMT and beam trawl net deployments collected in total 161 fish, 28 fish larvae, and 9177 zooplankton individuals. The collected fish consisted mostly of the species *Lycodes polaris*, *Liparis fabricii*, and *Benthosema glaciale* (Table 6-3). A clear difference in species composition between the fjord stations and the shelf break stations could be observed. Station SagBank, on the Labrador shelf, the catch was mostly Myctophidae or *Benthosema glaciale*. In the fjord stations Hebron and Nachvak, Liparidae and Zoarcidae were most abundant (Figure 6-12). The fish larvae comprised mostly of *Liparis* sp., *Gadus morhua*, and *Boreogadus saida* with small differences between the stations (Table 6-4; Figure 6-13). The shelf station Joey's gully showed highest abundance of zooplankton. Zooplankton catch was mainly composed of *Meganyctiphanes norvegica*, *Themisto libellula*, and *Pandalus borealis* (Table 6-5). During Leg 2, fifty-two net deployments were conducted to sample the fish and zooplankton communities (Table 6-2, Figure 6-3). The PETRL team was provided with samples from 16 nets. The KEBABB team, Jantunen team, Tufenkji team, MMEL team, Archambault team, were provided with 30, 19, 12, 21, and 13 samples, respectively (

Table 6-6). There were a total of 102 samples provided to other groups. Collaboration with multiple teams is an integral part of 'ArcticFish'. These projects help to piece together the puzzle that better

Principal Investigator	Michel	Jantunen	Stern	Tufenkji	Brown	Archambault
Project	KEBABB	Contaminants MPs	Hg	Contaminants MPs	Contaminants	Biodiversity
Station ID						
A1	T + H		B		T	B
A3	T + H		T	T	T	T
A5	T + H				T	T
196	T + H	T	T + B	T	T	B
198	T + H				T	T + B
B5	T + H	T	T	T	T	
B3	T + H				T	
B1	T + H	T	T	T	T	B
C5	T + H				T	
C3	T + H	T	T	T	T	T
C1	T + H				T	
D1	T + H		B		T	B
D3	T + H				T	T
D5	T + H	T	T	T	T	
D5	T + H				T	
Scott Inlet		T + M	T + M + B	T + M	T	B
323_east					T	
105_south		M	M	M	T	
108			B		T	B
115					T	
354		T + M	T + M	T + M	T	B
Total	**30**	**10**	**16**	**12**	**21**	**13**
					Grand total	**102**

understands fish and zooplankton communities in the Arctic. Collaborations across multiple groups help to link biotic responses studied by our group to responses like shifting contaminant pathways in the Arctic.

There were 64 larval fish were collected from the monster and the tucker nets from five different families identified, counted, and preserved. The most frequently occurring species were Arctic cod, followed by species from the Liparidae families (Figure 6-7). Seventy-two percent (n=46) of the larval fish captured were Arctic cod. The average standard length of these larval Arctic cod was 29.3mm (SD=7.7mm) (Figure 6-8). The number of larval fish collected this year was much lower than the cruise in 2021 in the same region (n=1,1013). However, larval fish like Arctic cod which accounted for 93% of larval fish collected in 2021, begin to descend to the mesopelagic layer (> 200 m) in October to overwinter with their congeners at depth (Geoffroy et al. 2016). The tucker net only samples the top 100 m of the water column, which may explain why so few larval fish were collected this year.

There were 548 fish from 14 families caught in the IKMT and Beamtrawl nets. The most frequently caught species were in the families: Liparidae, Gadidae, and Myctophidae (Figure 6-9). Fifty_six Arctic cod were collected and measured. In general, the length frequency of Arctic cod had a bimodal distribution (Figure 6-10), which most likely represents two age cohorts collected by the two different nets. Smaller Arctic cod were captured by the IKMT which is most likely due to the young of year Arctic cod descending from the pelagic zone to the mesopelagic to overwinter, while the beam trawl collected the larger and older Arctic cod near the sea floor. The average standard length was 88 mm (SD=49 mm), while the (Figure 6-10). Interestingly twenty-two polar cod (*Arctogadus glacialis*) were collected at three stations. Polar cod are generally considered rare in Baffin Bay, however they were more abundant at the stations located in fjords than Arctic cod, which is typically more abundant in Baffin Bay. Myctophids who are considered a sub-arctic species ranging as far as the North Atlantic were found in high numbers near Greenland beyond Davis Strait. The Moving Vessel Profiler (MVP) confirmed the distinct Atlantic Water mass which could help to explain the higher northward range of myctophids in these regions.

There were 4451 zooplankton from 21 groups identified, counted, and preserved from the IKMT nets. Cnidarians were also captured in the IKMT nets but could not be enumerated or preserved, however their presence and weight were recorded. Clionidae, Cnidaria, Euphausiidae, Hyperiidae, Mysidae, and Sagittidae were the most frequently occurring zooplankton groups (Figure 6-11). Sagittidae, Mysidae, Euphausidae, Hyperridae, and Decapoda typically had the highest relative abundance by station when they occurred (Figure 6-14).

6.3.3 *Baited Camera*

Deployment of the baited remote underwater video camera during Leg 2 occurred at two stations (Figure 6-3). Differences in benthic habitats, invertebrate and fish faunas were evident. Deployments at A1 were 280 minutes and showed a hard bottom sediment with few fish (one skate), some sea stars, some shrimp, and few isopodes, while the D1 recording lasted 430 minutes and showed a soft bottom, many ctetognaths, many shrimp and sea stars, few fish (mainly sculpins), and several visits by sharks. The presence of multiple Greenland sharks (*Somniosus microcephalus*) at D1 is similar to our results at this site in 2019 and 2021 and further comparisons of video data between years are in progress.

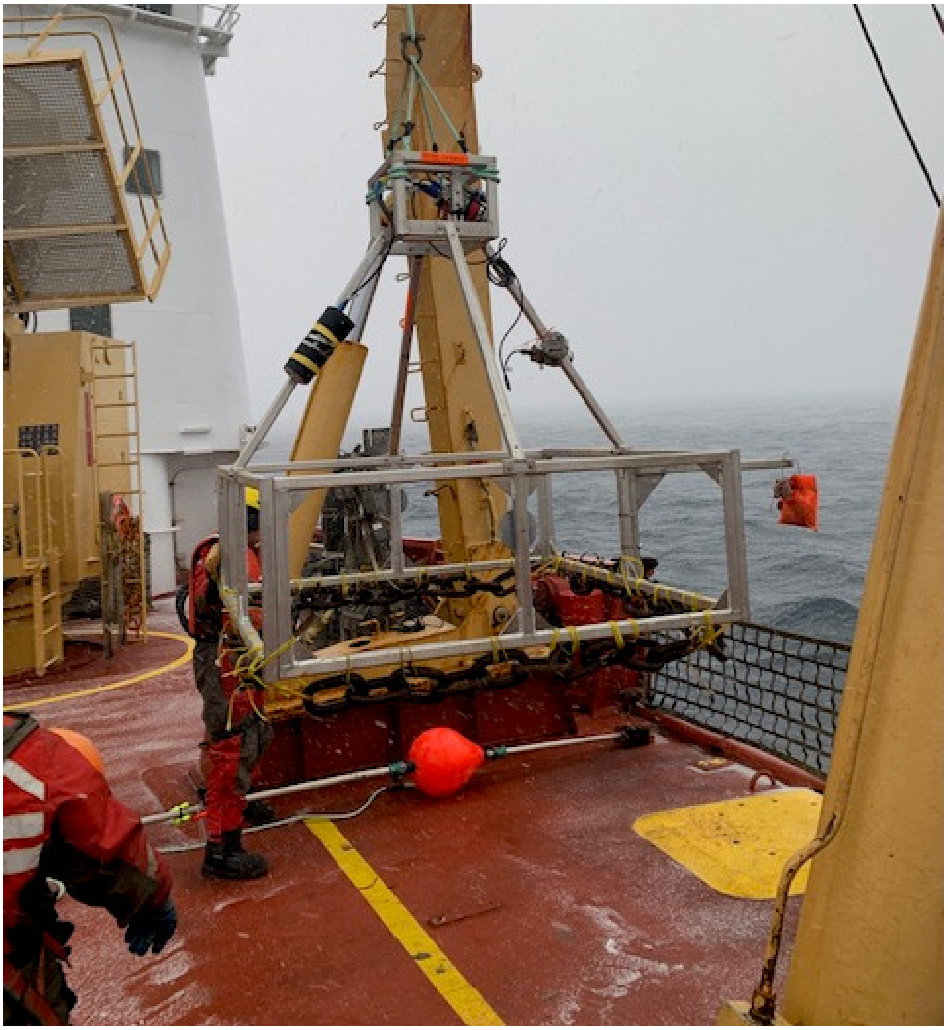


Figure 6-4. The baited remote underwater video camera system (camera, LED light, parallel lasers, lithium battery, bait arm, squid bait), which was used to characterize the benthic fish and invertebrate communities at two sampling locations.

6.3.4 *Continuous Plankton Recorder (CPR)*

During Leg 2, our goals for the deployment of the Continuous Plankton Recorder were met. In total, >2000 nautical miles of Continuous Plankton Recorder samples were obtained within seven transects (Figure 6-16) spanning from Anticosti Island (49°N) to the North Water Polynya (76°N). Those samples will be processed in collaboration with the Marine Biological Association of the United Kingdom to yield data at spatial scales of 10 nautical miles on phytoplankton greenness, phytoplankton abundance by species, small zooplankton abundance by species, large zooplankton abundance by species, and microplastic abundance. It is anticipated that >100 species categories will be collected, based on prior samples through this region. Those data will be examined in the context of fishery acoustics data (via EK80) to examine whether acoustic abundances of fishes and meso-zooplankton are associated with the abundance and composition of upper water column plankton.

Figure 6-5. The continuous plankton recorder was used to sample the plankton community and microplastics in the upper water column (~5m) during leg 2. The photo also shows the internal sampling cassette being removed.

6.3.5 *Red light experiment*

In Hebron Fjord, we conducted a series of light experiments with the Hydrobios at 250 m (3 deployments with red light; 3 deployments with white light). This work was conducted in accordance with previous light experiments performed by Maxime Geoffroy on Leg 5 of the 2021 CCGS *Amundsen* expedition. The purpose was to observe whether the white artificial lights on the ship created avoidance of the zooplankton during net deployments. When the lights were turned off and the red light mounted on the A-frame was lit-up, we saw an initial division of the backscatter layer using the EK80 at ~80 m (Figure 6-15). However, once the nets were retrieved, we observed no clear change in the zooplankton distributions in the collected bottles from the white light and red-light deployments. The Hydrobios samples should be analyzed further to determine whether there was more subtle changes in zooplankton abundance around 80m. This experiment was also undertaken during Leg 2 with similar results.

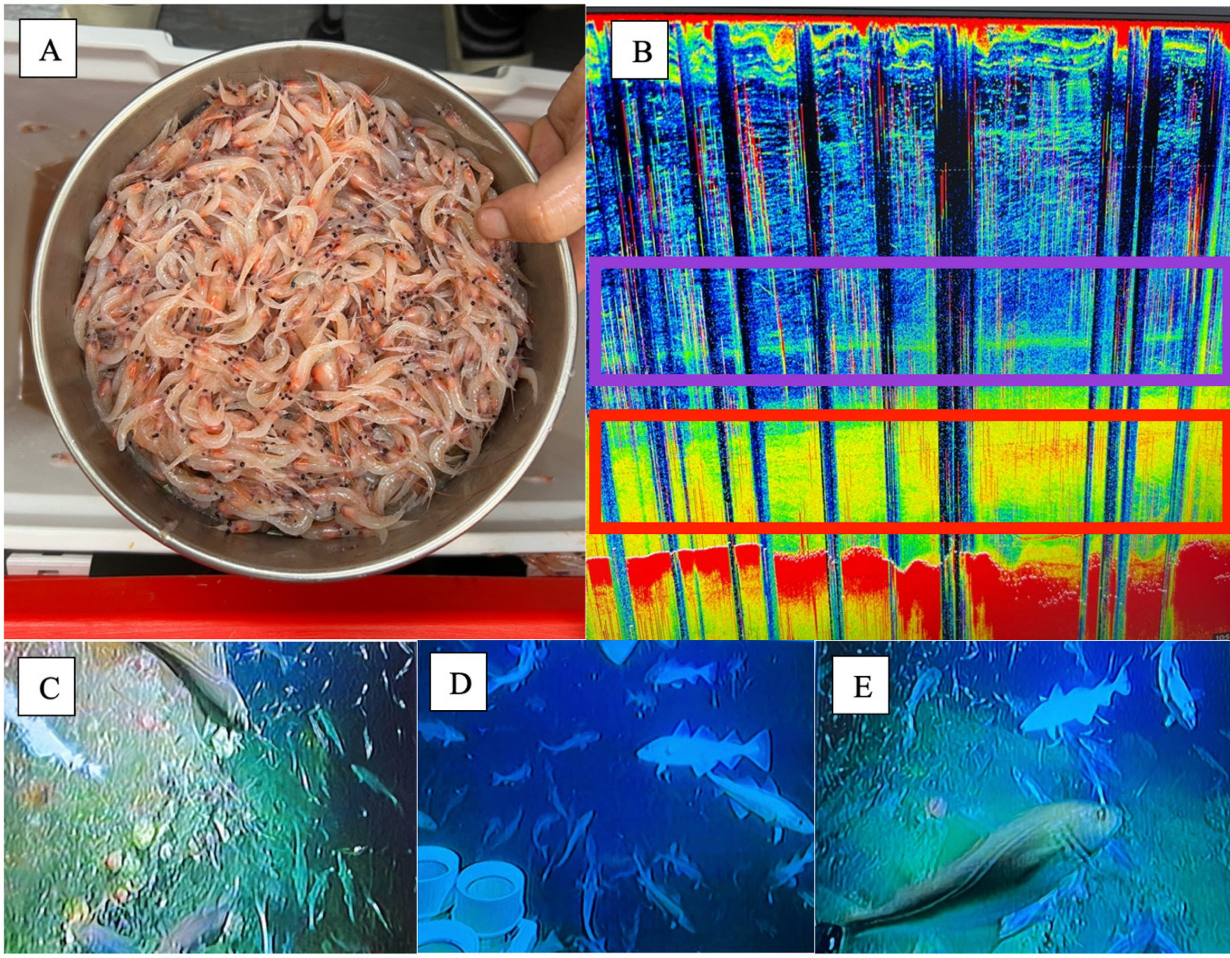


Figure 6-6: (A) IKMT catch at Joey's Gully (250m in depth) primarily *Meganyctiphanes norvergica*, (B) EK80 where the purple box shows where the IKMT was deployed ~200 m, while the red box is just below the trawl line with the adult Atlantic cod. (C-E) are images from the ROV deployment just before the IKMT deployment.

Table 6-3: Fish count per species caught with the nets during Leg 1

Group/Family	Genus	Species	Count
Zoarcidae	Lycodes	polaris	38
Liparidae	Liparis	fabricii	25
Myctophidae	Benthosema	glaciale	24
Gadidae	Boreogadus	saida	19
Zoarcidae	Lycodes	sp.	18
Stichaeidae	Leptoclinus	maculatus	16
Myctophidae	Lampanyctus	macdonaldi	7
Liparidae	Liparis	gibbus	5
Liparidae	Liparis	sp.	4
Zoarcidae	Lycenchelys	verrillii	2
Cottidae	Gymnocanthus	tricuspis	1
Unindentified fish	-	-	1
Zoarcidae	Lycodes	lavalaei	1

Table 6-4: Fish larvae count per species caught with the nets during Leg 1

Group/Family	Genus	Species	Count
Liparidae	Liparis	sp.	8
Gadidae	Gadus	morhua	6
Gadidae	Boreogadus	saida	5
Cottidae	-	-	3
Agonidae	-	-	2
Liparidae	-	-	1
Osmeridae	Mallotus	villosus	1
Stichaeidae	Lumpenus	lampretaeformis	1
Unidentified fish	-	-	1

Table 6-5: Zooplankton species count caught with the nets during Leg 1

Group/Family	**Genus**	**Species**	**Count**
Euphausiidae	Meganyctiphanes	norvegica	8454
Hyperiidae	Themisto	libellula	214
Decapoda	Pandalus	borealis	182
Cragonidae	Eualus	gaimardi belcheri	110
Cragonidae	Eualus	gaimardi gaimardi	60
Cnidaria	-	-	46
Decapoda	Pandalus	montagui	29
Cragonidae	Argis	dentata	22
Gonatidae	Gonatus	fabricii	22
Unidentified	-	-	18
Cragonidae	Sabinea	septemcarinata	12
Atollidae	Atolla	wyvillei	3
Decapoda	Pandalus	norvegicus	3
Sagittidae	Pseudosagitta	maxima	2

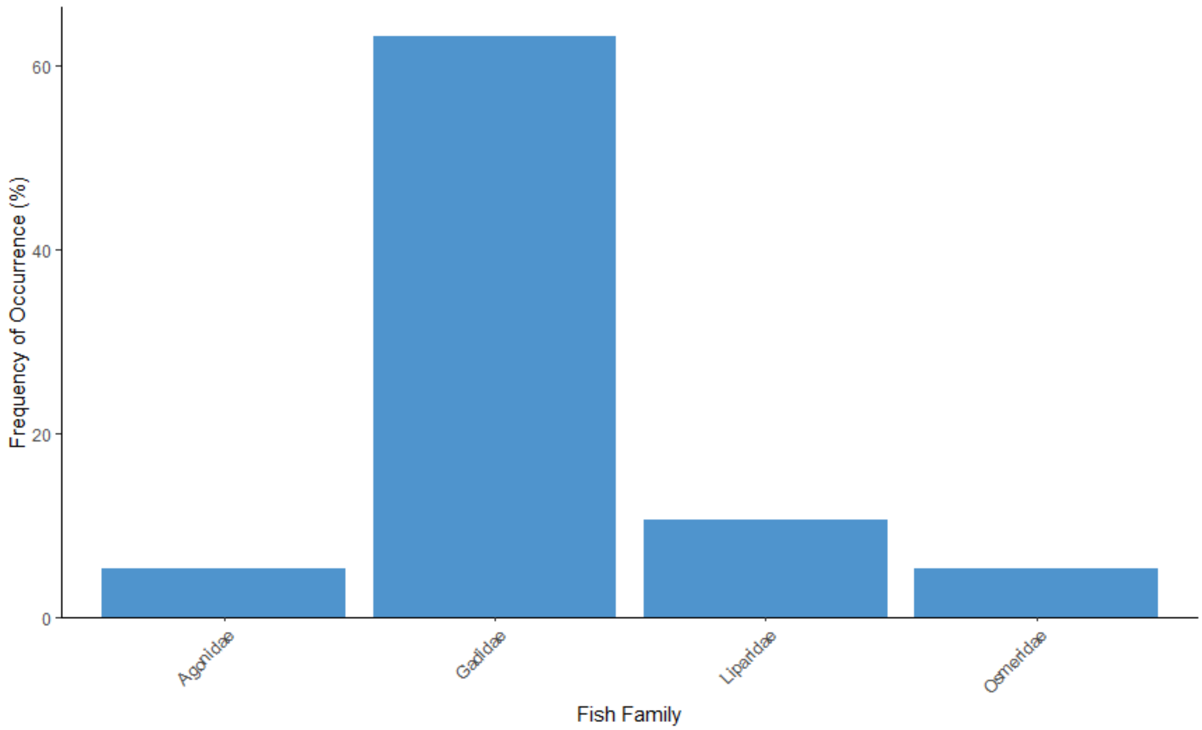


Figure 6-7. The frequency of occurrence (# of nets a species was captured in/total number of nets) of larval fish during Leg 2.

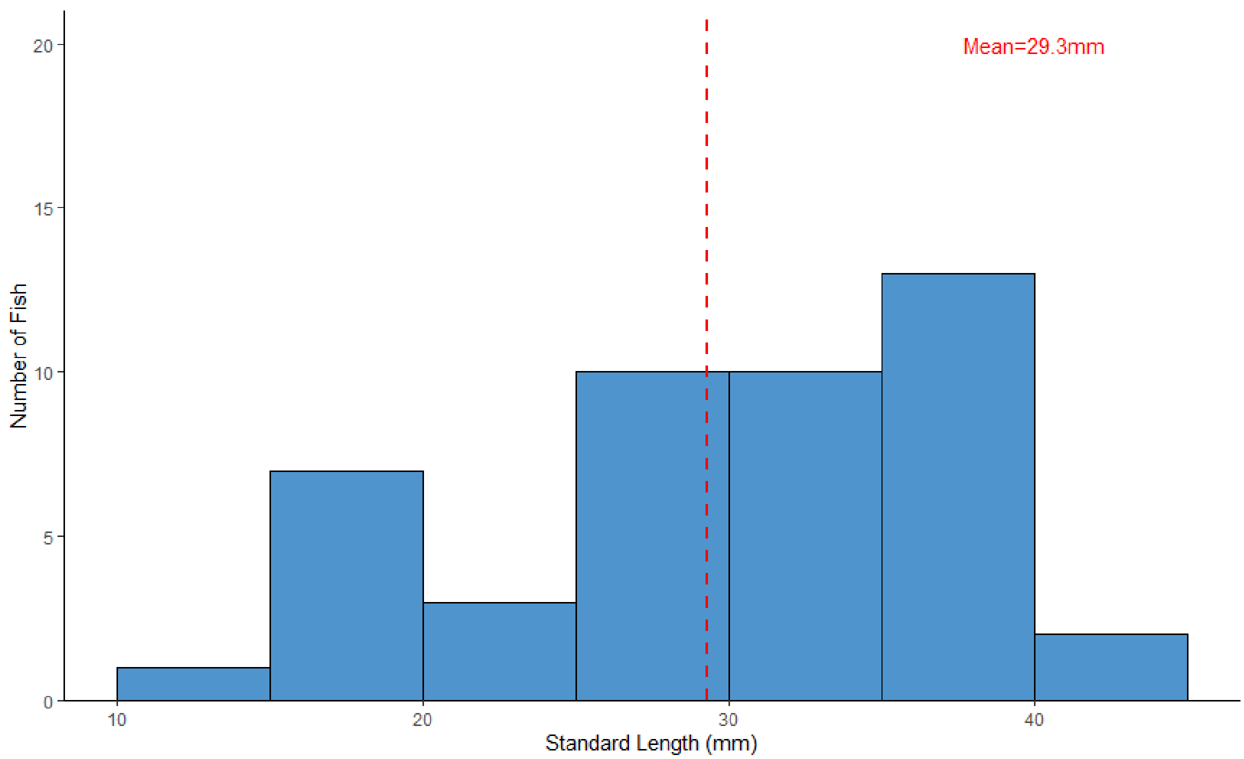


Figure 6-8. Length frequency of larval Arctic cod (n=46) during Leg 2. The vertical red line represents the mean.

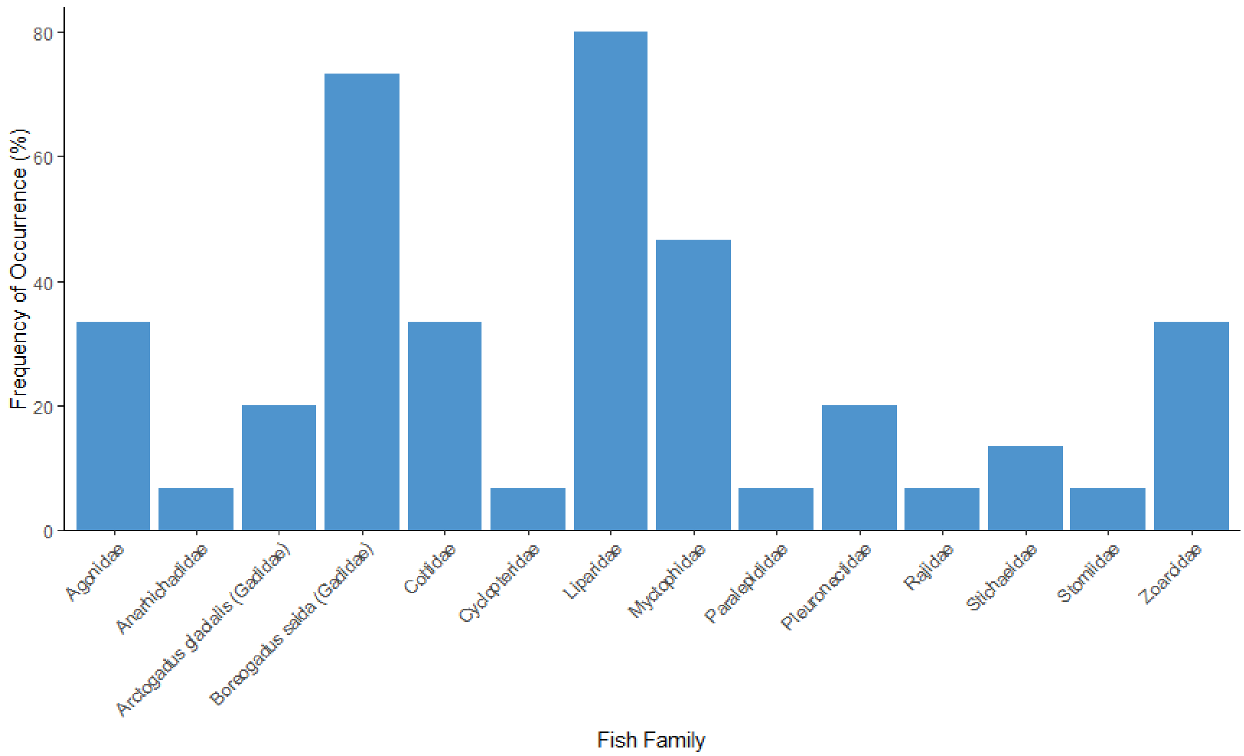


Figure 6-9. The frequency of occurrence (# of nets a species was captured in/total number of nets) of fish caught in the IKMT and Beam trawls during Leg 2.

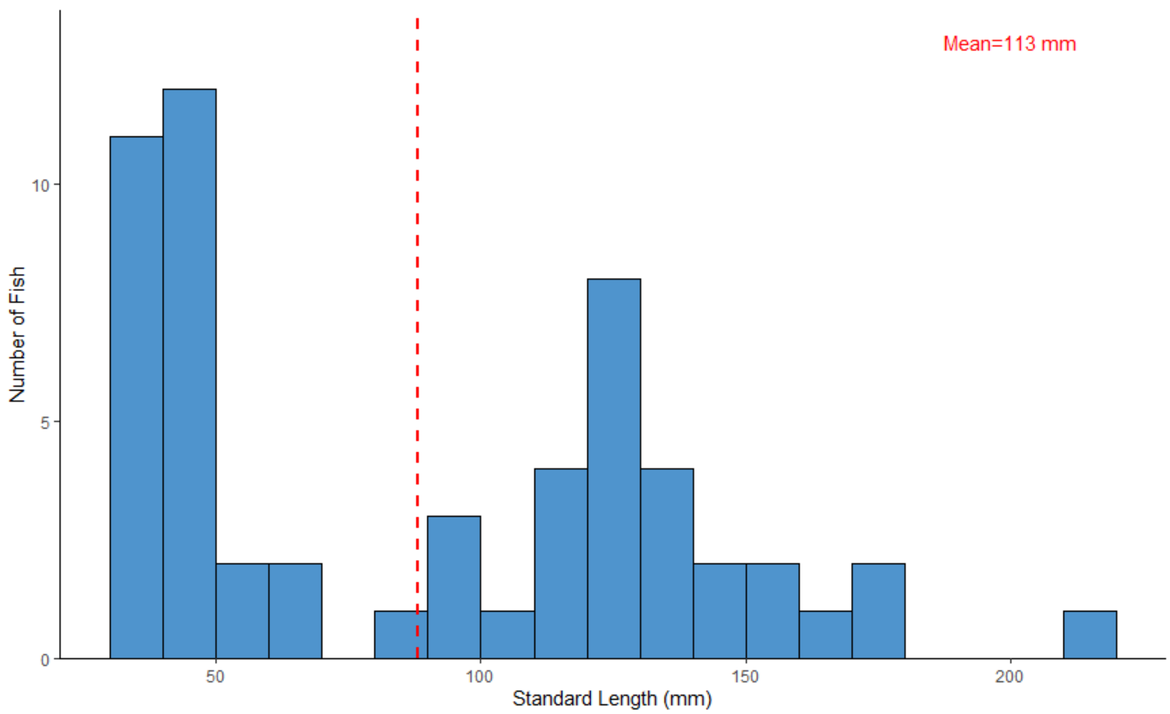


Figure 6-10. Length frequency of Arctic cod from the IKMT and Beam Trawl (n= 56) during Leg 2. The vertical red line represents the mean.

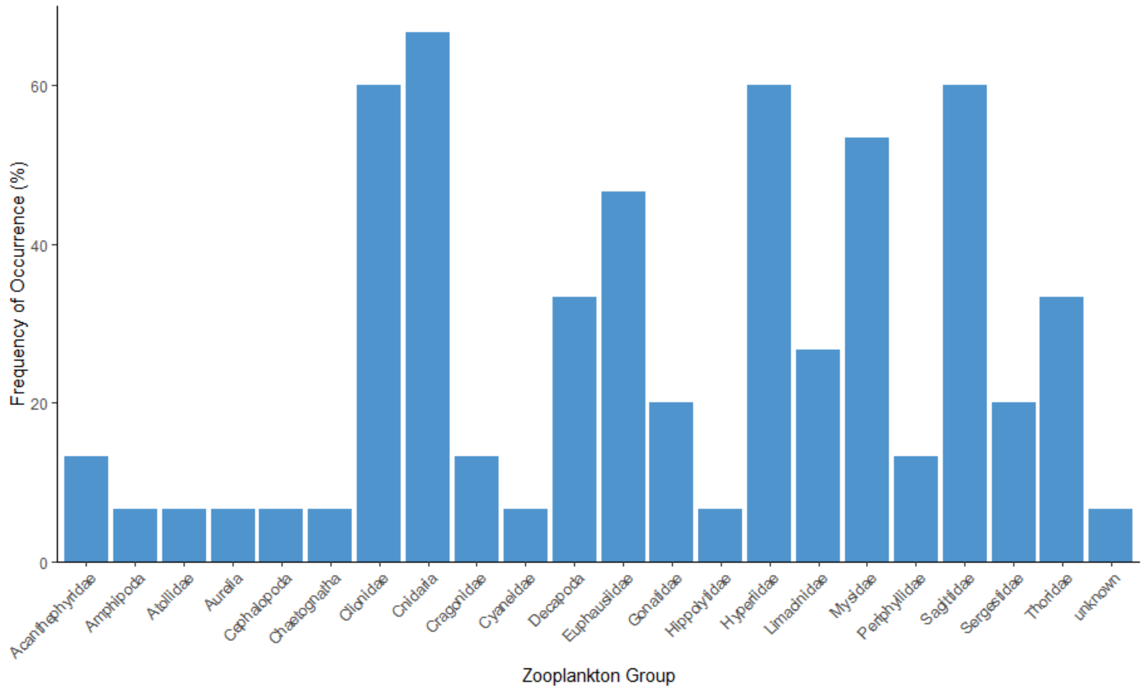


Figure 6-11. The frequency of occurrence (# of nets a species was captured in/total number of nets) of zooplankton caught in the IKMT nets during Leg 2.

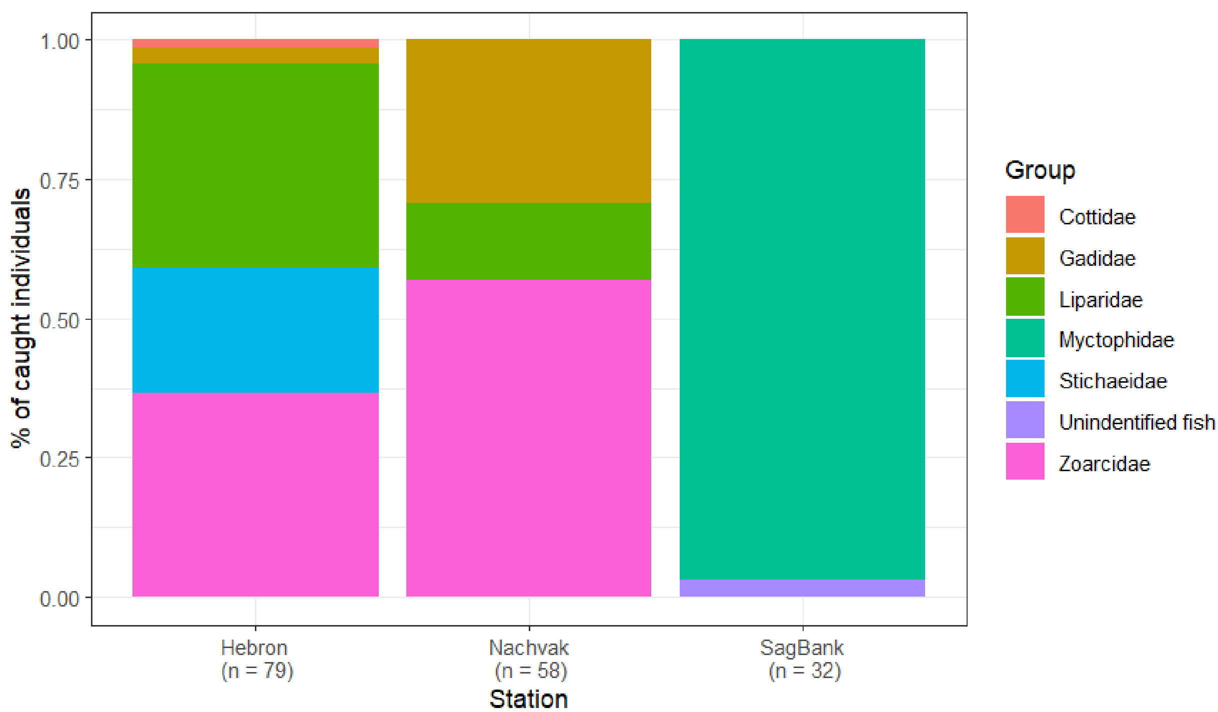


Figure 6-12: Fish group/family composition per sampling station during Leg 1

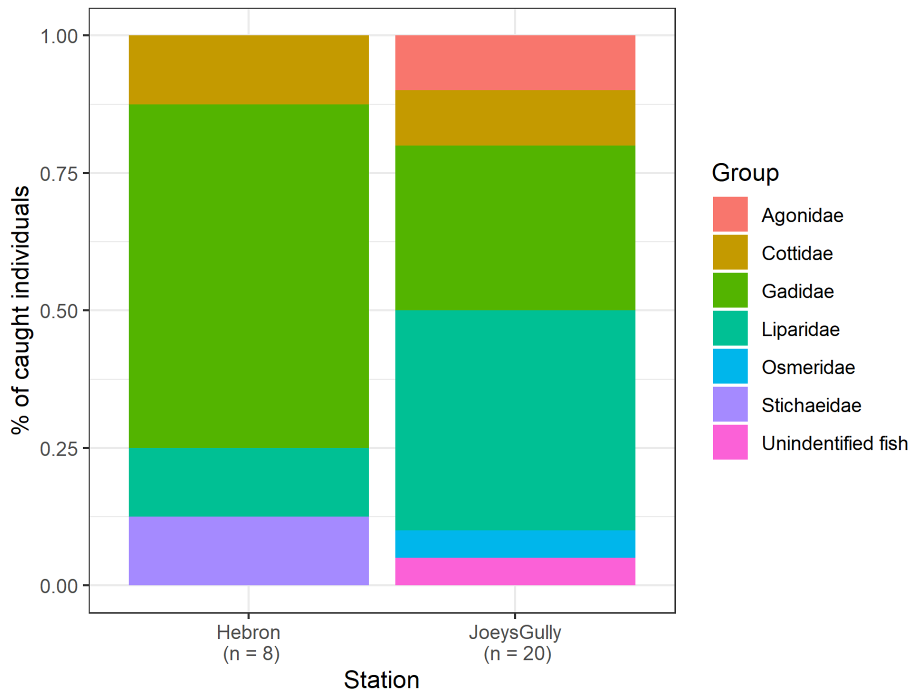


Figure 6-13: Larval fish composition per sampling station during Leg 1

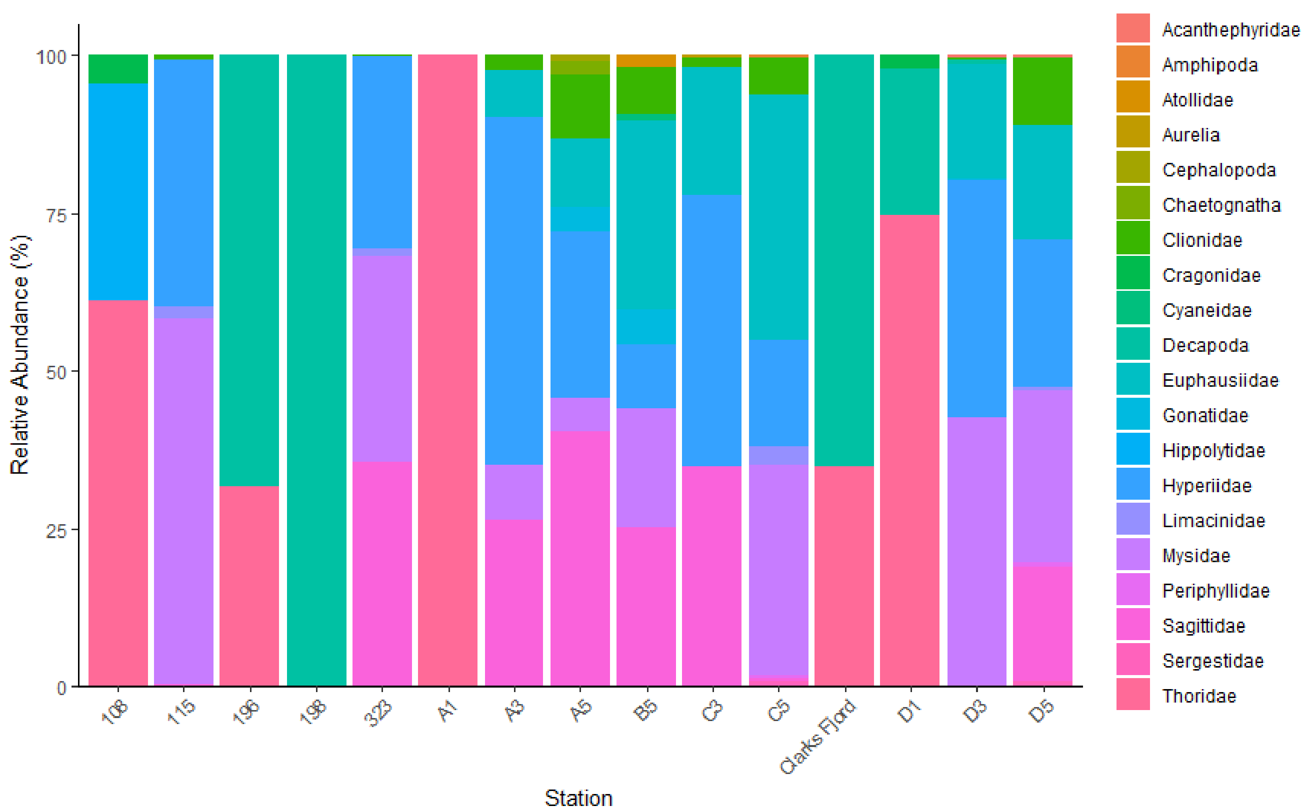


Figure 6-14. Relative abundance of zooplankton groups in the IKMT nets by station.

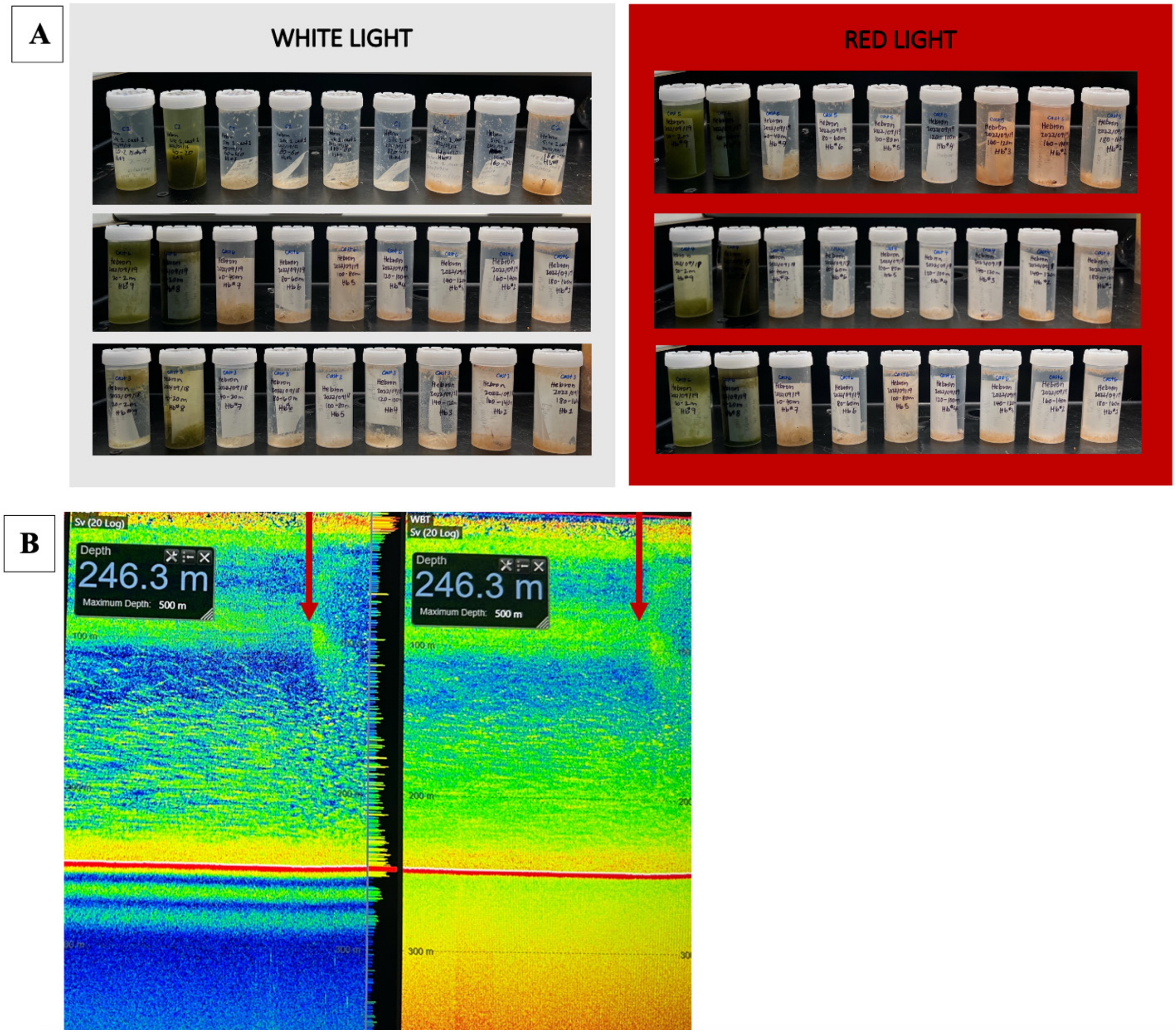


Figure 6-15: Red light experiment during Leg 1, where (A) is the hydrobios sampling bottles taken at each depth interval for red and white light and (B) is the echogram depicting the slight splitting of the surface backscatter layer at 80m the instant the red lights (red arrow) were turned on and the white lights turned off.

Table 6-6. Sample taken by other research groups during Leg 2 where letters represent a sample taken from the operation (T; tucker net, M; Monster net; H; Hydrobios, B; Beam trawl).

Principal Investigator	Michel	Jantunen	Stern	Tufenkji	Brown	Archambault
Project	KEBABB	Contaminants MPs	Hg	Contaminants MPs	Contaminants	Biodiversity
Station ID						
A1	T + H		B		T	B
A3	T + H		T	T	T	T
A5	T + H				T	T
196	T + H	T	T + B	T	T	B
198	T + H				T	T + B
B5	T + H	T	T	T	T	
B3	T + H				T	
B1	T + H	T	T	T	T	B
C5	T + H				T	
C3	T + H	T	T	T	T	T
C1	T + H				T	
D1	T + H		B		T	B
D3	T + H				T	T
D5	T + H	T	T	T	T	
D5	T + H				T	
Scott Inlet		T + M	T + M + B	T + M	T	B
323_east					T	
105_south		M	M	M	T	
108			B		T	B
115					T	
354		T + M	T + M	T + M	T	B
Total	**30**	**10**	**16**	**12**	**21**	**13**
					Grand total	**102**

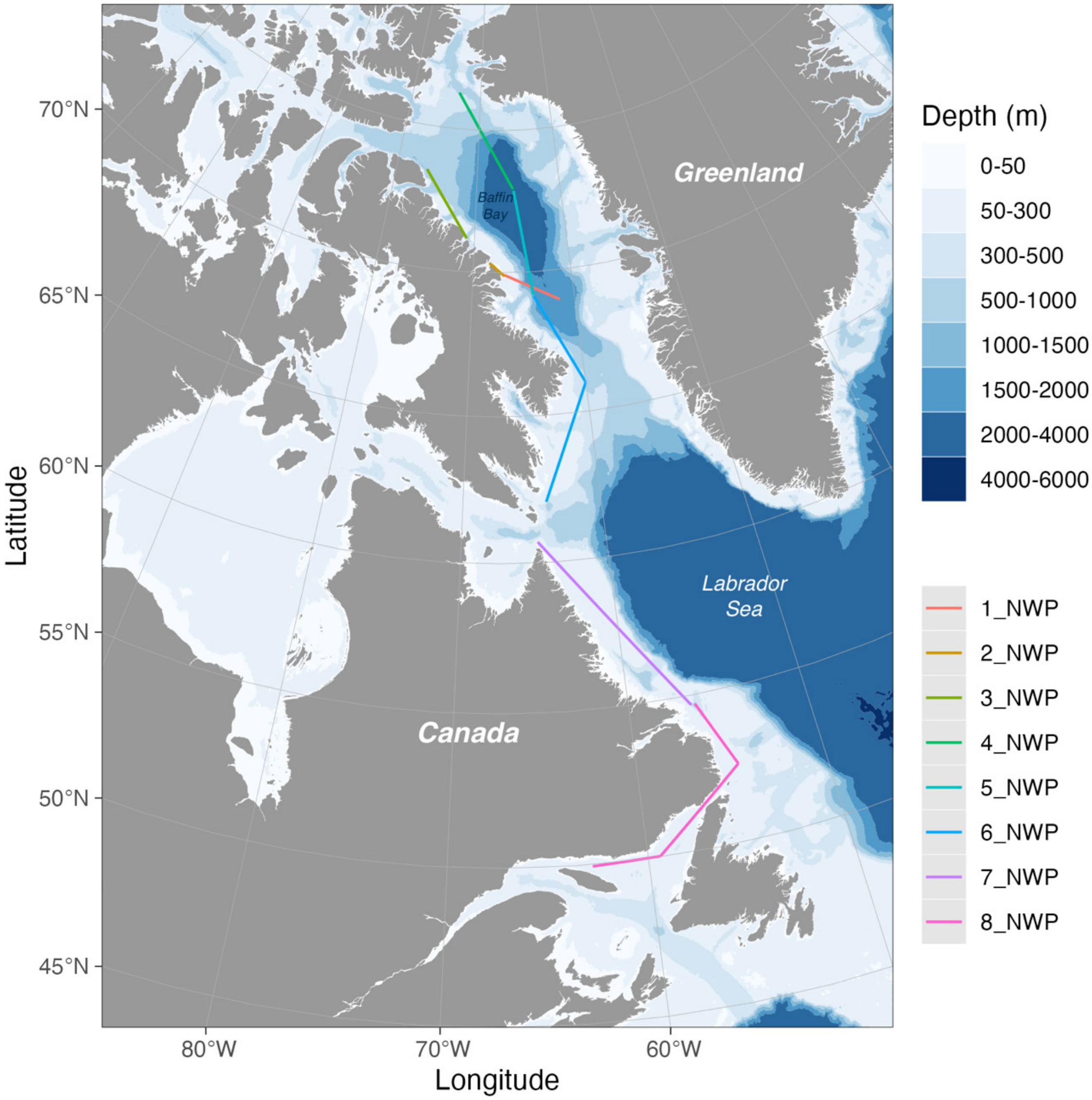


Figure 6-16. The continuous plankton recorder (CPR) transects.

6.4 Recommendations

In the planning on the CPR transects with Amundsen Science prior to boarding, we understood that there would be a night crew from the start of the trip up until the end of the trip. We planned the transects accordingly, but when the crew switched to only day operations this made it more challenging to coordinate. Although the crew seemed willing to help even during the early mornings or evenings, this put a burden on the crew and their time off when it could have been avoided all together. We felt that deploying the CPR might have caused tension between the science and crew teams and felt that they might feel disheartened that we were not respecting their schedules. In the future, it would be important to plan with the crew to schedule the CPR deployment and recoveries to respect their schedules while also meeting our scientific objectives together.

In the Zooplankton lab we are often restricted by space, which we know cannot be changed. However, it would be great if we could have more boat-safe shelving installed above/around the sink for drying petri dishes, hanging of dish cloths, and short-term storage of sorting containers. Additionally, we have a scale that we bring from St. John's every year, but if Amundsen Science has a finer resolution scale that is better at dealing with boat waves, that would be better. We also bring two microscopes every year, but if Amundsen Science has some we could use those too (the microscopes are not as much of an issue though).

6.5 References

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7 Seafloor mapping, investigation of geohazards and characterization of phytoplankton communities

Project leaders: Alexandre Normandeau[1] (alexandre.normandeau@nrcan-rncan.gc.ca) and Audrey Limoges[2]

Cruise participants – Leg 1: Robbie Bennett[1], Laura Broom[1], Thomas Carson[1], Margaret Atkinson[2], Hannah Sharpe[2]

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7.1 **Introduction and Objectives**

The work conducted by the Geological Survey of Canada – Atlantic (GSC-A) was completed under the Marine Geoscience for Marine Spatial Planning program. This program aims to improve our understanding of the seabed along Canada's Atlantic margin, including the Labrador region. This involves obtaining seabed information on surficial geology, geological processes and hazards (geohazards) to support decision making for public safety, marine infrastructure and marine conservation in the region. One of the main objectives of the work conducted during Leg 1 was to characterize a submarine landslide deposit in Nachvak Fjord, Labrador. Fjord environments are susceptible to subaerial and submarine landslides, which can have the potential to produce tsunamis, posing a potential risk to public safety and marine infrastructure. The submarine landslide in Nachvak Fjord will be characterized using gravity cores and an autonomous underwater vehicle (AUV) to collect high-resolution bathymetric data over the deposit. A secondary objective of the work conducted during Leg 1 included an experimental deployment of the AUV over an area with potential coral habitat. This deployment was conducted to find out if corals could be resolved by the AUV bathymetry.

The first objective of the University of New Brunswick (UNB) team was to collect opportunistic surface sediment samples (top first cm of sediment at sediment-water interface) from each box core. These samples will be used for subsequent identification of microfossils (e.g., dinoflagellate cysts, palynomorphs, diatoms, foraminifera) at the University of New Brunswick. Another objective was to collect opportunistic phytoplankton samples (i.e., free floating, microscopic organisms that live in the upper water column or sea-ice) using the phytoplankton net, which will be used to document and characterize baseline regional diatom and dinoflagellate communities at the Université du Québec à Rimouski – Institut des sciences de la mer de Rimouski.

7.2 **Methodology**

7.2.1 *Gravity coring*

A total of three gravity cores were collected during Leg 1 (Figure 7-1; Table 7-1). The gravity core utilised the piston corer without the trigger weight core and trip arm attached and uses a butterfly valve at top of the core liners. This system consists of a nine-metre long string with a 2000 lb core head (Figure 6-2). Once the corer is recovered on deck, it is taken apart sequentially, starting at the base. The three-meter long plastic liners were cut down to 1.5 m sections and caps were fitted on both ends. The sections were then taken to the lab where they were labelled and processed. If material was present in the core cutter and catcher (the very base of the core system), this material was recovered either in bags or extruded from the cutter into a separate piece of core liner.

On board processing of the cores consisted of taking one measurement and a subsample from the top and/or bottom of core sections where the material was suitable. Shear strength measurements where taken using a torvane that was inserted into the sediment at the bottom/top of the core liner and turned at a constant rate until the sediment failed. This measurement is used to help calibrate the shear strength measurements that will be taken along the length of the core at the GSC-A. Constant volume samples were collected using a cylinder of known volume which will be analysed for bulk density at the GSC-A. This measurement will help calibrate the bulk density measurements taken along the length of the core at the GSC-A. Suitable sediment for these procedures is undisturbed mud. Sand, soupy mud or core disturbance will make the measurements unsuitable. The cores were then resealed with tape, the ends were covered with wax and the cores were stored upright in a refrigerated container.

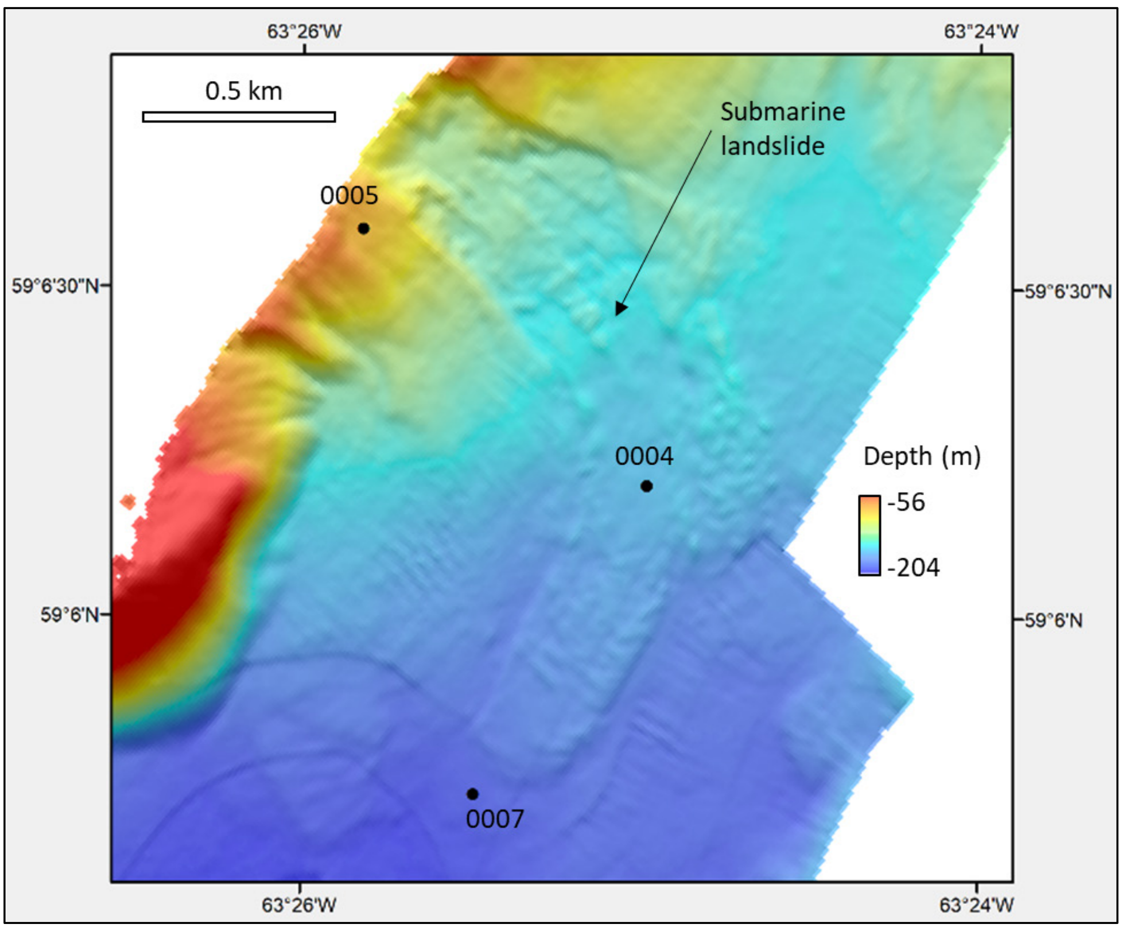

Figure 7-1: Locations of gravity cores (0004, 0007 and 0008) in Nachvak Fjord targeting submarine landslide observed in multibeam bathymetric data.

Table 7-1: Gravity coring and AUV dive operations conducted by the Geological Survey of Canada

GSC Station ID	Time (UTC)	Region	Latitude	Longitude	Activity	Event	Depth (m)	Core length (m)
0008	2022/09/16 15:29:51	Nachvak Fjord	59.0987542	-63.4163418	AUV	Recovery	194	N/A
0008	2022/09/16 12:36:16	Nachvak Fjord	59.0943858	-63.4227618	AUV	Deployment	199	N/A
0007	2022/09/16 10:30:42	Nachvak Fjord	59.0954943	-63.4248063	Gravity Core	Bottom	199	625
0005	2022/09/15 21:32:04	Nachvak Fjord	59.1097960	-63.4303615	Gravity Core	Bottom	138	661.5
0004	2022/09/15 19:56:43	Nachvak Fjord	59.1033245	-63.4163318	Gravity Core	Bottom	214	461.5
0002	2022/09/13 12:02:35	Joeys Gully	54.5912805	-56.3283425	AUV	Recovery	495	N/A
0002	2022/09/13 10:39:14	Joeys Gully	54.5893980	-56.3217718	AUV	Deployment	520	N/A

Figure 7-2: Gravity coring operations in Nachvak Fjord using the 9 m long piston corer

7.2.2 *AUV missions*

Two AUV missions were conducted during Leg 1.

- The AUV used during this cruise was a Gavia, manufactured by Teledyne Marine (Figure 7-3). It is approximately 12.5' in length and weighs 325 lbs. The main sensors on the AUV are: 1) an EdgeTech bathymetric sonar that collects side scan sonar and multibeam-like bathymetry at ~15 cm resolution; and 2) a sub-bottom profiler which operated between 12 – 23 kHz that is capable of imaging the upper 10 to 15 m of sediment. The Gavia AUV is a fully autonomous vehicle that does not receive corrections from the operator while on a mission.
- The AUV is programmed with a mission plan using a laptop computer (or tablet) that is connected through its own wifi network. The AUV is deployed from the foredeck of the *Amundsen* using the starboard crane (Figure 7-4) and then towed to the mission site using a fast rescue craft (FRC). When at the appropriate release point, the AUV is untied from the FRC and activated using a ruggedized tablet connected via the AUV's wifi network.

The first AUV mission was planned in Joey's Gully, an area with potential coral habitat. A two-hour mission was planned that covered 11.6-line km (Figure 7-5). The goal of this mission was to determine if it was possible to image corals using the AUV's bathymetric sonar. This area was selected by DFO as it had a high potential for the presence of corals. Multibeam bathymetry collected by the *Amundsen* showed unusual crescentic depressions in the seafloor that are thought to be formed by glacial activity. These depressions have slopes on their margins that should be favorable for the presence of corals. Unfortunately, this mission was not successful as detailed in Section 7.3

Figure 7-3: AUV used to collect high-resolution bathymetric data in Joey's Gully and Nachvak Fjord

Figure 7-4: Retrieval of AUV using the CCGS *Amundsen* FRC

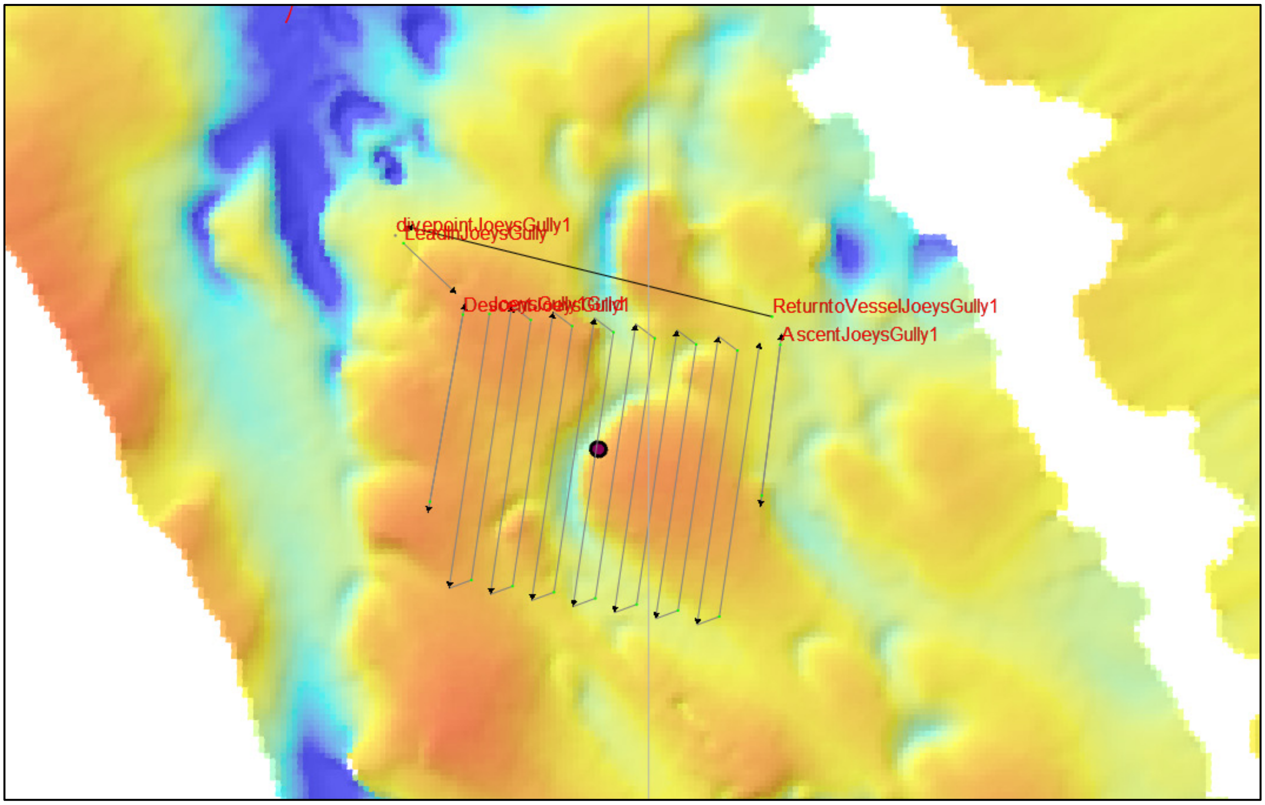

Figure 7-5: Planned AUV mission for Joey’s Gully

The second AUV deployment was in Nachvak Fjord to map the submarine landslide deposit. A two-hour mission was planned that covered 12.5-line km (Figure 7-6). The mission site was selected to image an area of the landslide where it appears that an older deposit is overlapping a younger one. The AUV completed the mission and the data was successfully downloaded when the vehicle was brought back on board the *Amundsen*.

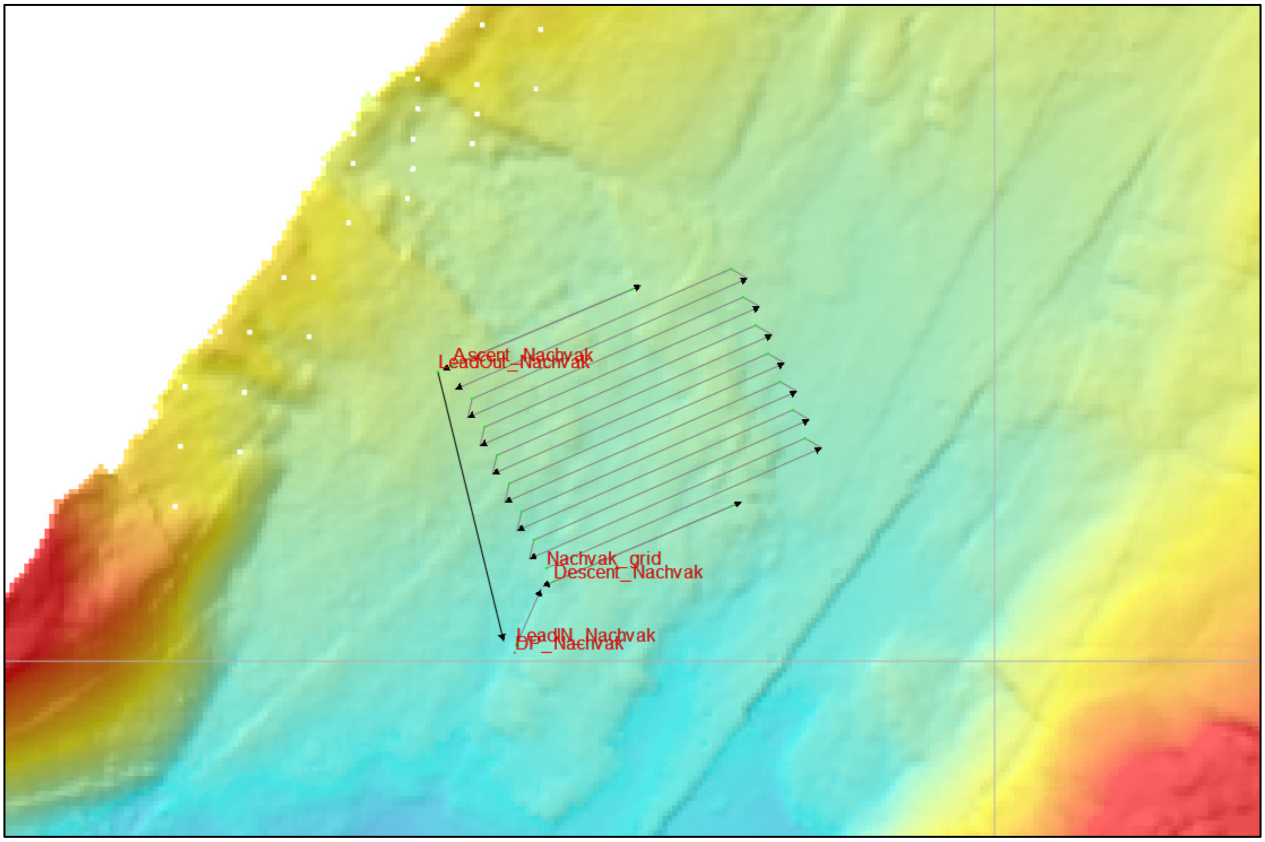

Figure 7-6: Planned AUV mission for Nachvak Fjord

7.2.3 *Box Cores*

Box cores collected in Joey's Gully, Nachvak Fjord, and Hebron Fjord were subsampled for the University of New Brunswick and GSC-A. From each box core, the top cm of sediment at sediment-water interface was collected for further analysis at UNB. A push core was also collected for the GSC-A from the Nachvak Fjord site. This was done using a small tube attached to a vacuum pump to prevent compression of the sediment. Once the push cores were inserted, the core was capped with endcaps, taped, sealed with wax and stored upright in the refrigerated container.

Figure 7-7: Box core collected from Nachvak Fjord, Labrador showing placement of push core (orange cap) collected by GSC-A

Table 7-2: Sediment samples from the box core collected by UNB and GSC-A. Surface samples will be archived at University of New Brunswick

Time (UTC)	**Station ID**	**Latitude**	**Longitude**	**Depth (m)**	**Push core length (cm)**
2022/09/19 04:05:49	Hebron Fjord Site 3	58.1515828	-62.650252	224.88	N/A
2022/09/18 01:46:01	Hebron Fjord Site 2	58.1194075	-63.000927	130.45	N/A
2022/09/17 17:03:42	Hebron Fjord Site 1	58.1490125	-62.776972	254.17	N/A
2022/09/16 08:02:54	Nachvak Fjord	59.0761075	-63.530294	204.12	47
2022/09/13 03:47:14	Joey's Gully	54.6181995	-56.445083	359.22	N/A

7.2.4 *Phytoplankton net*

The phytoplankton net is conical with a 30 cm diameter at the top, approx. 1 m length, and 20 μm mesh net. A vertical tow is conducted from 5 m above the seafloor to the surface at stations where water depth is less than 100 m, whereas a vertical tow is conducted from 100 m to the surface at stations where water depth is more than 100 m. The net is attached to the A-frame and is deployed with a descending and ascending speed of 60 m/min. Additional weight is attached to the shackle at the base of the net to facilitate sinking.

Once the net is back on board, the outside of the net is rinsed with local seawater from the hose, before taking the net to the laboratory. There, the inside walls of the net are rinsed with filtered (20 μm mesh) local seawater to ensure all phytoplankton is collected in the codend at the base of the net. The codend is then unscrewed and the contents are transferred to the sample bottle. 10 mL of 37% formaldehyde is added to the sample with a syringe and the bottle is sealed with black electrical tape. The bottle is gently mixed to homogenize the sample and refrigerated at approximately 4°C in the dark.

Table 7-3: Phytoplankton net stations. Samples archived at Université du Québec à Rimouski – Institut des sciences de la mer de Rimouski

Time (UTC)	**Station ID**	**Latitude**	**Longitude**	**Depth (m)**
2022/09/17 08:55:30	Hebron Fjord	58.1506363	-62.8015995	246.11
2022/09/16 02:00:39	Nachvak Fjord	59.0756772	-63.4996363	208.07
2022/09/14 21:14:22	Hopedale Saddle	56.0931058	-57.4433177	314.42

7.3 **Preliminary Results**

7.3.1 *Joey's Gully (September 13, 2022)*

The AUV did not successfully complete its mission to collect bathymetric data over a potential coral habitat in Joey's Gully. The AUV mission at this site was attempted twice and during both dives, the AUV resurfaced before completing its mission. After reviewing the AUV diagnostic data, the vehicle did not dive beyond about 10 m water depth (Figure 7-8). The on board CTD showed that the water density increased steadily from about 1024 kg/m^3 at the surface to 1028.5 kg/m^3 at 10 m depth (Figure 7-9). These water densities caused the AUV to become too buoyant at depth, preventing it from diving to the water depth programmed into the mission.

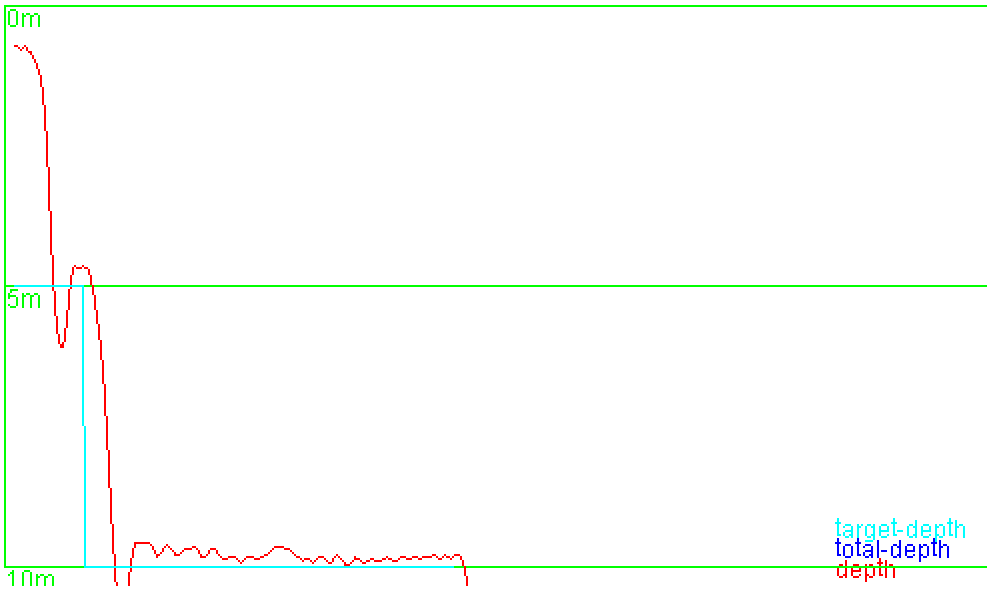

Figure 7-8: AUV depth plot for mission attempted in Joey's Gully

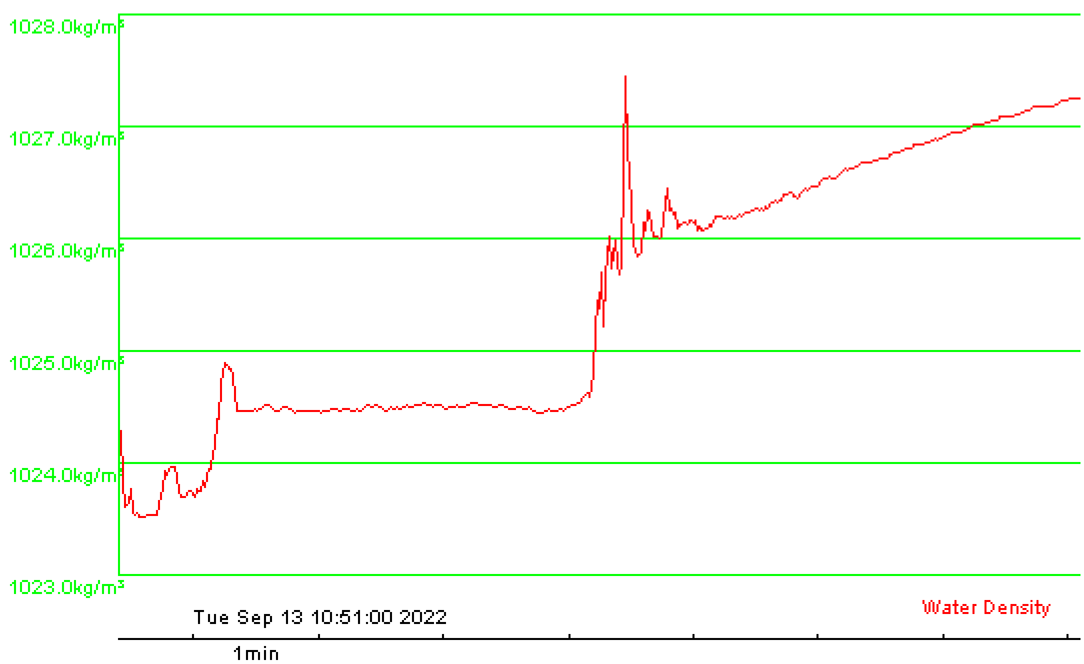

Figure 7-9: AUV water density plot for mission attempted in Joey's Gully.

Since the mission did not complete it is still unknown whether the AUV bathymetric data can resolve corals on the seabed.

7.3.2 *Nachvak Fjord Submarine Landslide (September 15-16, 2022)*

The gravity coring and AUV operations on the submarine landslide in Nachvak Fjord were successful. Three cores were collected: one from inside the landslide deposit (0004), one from outside the landslide deposit (0005), and one from the distal end of the landslide (0007) (Figure 7-1). The core lengths ranged from 461.5-625 m (Table 7-1) which is good recovery for this system. The sediment within the cores will be analysed back in the lab at the GSC-A where the goal is to characterize and radiocarbon date this landslide deposit. The AUV data will also be analysed at the GSC-A to characterise the landslide deposit over a higher (cm scale) resolution than the multibeam bathymetric data. While the ship was coring, the cliffs around the submarine landside were observed for any evidence of a subaerial component. It was noted that there appeared to be a small subaerial slide on one section of the cliff (Figure 7-10; Figure 7-11). It is unknown at this point if it occurred synchronously with the submarine landslide or if it was an independent event with no submarine component.

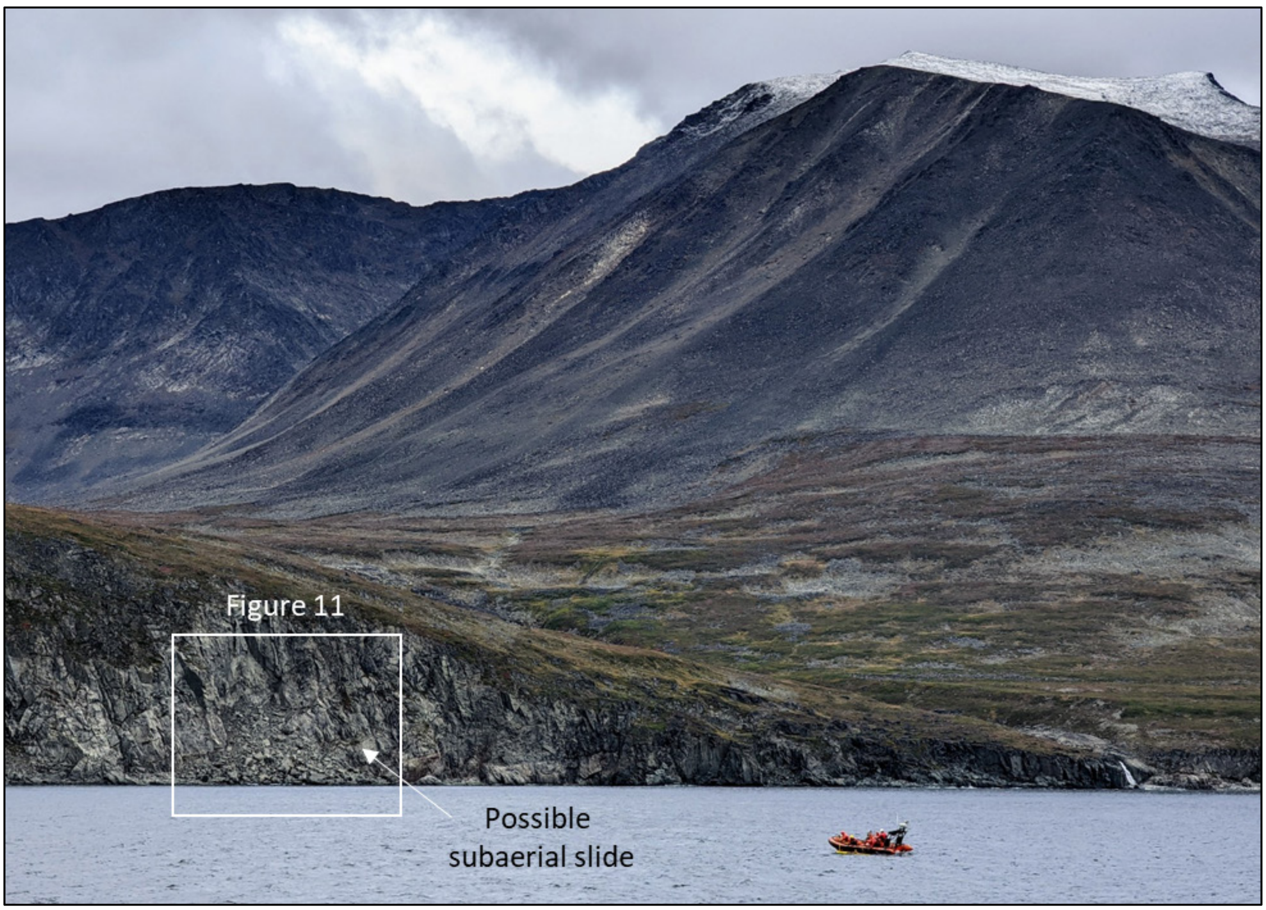

Figure 7-10: Retrieval of AUV in font of the cliff face above where the submarine landslide

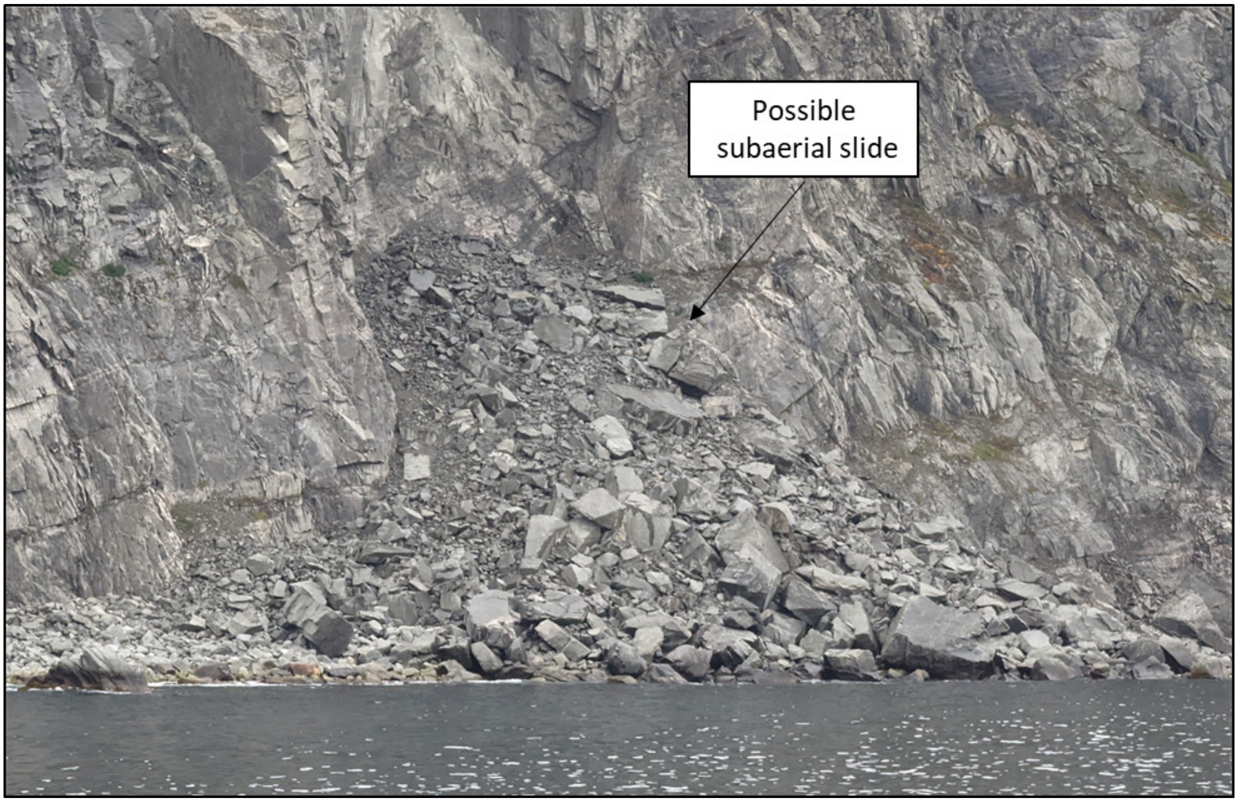

Figure 7-11: Possible subaerial landslide along the cliff face above the submarine landslide

7.4 **Recommendations**

Below are recommendations for future operations:

Coring operations:

1. The lifting straps used to lift the gravity corer are in poor condition (one has a manufacture date of 2010). It is imperative for new lifting straps to be purchased for next year. These straps are not expensive and ideally would be replaced every year.

2. The bottle jacks used to level and stabilize the gravity corer during assembly / disassembly are a little small which can cause them to tip over, and their operation can be tedious. Larger bottle jacks would be beneficial.

AUV operations:

1. NRCan to develop quick-connect solution for tag lines during retrieval.

8 Sediment biogeochemistry and benthic pelagic nutrient coupling

Principal Investigators: C. Algar[1], M. Armstrong[1], H. Geizer[1], P. Snelgrove[2]

Cruise Participants – Leg 1: M. Armstrong[1], H. Geizer[1]

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8.1 Introduction

Marine sediments on the coast, continental shelf, and slope (< 1000 m water depth) play an important role in nutrient biogeochemistry. For example, they are sites of significant carbon burial and can be responsible for up to 50% of global denitrification. As the Arctic warms, changes in primary productivity will alter carbon delivery to the sediments driving changes in biogeochemistry and the recycling of nutrients to the overlying water. This provides the motivation for the sediment biogeochemical studies conducted during this cruise, continuing from the work on the *Amundsen* 2021 Leg 2, which were to quantify the strength of benthic-pelagic nutrient cycling across a variety of coastal, continental, and slope habitats in the Eastern Canadian Arctic Gateway.

8.2 Methods

To accomplish this objective, sediment cores were collected using both ROV push coring and sub sampling of box cores (Figure 8-1) to examine sediment carbon remineralization pathways along a gradient of sites. During the 2021 cruise, the sites included coastal (Southwind Fjord), continental shelf (Makkovik), slope (644, Davis Strait, Disko Fan), and a cold seep site (Scott Inlet). This year (2022 Leg 1), sediment cores were collected from fjords (Nackvak Fjord and Hebron Fjord) to off the coast (Joey's Gully). We had planned to return to Makkovik to resample but were limited by weather conditions. Carbon and nutrient flow through the redox cascade of remineralization pathways was quantified using a combination of whole core flux incubations, and porewater nutrient profiles (Figure 8-2). Oxygen penetration depths were determined using microsensor profiling (Figure 8-2). To relate sediment biogeochemical processes to the resident populations of infauna and microbes, cores were sectioned to examine both macro-infauna diversity and microbial diversity (16S sequencing and metagenomics; Figure 8-2).

8.2.1 *Flux incubations:*

Flux incubations were conducted at all 3 sites. Cores for incubations at the Nackvak site were collected using sub cores from box core deployments, while at all other sites, incubations were performed with ROV push cores (Table 8-1). Hebron Fjord consisted of 2 fluxes, with 3 cores each, at a site near a cerianthid field and away from the cerianthid field at a similar depth (Figure 8-1). Upon retrieval, cores were placed in a ~4°C cold room and measured, photographed, and color changes with depth noted (Figure 8-3). The first site (Joey's Gully), the cold room was reading between 5-7°C. For Nackvak and Hebron sites, we changed the temperature to 4°C. Both Nackvak and Hebron Fjord samples demonstrated dark anaerobic sediment whereas Joey's Gully cores did not (Figure 8-3). Cores were left uncapped for ~12 hours prior to the initiation of the flux incubations to allow time for cores to recover from sampling disturbances. One core at Joey's Gully site contained a shrimp (*Meganyctiphanes norvegica*) which stirred up the sediment (Figure 8-2A). The organism died by the end of the flux experiment and was collected and preserved. Because the shrimp was using oxygen, this core had a steeper oxygen decline throughout 36 hours compared to the other cores without shrimp (Figure 8-4). Hebron cores were retrieved during 2 ROV dives and were incubated for 12 and 18 hours for near and away from cerianthid fields respectively. Overlaying water was replaced just before the start of the flux incubation with bottom water collected from Niskins deployed on the ROV at each location. This step was missed for cores retrieved at Joey's Gully. Nackvak Fjord used bottom water (2 m above seafloor) from the CTD rosette near that box core location. In addition, at each site a control incubation was performed with only bottom water (no sediment). Flux incubations were conducted for a period of 24-36 hours. Oxygen measurements were made every ~4 hours and dissolved nutrient samples (NO_x^-, NH_4^+, PO_4^{3-}, SiO_2) were collected every 8 hours then frozen at -20°C. At the initial and final timepoints larger water samples for dissolved inorganic carbon (DIC), pH, $\delta^{15}N$ and nutrients were collected. Samples will be analyzed post cruise in Dr. Algar's laboratory in the Oceanography Department at Dalhousie University.

After the flux was complete, cores were sectioned at 0-2 cm, 2-5 cm, 5-10 cm increments (Figure 8-2D). A small sample (<1 mL) was collected for genomic sequencing (16S and metagenomics) from the surface at each section. Sediment slices were preserved in 10% formalin for the characterization of macro faunal populations. Macrofauna identification will be conducted post cruise by Dr. Paul Snelgrove (Memorial University) for Joey's Gully and Nackvak Fjord sites while Dr. Bárbara Neves (DFO) conducts identification for Hebron Fjord sites.

8.2.2 *Porewater sampling:*

At all sites, cores were collected for the characterization of porewater chemistry. When possible, cores were collected in duplicate to assess spatial heterogeneity (Table 8-1), but this was not always possible due to operational constraints such as the number of cores that can be placed on the ROV. At the Hebron Fjord sites near cerianthids and away from the cerianthids, two of the four porewater cores from each site was compromised while placing in the ROV holster on the seafloor leaving one porewater core for each location. Porewater samples were extracted at 2 cm intervals through pre-drilled holes in the core liners using rhizons in the cold room on board (Figure 8-2B). After porewater collection, samples were sub-divided for analysis. Aliquots were taken for dissolved Fe^{2+}, DIC, H_2S and dissolved nutrients (NO_x^-, NH_4^+, PO_4^{3+}). DIC, Fe^{2+} (fixed with Ferrozine reagent) and H_2S (fixed with zinc acetate reagent) subsamples were stored at ~4°C, while nutrient samples were frozen at -20°C until analysis. Samples will be analyzed post-cruise in Dr. Algar's laboratory at Dalhousie University. Following porewater extraction, the remaining sediment was sectioned at the same intervals as the flux cores (ie 0-2, 2-5, 5-10 cm), plus deeper sections every 5 cm (i.e., 10-15, 15-20 cm), and then frozen at -20 °C, until they can be analyzed at our lab for total carbon, total nitrogen, and grain size. At Joey's Gully, porewater cores were not sectioned after analysis. They were however at Hebron Fjord and Nackvak Fjord but samples were not preserved for microbial sequencing because it is unclear to what extent porewater extraction may bias the results.

8.2.3 *Microsensor Profiling:*

To determine oxygen penetration into the sediments, microsensor profiling was conducted using Clark Type electrodes (UNISENSE OX-100). Briefly, a 100 μm diameter oxygen electrode was lowered into the sediments at 100-200 μm increments using a programable stepper motor controlled using UNISENSE SensorTrace profiling software (Figure 8-2C). This analysis is difficult while the ship's thrusters are being used due to strong vibrations in the lab, however, we managed to find a time frame with enough stability. Oxygen profiling measurements were performed in the cold room (~4°C) at close to ambient *in situ* temperatures and the overlying water was bubbled with air to ensure 100% O_2 saturation. In each core, three oxygen profiles were measured and combined to create an average profile and standard deviation.

Profiling was conducted over the top ~2.5 cm of sediment for all cores. At all sites, oxygen depleted within the first few centimeters demonstrating greater oxygen demand and productivity. In the core from Joey's Gully, there were oxygen spikes with depth likely because of bioirrigation or bioturbation (Figure 8-5). At Hebron Fjord, cores were collected for microsensor profiles both near a cerianthid field away from the cerianthid field. The goal is to determine if there are biogeochemical differences due to the abundance of such species. Figures of other sites will be created post cruise. After profiling the microsensor cores, they were also sectioned for total carbon, total nitrogen, and grain size (same sectioning scheme as porewater cores).

Table 8-1: Summary of cores collected at each study site. Location, water depth, method of collection and the analysis preformed on the core are recorded below. Location and water depth reported in this table are the general locations for the site, not the specific locations where individual cores were collected.

Site	Latitude	Longitude	Depth (m)	Total Cores	Method	Micro-sensor	Pore-water	Flux
Joey's Gully	54.373116	-56.271656	381.2	6	ROV	1	2	3
Nackvak Fjord	59.07611	-63.53029	204.12	6	Box core	1	2	3
Hebron Fjord (near cerianthid)	58.89208	-62.4737	245.7	6	ROV	1	1	3
Hebron Fjord (away from cerianthid)	58.91065	-62.480744	243	6	ROV	1	1	3

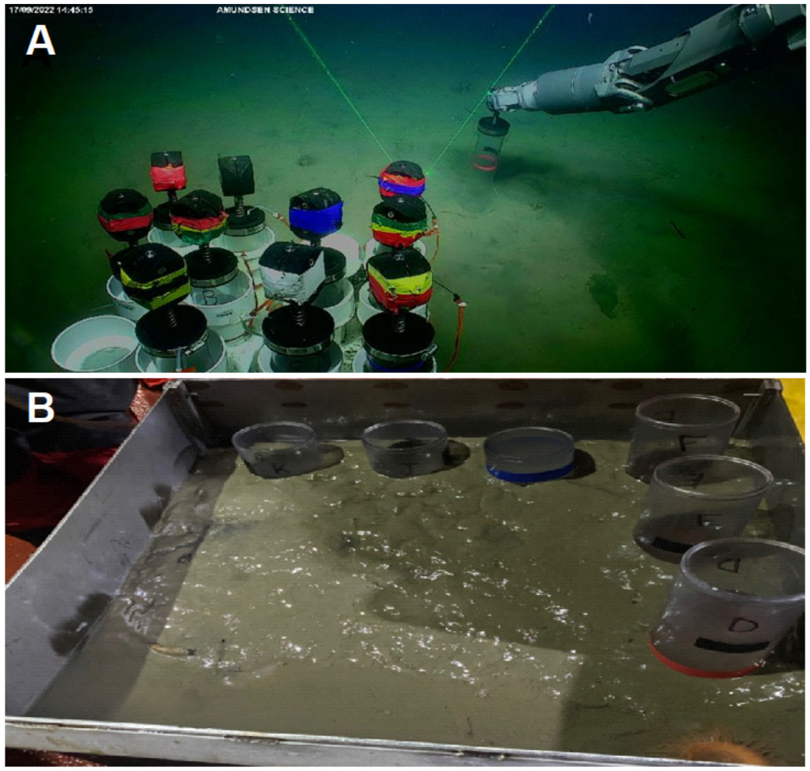

Figure 8-1: Photos demonstrating A) push core collection from the ROV at the Hebron cerianthid field site. B) Core positions while subcoring a box core in Nackvak Fjord.

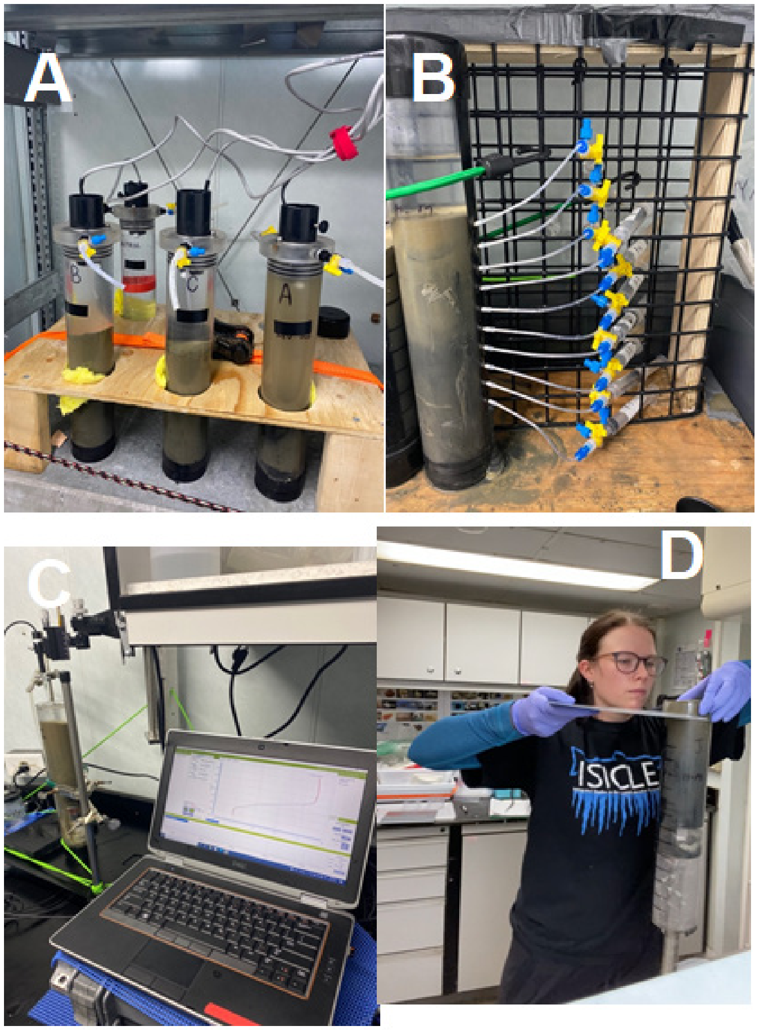

Figure 8-2: Images demonstrating the experimental setup for: A) flux incubations at Joey's Gully with core A being stirred up by the shrimp, B) porewater extraction, C) microsensor profiling, and D) core sectioning.

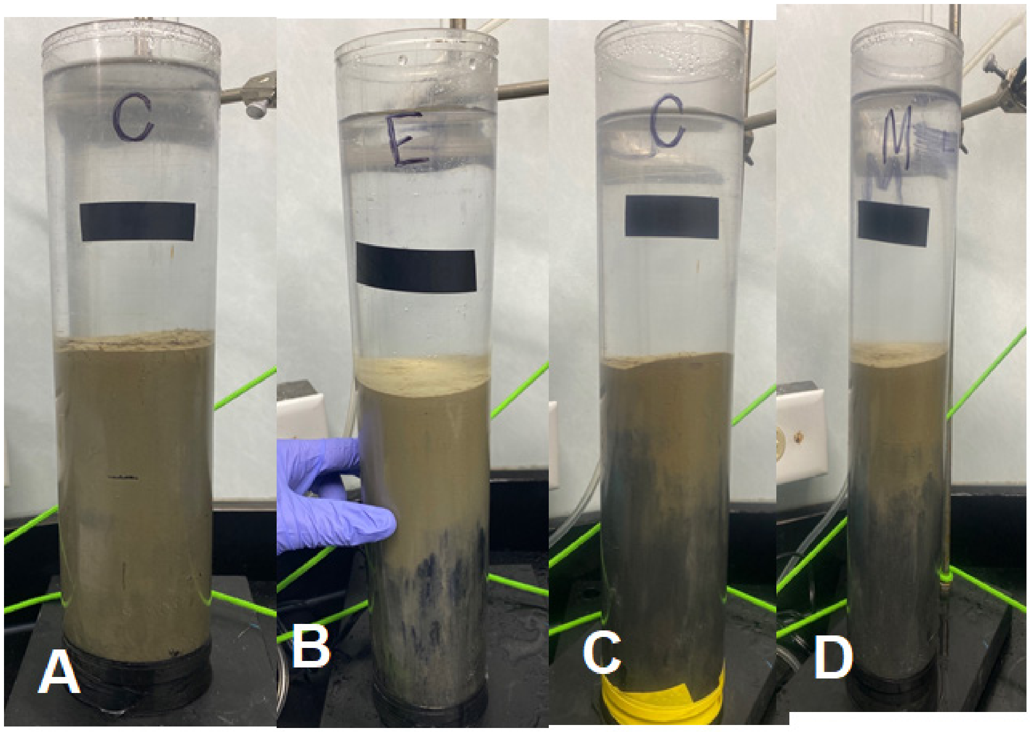

Figure 8-3: Representation cores from each sampling site, A) Joey's Gully, Core ID: JG-R30-2-C, B) Nackvak, Core ID: NF-BC1-E, C) Hebron away from cerianthids, Core ID: HF-R32-7-C, D) Hebron near cerianthids, Core ID: HF-R33-6-M)

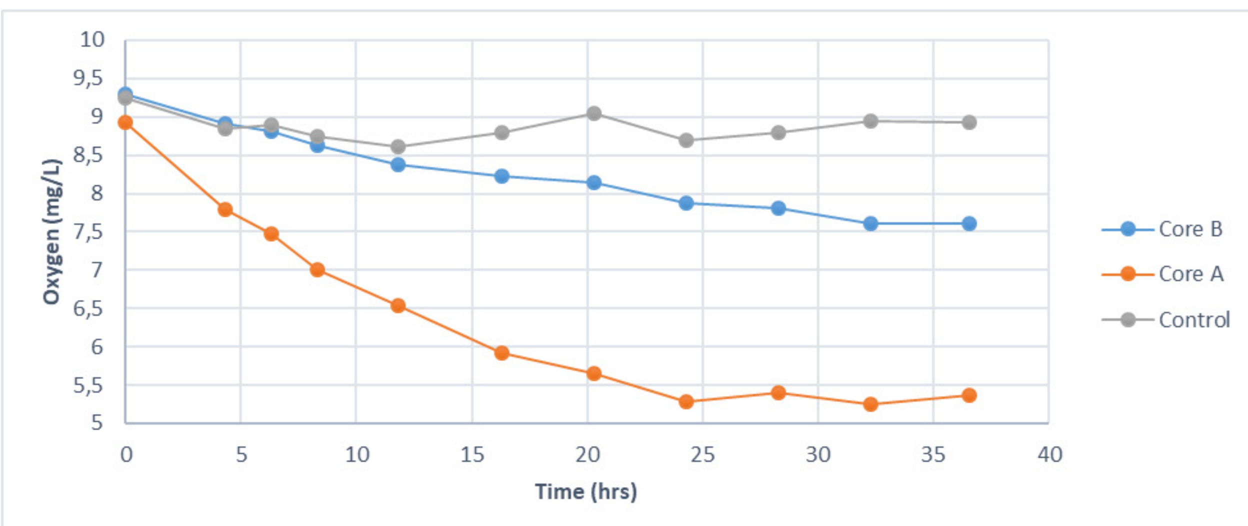

Figure 8-4: Oxygen concentrations over 36-hour flux experiments showing cores A, B and control. Core A contained a shrimp which was using oxygen and explains why oxygen concentrations decreased rapidly.

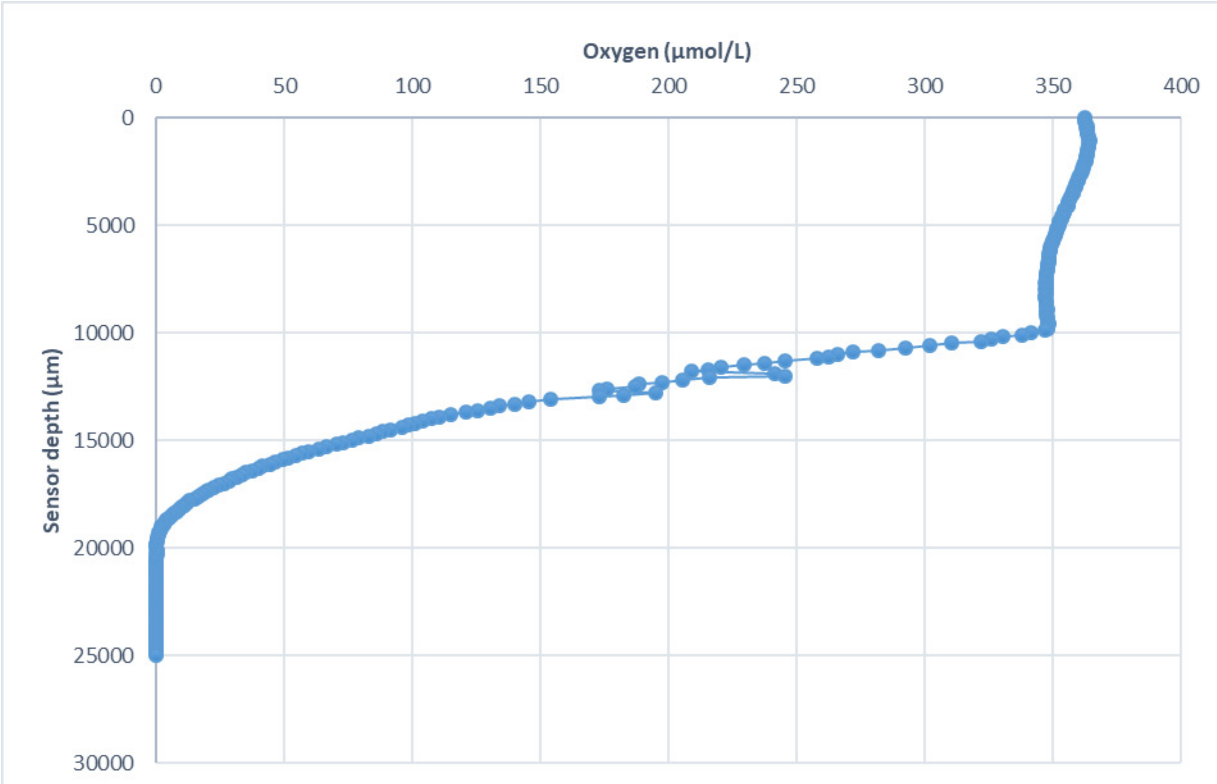

Figure 8-5: Oxygen concentrations decreasing with sensor depth during the microsensor analysis of core JG-R30-5-I. This core had evidence of bioturbation and or bioirrigation with oxygen spikes near 12500 µm in depth. Based on this profile, exponential decay seems to commence at a depth of 11300 µm suggesting the oxygen penetration depth is ~1cm into the sediment.

9 Microbial Baseline Characterization

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Cruise participants – Leg 1: Whitney England[1], Casey Hubert[1], Meng Ji[1]

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9.1 Introduction and Objectives

As climate change reduces the extent and duration of sea ice cover, shipping and industrial development in (sub)Arctic marine environments is expected to escalate, increasing the risk of oil and fuel spills in this extreme marine environment. Diesel re-supply to remote northern communities also poses a risk of spill that could affect the marine environment. Microorganisms indigenous to arctic marine environments are nature's 'first responders' to oil spills and some have the appropriate metabolic pathways to degrade toxic hydrocarbons into innocuous CO_2 (ZoBell 1946; Atlas 1981). Our sampling objective along the Nunatsiavut coast is to collect pristine seawater and sediment samples to establish microbiological baselines. Baseline data enhances the expedient understanding of the structure, diversity, and complexity of bacterial communities and their potential to respond to an oil spill (Angelova et al. 2021) or other environmental perturbations that would similarly provoke a re-organization of resident microbial communities. As such, understanding hydrocarbon-degrading populations within the marine microbiome is important with respect to (1) the potential that these microorganisms have to contribute to clean-up and mitigating the negative effects of oil spills, and (2) providing an environmental signature for the state of the ecosystem, i.e., the presence of or exposure to an input of hydrocarbons.

9.2 Methodology

9.2.1 *Water Sampling*

The *CCGS Amundsen* was equipped with a CTD-Rosette fitted with twenty-four 12L Niskin bottles (Figure 9-1A). Sensors on the CTD captured profiles of chlorophyll fluorescence, dissolved oxygen concentrations, water temperature, and salinity. Samples from the water column up to 4 depths were taken at 4 different sampling stations using the CTD-Rosette (Table 9-1). At each station, surface and bottom water were sampled, as well as an intermediate depth that was selected either above or below the pycno- or thermocline, where a change was evident from the CTD data. A surface pump was also deployed to collect true surface water in addition to the surface water from the Rosette, which corresponds to about 2 m below the sea surface. All samples were obtained in triplicate (i.e., three Niskin bottles from the Rosette were dedicated to each sampling depth, and the surface pump was used to fill three separate carboys).

Approximately 2 L of seawater was collected through milliQ rinsed tubing and stored in 5 L and 10 L milliQ rinsed carboys and filtered through 0.2 µm Pall membrane filters using a vacuum pump and Pall filtration manifold. At one station (Hopedale Saddle), an additional 6 L of true surface water and bottom water were sampled in triplicate and filtered to facilitate comparison of the biomass difference in volumes filtered (2 L vs 6 L) and whether or not this could impact possibilities for downstream analysis (e.g., sufficient yield of environmental DNA to allow microbial metagenomic sequencing). When filtration of the desired volume was complete, filters were folded using sterile forceps, placed into Whirl-Pak bags, and stored at -80°C for future microbial analyses. To preserve water for cell counting, 940 μL of each sample was placed into pre-measured 2 mL sterile plastic test tubes containing 60 μL of 37% formaldehyde. These samples for vortexed for 15 seconds and stored at 4°C for future cell counting.

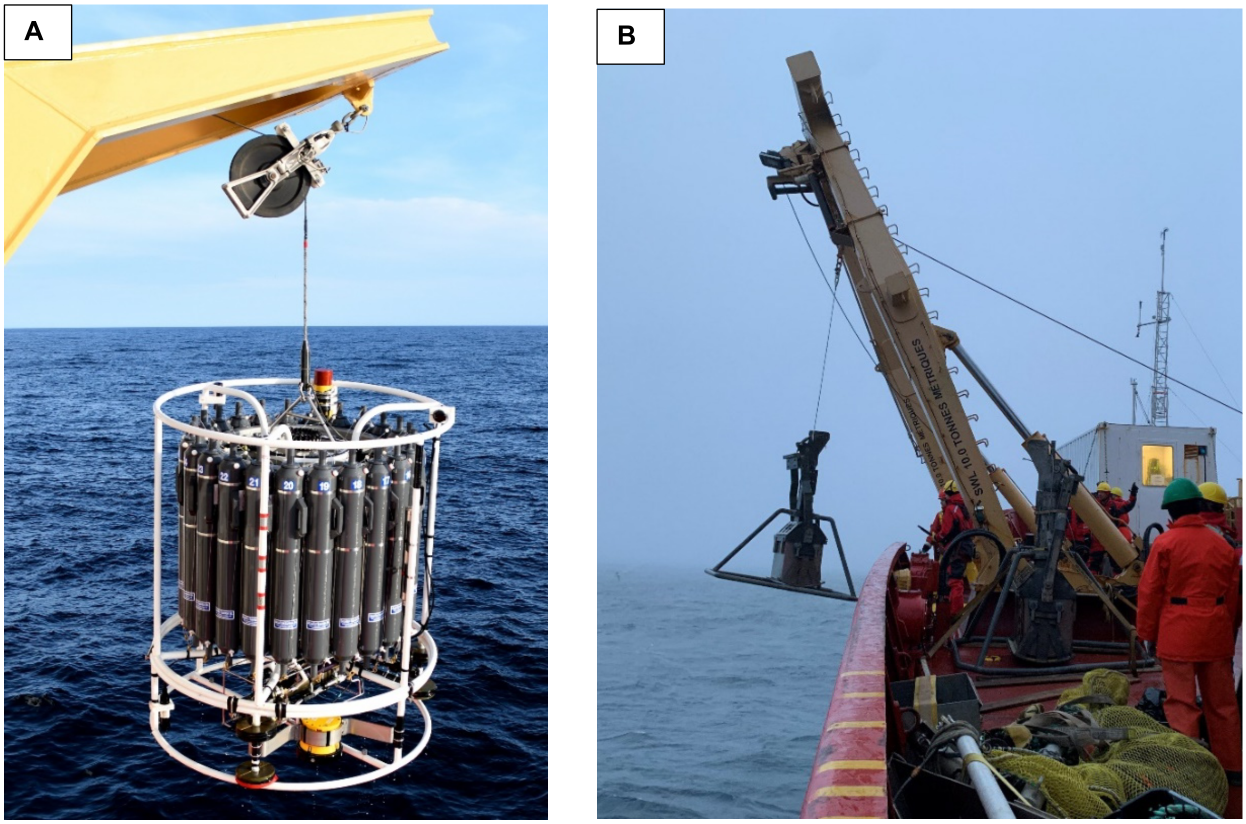

Figure 9-1: A) CTD-Rosette being deployed. B) Box core being retrieved

Table 9-1: Water samples collected using CTD-Rosette and surface pump.

Station	Date	Lat.	Long.	Station depth (m)	Cast	Depths sampled (m)	Analyses
Joey's Gully	Sep 13/22	54.574	-56.293	535	Surface pump	True surface	Microbial DNA, Cell counting
					CTD-Rosette	Rosette surface	
						201	
						531	
Hopedale Saddle	Sep 14/22	56.092	-57.421	510	Surface pump	True surface	Microbial DNA, Cell counting
					CTD-Rosette	Rosette surface	
						179	
						501	
Nachvak Fjord	Sep 16/22	59.077	-63.528	200	Surface pump	True surface	Microbial DNA, Cell counting
					CTD-Rosette	Rosette surface	
						70	
						192	
Hebron Fjord	Sep 17/22	58.149	-62.798	241	Surface pump	True surface	Microbial DNA, Cell counting
					CTD-Rosette	Rosette surface	
						50	
						230	
SagBank	Sep 20/22	59.3696	-60.293	521	Surface pump	True surface	Microbial DNA, Cell counting
					CTD-Rosette	Rosette surface	
						99	
						506	
Hi Bio A	Sep 20/22	60.472	-61.251	572	Surface pump	True surface	Microbial DNA
					CTD-Rosette	Rosette surface	Microbial DNA, Cell counting
						99	
						562	

9.2.2 *Box Cores*

Surface sediment was collected at six different stations with between one and three replicates per station using the box cores aboard the *Amundsen* (Figure 9-1B). Once the box core came back on deck, the overlying water was siphoned off and the surface sediment temperature was recorded. For each box core, ~1mL of surface sediment (0-5 cm bsf) was collected using cut-off 1mL syringes in triplicate into 2mL cryovials and frozen at -80°C for future microbial analyses (Table 9-2). ~200µL of surface sediment (0-1cmbsf) was collected in the same manner into pre-measured 2mL epitubes containing 1.8mL of 4% paraformaldehyde for cell counting. These samples were vortexed for 15 seconds and stored at 4°C for future cell counting. Triplicate collections of ca. 80-100 mL 'bulk' surface sediment (0-5cmbsf) were also collected into Whirl-Pak bags or sterile plastic 'pee cups' and stored at 4°C.

Replicate box core casts took place at three stations in Hebron Fjord. At Hebron Fjord Site 1, triplicate box cores were deployed to capture replication within short spatial distances. Mini triplicate push cores using 60 mL syringes were collected from the first box core and sectioned into 1.5 cm sections onto clean tin foil. Each section was homogenized using an ethanol-sterilized spatula and placed into 2 mL cryovials and stored at -80°C for future microbial analyses (Table 9-3). Duplicate box core casts took place at Hebron Fjord sites 2 and 3 (without sub-coring).

Table 9-2: Surface sediment samples collected from box cores.

Station	**Date**	**Box core cast**	**Depth (cmbsf)**	**Lat**	**Long**	**Station depth (m)**	**Analyses**
Joey's Gully	Sep 12/22	Box core 1	0-5	54.618	-56.445	359.22	Microbial DNA, Cell counting
Hopedale Saddle	Sep 14/22	Box core 1	0-5	56.066	-57.460	273.86	Microbial DNA, Cell counting
Nachvak Fjord	Sep 16/22	Box core 1	0-5	59.077	-63.528	204.12	Microbial DNA, Cell counting
Hebron Fjord	Sep 17/22	Box core 1	0-5	58.149	-62.777	254.17	Microbial DNA, Cell counting
Hebron Fjord	Sep 17/22	Box core 2	0-5	58.150	-62.776	254.07	Microbial DNA, Cell counting
Hebron Fjord	Sep 17/22	Box core 3	0-5	58.149	-62.777	254.28	Microbial DNA, Cell counting
Hebron Fjord 2	Sep 18/22	Box core 1	0-5	58.119	-63.001	130.45	Microbial DNA, Cell counting
Hebron Fjord 2	Sep 18/22	Box core 2	0-5	58.119	-63.002	130.1	Microbial DNA, Cell counting
Hebron Fjord 3	Sep 18/22	Box core 1	0-5	58.152	-62.650	224.88	Microbial DNA, Cell counting
Hebron Fjord 3	Sep 18/22	Box core 2	0-5	58.152	-62.650	225.16	Microbial DNA, Cell counting

Table 9-3: Sectioned push core samples obtained using a 60mL syringe from the three box cores at Hebron Fjord

Station	Date	Core Cast	Lat	Long	Seafloor depth (m)	Interval sampled (cmbsf)	Analysis
Hebron Fjord	Sep 17/22	Box core 1	58.149	-62.777	254.17	0-1.5	Microbial DNA
						1.5-3	
						3-4.5	
						4.5-6	
						6-7.5	
						7.5-9	
	Sep 17/22	Box core 2	58.1496	-62.776	254.07	0-1.5	
						1.5-3	
						3-4.5	
						4.5-6	
						6-7.5	
						7.5-9	
	Sep 18/22	Box core 3	58.1496	-62.776	254.28	0-1.5	
						1.5-3	
						3-4.5	
						4.5-6	
						6-7.5	
						7.5-9	

9.2.3 *Gravity Cores*

At Nachvak Fjord, three gravity cores were deployed to collect sub- to deep subsurface sediment (Figure 9-2) and each core was sectioned into 1.5 m sections using a handsaw. Approximately 2 mL of sediment was collected in triplicate from the ends of each section and stored at -80°C for future microbial analyses. Surface sediment was collected from the first two gravity cores whereas the third core was too wet to open the top, so only subsurface intervals were collected from gravity core 3 (Table 9-4).

Figure 9-2: Gravity core being deployed.

Table 9-4: Sediment samples from the gravity cores deployed in Nachvak Fjord.

Station	Date	Core Cast	Lat	Long	Seafloor depth (m)	Interval sampled (cmbsf)	Analysis
Nachvak Fjord	Sep 15/22	Gravity Core 1	59.1033	-63.416	214	0-5	Microbial DNA
						75-76	
						156-157	
						310-311	
						460.5-461.5	
	Sep 15/22	Gravity Core 2	59.1098	-63.43	137.78	0-5	
						185-186	
						336-337	
						494-495	
						660-661	
	Sep 16/22	Gravity Core 3	59.0955	-63.425	198.82	0-5	
						175-176	
						326-327	
						472-473	
						624-625	

9.2.4 *Methane sampling*

Water collected from the CTD-Rosette was preserved for methane analysis from 2 stations (Table 9-5). Tubing was attached to the spout of the Niskin bottle and inserted into a 50 mL glass serum bottle. Each serum bottle was rinsed with the sample water three times before filling to the top, ensuring no air bubbles are trapped inside. Once triplicate serum bottles were filled, samples were taken to the dedicated lab for mercury chloride ($HgCl_2$) poisoning. Each sample was spiked with 100 µL of $HgCl_2$ and capped with a Teflon rubber stopper and metal cap before being crimped closed and stored at 4°C in the dark. Methane measurements will be performed in collaboration with University of British Columbia.

Table 9-5: Water samples preserved for methane analysis.

Station	Date	Lat	Long	Station depth (m)	Cast	Depths sampled (m)	Analysis
SagBank	Sep 20/22	59.3696	-60.293	521	Rosette	2.092	Methane (CH_4)
						98.973	
						506.948	
Hi Bio A	Sep 20/22	60.472	-61.251	572	Rosette	1.749	
						99.055	
						562.948	

9.3 **Preliminary Results**

No analyses were conducted during Leg 1 of the *CCGS Amundsen* 2022 expedition.

9.4 **Recommendations**

The GPS positional beacon is particularly important when doing replicate box core casts. Unfortunately, the beacon was damaged at Hebron Fjord box core site 2. Having one or more back-up beacons is recommended. Alternatively, a GPS beacon could be attached semi-permanently to the box core frame (or to both of the frames). This is important for acquiring the precise location of where sediment is collected, especially when doing duplicate/triplicate box cores in the same area.

An autoclave on board would be useful for future work by microbiologists and other teams requiring clean, sterile conditions on a regular basis. This could potentially reduce the amount of equipment that needs to be brought on board, by allowing repeat cleaning and use of the same equipment. Autoclaves do not necessarily occupy a large footprint

9.5 **References**

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10 Demersal fish diversity (baited camera)

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Cruise participants – Leg 1: David Coté[1], Sheena Roul, Jessica Desforges[1], Rachel Forbes[2], and Jordan Sutton[1]

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Prepared by: Sheena Roul and Jessica Desforges

10.1 **Introduction and objectives**

Baited cameras are a useful tool to characterize benthic fish, fauna and habitat. During Leg 1 of the *Amundsen* expedition, the baited camera system was successfully deployed four times at three stations; Joey's Gully, Nachvak Fjord and Hebron Fjord (Table 10-1). The baited camera was used to meet the following objectives: 1. Expand coverage of previous Integrated Studies in the Coastal Labrador Ecosystem (ISICLE) and Integrated Studies and Ecosystem Characterization of the Labrador Sea Deep Ocean (ISECOLD) baited camera surveys (i.e. Clears Cove Pride 2017; Odyssey 2019; *Amundsen* 2020; What's Happening 2020; *Amundsen* 2021) in areas of interest such as Joey's Gully and fjords along the Labrador coast; and, 2. Collect pilot data on the inner Labrador Shelf to support the Imappivut marine planning initiative in collaboration with the Nunatsiavut Government.

10.2 **Methods**

The deep-sea camera system was comprised of two cameras (a Sony 4K camera and a SubC 1CAM Alpha), a SubC LED light and battery. This equipment was fixed to a frame equipped with an arm baited with 6 large squid (two of which were contained within a bait bag; Figure 10-1). In past deployments, the frame would tip over once settled onto the bottom due to the large amount of current or lateral pulling on the surface buoy. To help prevent this from happening this year, approximately 100 kg of large chain link was attached to the bottom four edges of the frame (Figure 10-1). We also opted to equip the frame with the SubC 1Cam Alpha in the later deployments as this would provide additional light and increase the amount of footage. On the first deployment, we also tested a new camera and battery from GroupB (Passive Video Basic Underwater Housing Kit #2 for GITUP camera); however, water entered the casing and the camera and battery were no longer functional.

The camera frame system was attached to a predetermined amount of rope using spliced eye-hooks and shackles. We used buoy lines 1.5-2 times the sample depth to accommodate strong currents and elevated sea states. Two methods were tested; the first using rope that was stored in garbage buckets, each bucket holding approximately 365 m of rope. Once this system was arranged, it was attached to a hauler system that consisted of a pulley on the A-frame and a hauler (capstan) drum and lowered from the vessel at ~30 m/min. A deckhand operated the hauler drum, while another kept the line in place on the drum. Two science staff fed rope from the buckets to feed the hauler drum, making sure the line was not coiled or kinked. Once the frame was on bottom, the rope was detached from the hauler drum and the remaining rope was payed out by hand. When the end of the rope was reached, a high-flyer with two large surface floats was attached using a shackle. The high-flyer was equipped with two strobe lights to help with camera recovery in poor weather conditions. The frame was left on the bottom for at least 3 hours; the Sony cam would have sufficient battery for the first 1.5 h, while the SubC 1Cam would last the duration of the deployment. The second deployment method used rope that was coiled in a “figure 8” pattern in tote boxes which were then positioned and secured next to the edge of the deck underneath the A-frame. The camera frame was attached to the rope on one end using a shackle and then lowered into the water using the A-frame and the sea-catch. Once the sea-catch was released, the frame was allowed to freely sink to the bottom, while the rope spooled from the boxes. Once the frame reached the bottom, the ship slowly backed away from the site to allow the remaining rope to spool overboard. As the last of the rope was payed out, the highflyer was positioned at the edge of the deck and thrown overboard. Both methods were effective, however the second method was much faster averaging 7 minutes for deployment compared to >1 hr for the first.

Once the camera was back on deck, the camera apparatus was rinsed with fresh water, removed from the frame, and taken to the foredeck lab to have the video footage from the Sony 4K camera and SubC camera downloaded and saved to an external hard drive. Since the SubC cam contained 3 hours of footage, it was necessary to immerse the camera in an ice water bath to prevent overheating while downloading. The memory on the SubC cam quickly became full, it was necessary to ensure that we cleared the memory on the camera once the footage was downloaded to have enough space for the next deployment. When the camera was retrieved at one station, the SubC lights were off which could either indicate a dead battery or that the memory on the camera was full and it powered off.

10.3 **Preliminary Results**

Of the five camera deployments, four were successful, but lighting issues prevented clear imagery for Nachvak and Hebron stations. Another challenge was the limited battery life of the Sony 4K camera (approximately 70-130 minutes). Despite this, four camera deployments were successful in capturing footage of both fish and invertebrates. The stations Joey’s Gully had higher abundance and diversity than the Fjord stations (Table 10-2).

At least one species of fish were identified at the cameras (Table 10-2; Figure 10-3) and other invertebrate taxa such as squid, shrimp, whelk, brittle stars, and anemones were also observed (Table 10-2; Figure 10-4).

Table 10-1: Metadata associated with drop camera stations for Leg 1 *Amundsen* expedition (2022).

Station ID	GPS Coordinates on Bottom (Start)	GPS Coordinates on Bottom (End)	Time Deployed (UTC)	Approximate Time on Bottom (min)	Approximate Bottom Depth (m)
Joey's Gully	54.5986023 -56.3207883	54.5987412 -56.3161233	09:23:25	384	567
Nachvak Fjord	59.0871175 -63.4853777	59.0880997 -63.4854858	09:39:57	288	205
Hebron Fjord	58.1488213 -62.7887330	58.1486770 -62.7863357	23:53:53	613	393
Hebron Fjord	58.1505670 -62.8783700	58.1519027 -62.8754352	03:00:51	840	216

Table 10-2: Biodiversity observed at baited camera stations for Leg 2 *Amundsen* expedition (2022).

Station ID	Bottom Type	Video Quality	Biological Productivity	Megafauna/flora observed
Joey's Gully	Mud	Good, cloudy at times due to high concentration of plankton, and frame moving through mud	High abundance of codfish and squid	Various jellyfish, shrimp, squid (07:50), Atlantic Cod, salp, anemone, isopod
Nachvak	Mud	Cloudy from mud and glare from light	High abundance of plankton	Various jellyfish, isopods, polychaete tubes
Hebron Fjord	Mud	Cloudy from mud and glare from light	High abundance of plankton	Various jellyfish, brittle stars, whelk, shrimp
Hebron Fjord	Mud	Cloudy from mud and glare from light	High abundance of plankton	Isopods

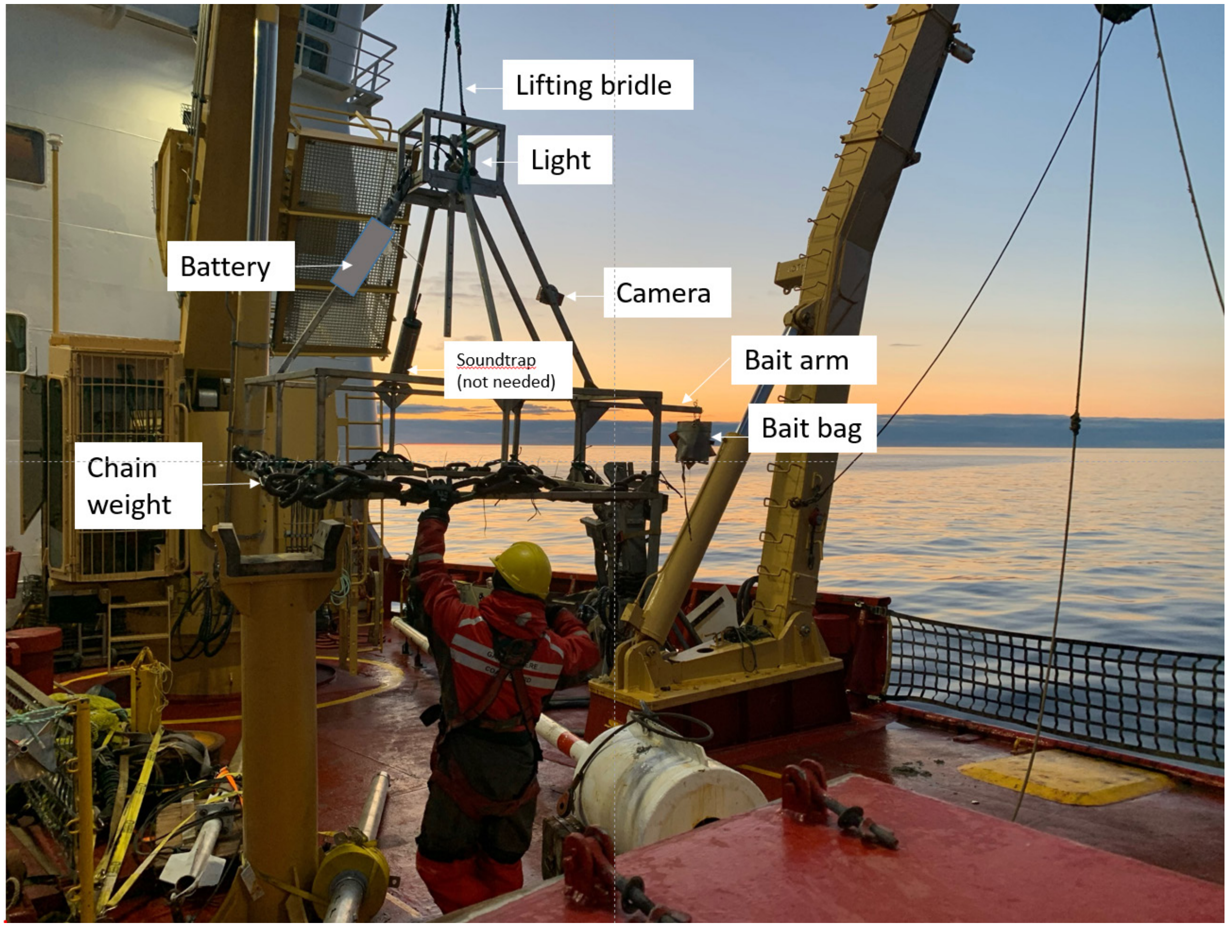

Figure 10-1: Baited camera configuration for Leg 1 *Amundsen* expedition (2022), without the SubC 1Cam Alpha and SoundTrap.

Figure 10-2: Baited camera equipped with both the Sony and 1Cam (mounted side by side near the bait arm). Chain was attached to the frame to stabilize it in the bottom and reduce drift, rope was coiled in figure 8 patterns in the boxes behind the frame. The 1Cam was connected to both the battery and the SubC light, attached on the top end of the frame.

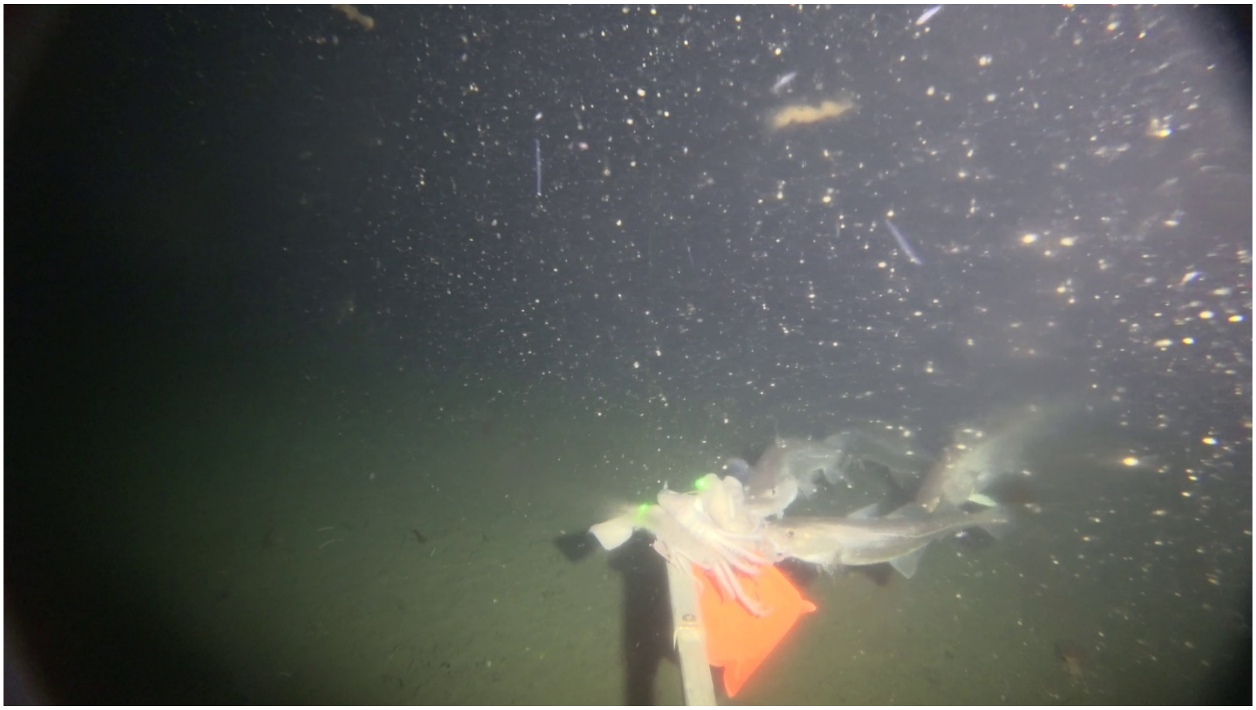

Figure 10-3: Photo capture of Atlantic cod visiting the baited camera.

Figure 10-4: Photo captures of squid at the baited camera.

11 Drop camera

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11.1 **Introduction**

Drop cameras are an efficient tool to characterize benthic fauna and habitat, particularly when sampling is not required. The drop camera was used in Leg 1 of 2022 to: 1) Extend the surveys of ISICLE stations and conduct preliminary exploration of the shelf near Joey's Gully, Hopedale Saddle, Nachvak Fjord, Hebron Fjord, Saglek Bank, and HiBios; and 2) Scout areas of interest for potential ROV dives.

11.2 **Methods**

The deep-sea camera system consisted of two cameras (a SubC deep-water camera and Sony 4K camera) and 2 x LED lights in GroupB underwater housings supplied with 4 x 3.7V 3200Mah 18650 lithium batteries. This equipment was fixed to a modified box-core frame (Figure 11-1). The modified box-corer apparatus containing the drop camera setup was initially attached to a winch cable system at our first station (Joey's Gully) and lowered from the vessel at 80 m/min. When the drop camera was within ~50 m from the last reported depth, it was lowered at 20 m/min until it touched bottom. Typically, the deckhand operating the winch would be able to determine if the camera was on bottom by using a tensiometer. However, the tensiometer and winch required calibration after refit and the frame was too light to change the tension on the cable when it reached bottom at 500 meter-deep stations. The HiPAP also required calibration and was reading different depths from both the bridge and the winch. It was therefore difficult to observe when the frame was actually on bottom and maneuver it as intended. Two GroupB lights were lost during this first deployment due to the dragging of the frame on the seafloor.

For the two following stations (Hopedale Saddle and Nachvak Fjord), we relied on 5/8" rope to deploy the drop camera since we could easily observe when the frame was on the sea floor from the slack in the rope. From thereon, a "yo-yo" method was employed whereby the camera would be raised ~1-2 m off the bottom (as measured by the length of rope retracted), and dropped on the bottom again, and this procedure was repeated for 30 minutes. Since there was stretch in the rope, a longer distance of rope had to be hauled in and payed out for the frame to detach from bottom and reach it again after hovering for 10-15 seconds. Consistency was maintained throughout the deployment by observing HiPAP readings and counting the rotations of the capstan as the rope was adjusted.

By the time we reached Hebron, the HiPAP and tensiometer had been calibrated so we attempted to rely on a combination of both of these tools to observe when the frame touched bottom. We opted to use the winch since these stations were only approximately 200 meters deep. For deeper stations, we recommend adding at least 400 lbs of weight to the frame to observe changes with the tensiometer. We knew the frame was on bottom when the HiPAP stopped reading a different depth value and the tension value from the cable was reduced by approximately 1/3-1/2 on the winch's tensionmeter. The winch system was the preferred method of deployment since it was ultimately more accurate and required less staff on deck to perform the operation successfully compared to the rope.

A record was kept of the time of the camera deployment, time on bottom, time removed from bottom, and time that the camera was lifted back on the deck. Once the camera was back on deck, the camera apparatus was rinsed with fresh water, removed from the box-core frame, and taken to the foredeck lab to have the video footage from both the SubC camera and the Sony 4K camera downloaded and saved to an external hard drive. Drop camera footage was also used to inform the suitability of bottom habitats for other sampling devices (e.g. box-corer, beam trawl, and ROV). A total of 10 drop camera deployments were conducted during Leg 1 of the 2022 *Amundsen* Expedition (Table 11-1).

All drops were successful in providing an understanding of the bottom conditions at each site (Table 11-2, Figure 11-2), though the first few drops during this trip may contain less usable footage since equipment involved in operations required calibration and the frame ended up drifting for some time. Biodiversity seemed highest at Hopedale Saddle, then Joey's Gully, followed by Hebron Fjord, and then Nachvak Fjord. Only one transect was obtained at Hopedale Saddle, at depths of approximately 550 m. This site had lots of zoanthids, corals (primarily soft, and branched), sponges, anemones, mysids, bryozoans, hydroids, and sea stars. In Joey's Gully, the Drop Cam was deployed at stations that were between 350-550 m deep. Here, we saw lots of shrimp, a snow crab, squat lobster, eel pout, squid, and other species of fish. The ROV dive further corroborates these data by identifying large schools of Atlantic Cod and an abundance of shrimp. We sampled 4 different sites in Hebron Fjord, both shallow (60 m) and deep (100-200 m), where we saw much more biodiversity in shallow waters. There was a large population of cerianthids, some brittle stars and larger sea stars, anemones, sponges, soft corals, shrimp, flat fish (possibly Greenland Halibut), worms, and crinoids. Hebron was markedly different than Nachvak Fjord, though we did not sample shallower sites in the latter. In Nachvak, the bottom was very silty and the vision was frequently obscured as the frame reached the sea floor. Here, we found some anemones, polychaete tubes, some whelks, and sea stars.

Figure 11-1: The drop camera system attached to a modified box-core frame utilized in Leg 1 of the 2022 *Amundsen* expedition.

Table 11-1: Metadata for drop camera stations of Leg 1, 2022.

Station ID	Lat Bottom Start	Long Bottom Start	Lat Bottom End	Long Bottom End	Date	Start time	Duration (minutes)	Avg Bottom Depth (m)
Joey's Gully 1	54.6178995	-56.4453420	54.6159957	-56.4463755	12-Sep-22	13:21	30	360
Joey's Gully 2	54.5868803	-56.3007303	54.5863757	-56.3012288	13-Sep-22	3:39	30	525
Hopedale Saddle 1	56.0257833	-57.4374648	56.0246507	-57.4270118	14-Sep-22	8:45	30	550
Nachvak Fjord 1	59.0760725	-63.5282477	59.0743145	-63.5254143	15-Sep-22	23:45	30	206
Nachvak Fjord 2	59.0744418	-63.4833430	59.0772775	-63.4795647	16-Sep-22	2:15	30	180
Nachvak Fjord 3	59.0909207	-63.4291022	59.0937132	-63.4285045	16-Sep-22	3:20	30	203
Hebron 1	58.1452728	-62.7427538	58.1464295	-62.7365230	17-Sep-22	19:49	30	254
Hebron 2	58.1341490	-62.9654582	58.1330562	-62.9691330	17-Sep-22	23:02	30	75
Hebron 3	58.1514053	-62.8768567	58.1497785	-62.8732717	18-Sep-22	3:20	30	216
Hebron 4	58.1374255	-62.9691580	58.1347708	-62.9656962	18-Sep-22	4:49	30	88

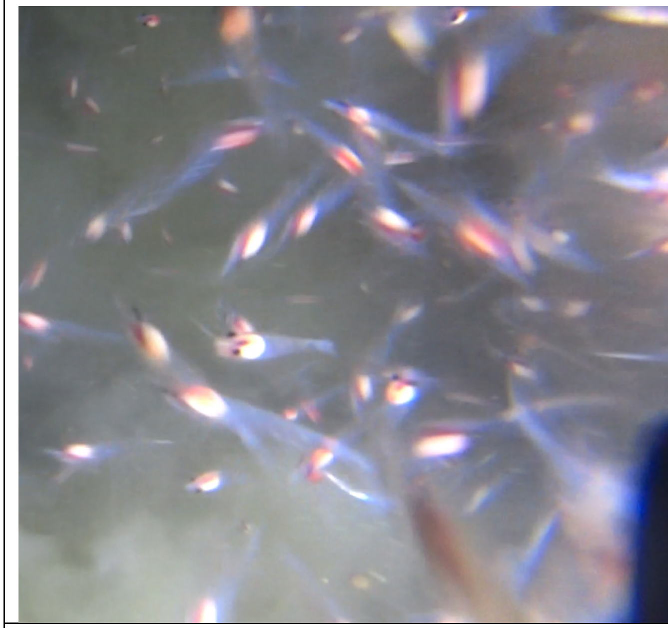
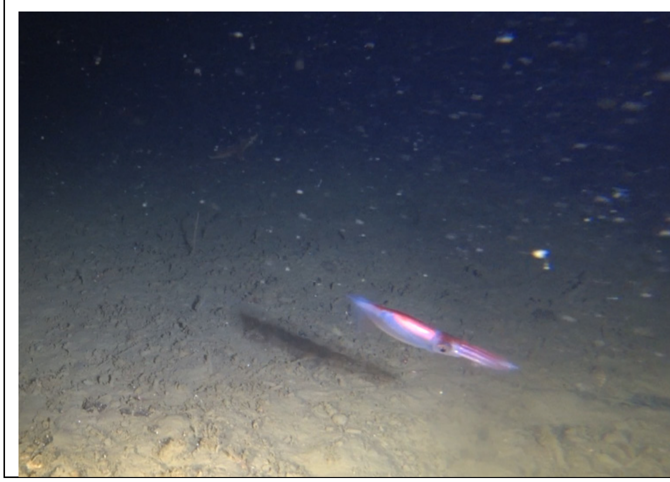
Table 11-2: General Description of Drop Camera Sampling Stations by Bottom Type, Video Quality, Biological Productivity, and Megafauna/flora observed from preliminary observation of Drop Camera Footage for Leg 1 of the 2022 *Amundsen* Expedition.

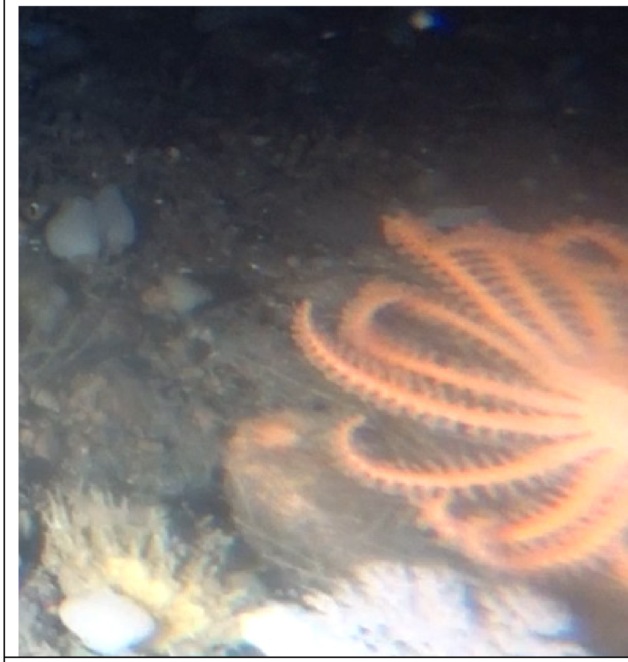
Station ID	**Bottom Type**	**Video Quality**	**Biological Productivity**	**Megafauna/flora observed**
Joey's Gully 1	Muddy/silty bottom	Low-Medium, lost the lights due to drag at the end of the video.	High productivity area, lots of shrimp and anemones.	Soft coral (-12:25), Venus flytrap anemones, snow crab and pout (-15 :02), redfish, lots of shrimp
Joey's Gully 2	Muddy/silty bottom	Low, dragged bottom.	Not as productive as Joey's Gully 1.	Shrimp, some anemones. More sparse than Joey's Gully 1.
Hopedale Saddle 1	Boulder, cobble, gravel, shell hash bottom, transitioning to small cobble with mud	Good	Very high for echinoderms such as brittle stars, sea cucumbers and sea urchins. Lots of sponges, corals. Shrimp, myctophids. High amount of epifauna	Sea cucumber, sea lilies, brittle stars, urchins, anemones, myctophiids as the camera reaches bottom, zoanthids, soft corals, cauliflower corals, branching corals, polychaete tubes, whelks, large sponges, branching corals, squat lobster
Nachvak 1	Mud and silt, occasional boulders	Low-Medium, lots of shots of water and no sea floor due to excessive lifting with the rope in attempt to prevent hitting bottom. Sediment obscures vision when frame lands	Muddy, relatively low biodiversity	Polychaetes, many isopods, some anemones, sea stars, and polychaete tubes.
Nachvak 2	Mud and silt, occasional boulders	Good, sediment occasionally obscures vision. Still too much time above the seafloor	Relatively low biodiversity	Anemones, polychaetes, isopods, sea stars, relatively low biodiversity.
Nachvak 3	Mud and silt, occasional boulders	Good visibility except when obscured by silt, still too much time above the sea floor but no dragging.	Lots of sea stars, some shrimp. Very little epifauna	Sea stars, anemones, flat fish. Cerianthids.
Hebron 1	Mud with sparse boulders, transitioning to boulder fields with mud	Video obscured at times by sediment, but otherwise good. Lost one Sony file	Lots of plankton and jellies on the way down, some epifauna.	Jelly fish, some shrimp. Isopods, small sponges, scallops, anemones, brittle stars,

Station ID	Bottom Type	Video Quality	Biological Productivity	Megafauna/flora observed
		during download process (corrupt).		
Hebron 2	Combination of mud, silt, cobble and some larger rocks.	Great.	Decent amount of epifauna, lots of pelagic species on the way down.	Brittle stars, other species of sea stars, myctophids, sponges, corals, anemones, scallops, shrimp, snails, crynoids
Hebron 3	Mud and silt with occasional boulders and cobble.	Great, though sediment sometimes obscures view	Decent amount of epifauna, lots of pelagic species on the way down.	Cerianthid field, isopods, polychaete tubes, anemones, whelk, large unidentified orange worm, eel pout, shrimp, other small fishes, flat fish (5:31)
Hebron 4	Mud and silt with occasional boulders and cobble.	Great, though dragged a bit for a portion of the drop since we were going upslope.	Decent amount of epifauna, lots of pelagic species on the way down.	Cerianthid field, brittle stars, anemones, scallops, large orange sea star, large cerianthids, myctophids, shrimp, isopods, jellies

Table 11-3: Examples of fauna and substrates observed with the drop camera on Leg 1 of the 2022 *Amundsen* expedition.

Joey's Gully, Drop 1 (Sony Cam). Snow crab and pout.

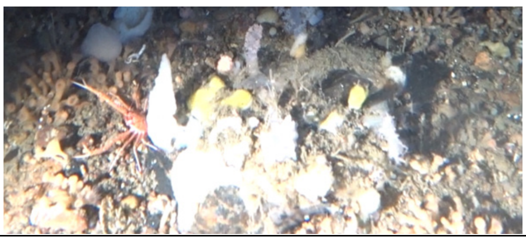
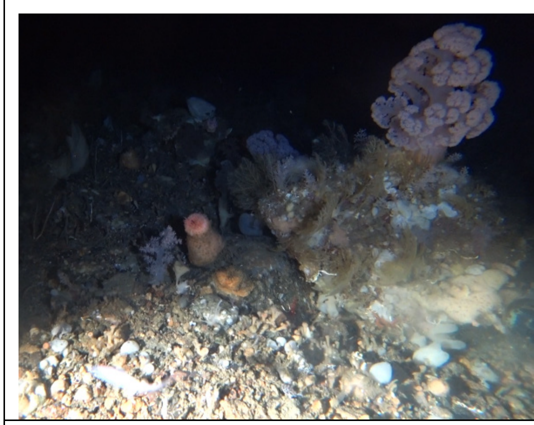
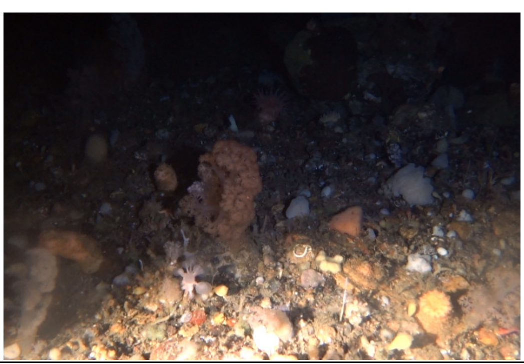
	Joey’s Gully, Drop 1 (Sony Cam). Krill.
	Joey’s Gully, Drop 2 (Sony Cam). Squid.

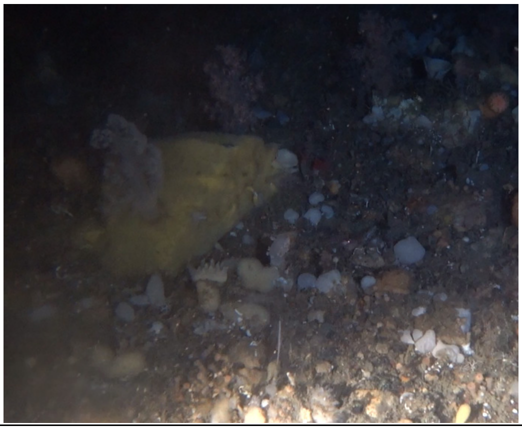


Hopedale Saddle, Drop1. *Brisingiidae* sea star.

Hopedale Saddle, Drop 1, Sony cam. Soft coral and sponge

Hopedale Saddle, Drop 1, Sony cam. Soft coral, sponges, anemones

	Hopedale Saddle, Drop 1, Sony cam. Soft coral, sponges, anemones, zoanthids
	Hopedale Saddle, Drop 1, Sony cam. Squat lobster
	Hopedale Saddle, Drop 1, Sony cam. Cauliflower (*Duva*), anemone, zoanthids.
	Hopedale Saddle, Drop 1, Sony cam. Soft corals, zoanthids, unidentified translucent coral, sponges, anemones.

	Hopedale Saddle, Drop 1, Sony cam. Sponge and soft corals.
	Nachvak, Drop 2, Sony cam. Isopod and anemone.


Hebron, Drop 3. One cam and Sony cam. Unidentified worm.

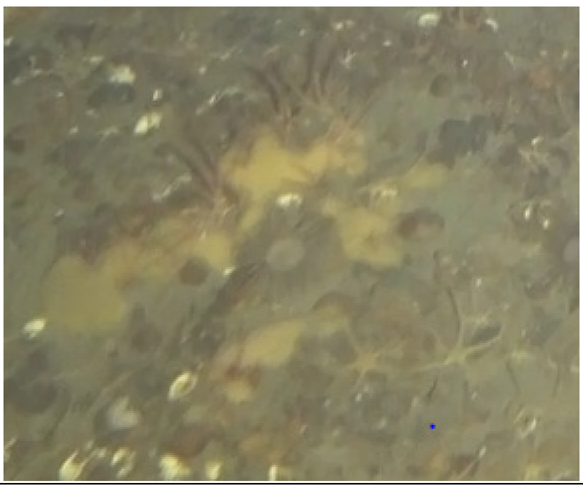
Nachvak, Drop 3. Sony cam. Anemone.

Nachvak, Drop 3, Sony cam. Shrimp, anemone.

Hebron, Drop 1, Sony Cam. Brittle star, gastropod, polychaete tubes, and cerianthids.

Hebron, Drop 1, Sony Cam. Brittle stars, polychaete tubes, urchins, small sponges.

	Hebron, Drop 1, Sony cam. Liparid fish.
	Hebron, Drop 1, Sony cam, pout.
 	Hebron, Drop 2, Sony cam. Anemones, soft corals, scallops, brittle stars, crinoids

	Hebron, Drop cam 2, Sony cam. Scallop and brittle stars.
	Hebron, Drop Cam 2, Sony cam. Sponge, brittle stars, anemone
	Hebron, Drop Cam 3, Sony Cam. Cerianthid field.

	Hebron, Drop 3, Sony cam. Cerianthid, isopod, anemone.
	Hebron, Drop 3, Sony cam. Whelk carrying an anemone.
	Hebron, Drop 3, Sony Cam. Gastropod and possible sponge.
	Hebron, Drop 3, Sony Cam. Daubed Shanny.

	Hebron, Drop 4, Sony cam. Cerianthid field, brittle stars, anemones, scallops
	Hebron, Drop 4, Sony cam. Sea stars, crinoids, brittle stars

12 Benthic and Pelagic Community Characterization from eDNA Water Samples

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Cruise participants – Leg 1: David Coté[1], Sheena Roul[1], Jessica Desforges[1]

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Prepared by: Sheena Roul

12.1 **Introduction**

Environmental DNA is an emerging scientific tool that uses DNA fragments shed from animals into the water column to characterize biotic community composition. Multicellular organisms constantly shed cells containing DNA into their environment (skin cells, feathers, hair, feces, urine, saliva, etc.) which can be collected for analysis. The technique has promise as a noninvasive approach that is complementary to other conventional methods, particularly in remote marine areas where specimens are very difficult to collect. The Leg 1 *Amundsen* mission had two primary objectives:

1) Extend previous collections of eDNA in coastal and shelf areas of the Labrador Sea; and
2) Evaluate the benefits of filtering large volumes of water for assessing biodiversity.

12.2 **Methods**

To characterize benthic and pelagic faunal communities, sea water was collected at most stations (Table 12-1) using the CTD-Rosette water sampling system comprised of twenty-four 12 L Niskin bottles. Samples were collected from the ocean surface (2 m) and bottom. These depths were selected to match other sampling activities that could be used to validate and compare results such as the Hydrobios and IKMT nets.

Prior to the CTD-Rosette deployment, the inside and upper and lower lids of the Niskin bottles were sprayed with a 10% bleach solution. Niskins were also rinsed with distilled water after waiting 10 minutes and closed until deployment to prevent contamination. During deployment, the CTD-Rosette was lowered from the vessel on a winch system. Niskins remained open during down-cast and were closed at programmed depths during up-cast to collect water samples. The CTD-Rosette stopped at each sampling depth for 1 minute prior to Niskins closing to ensure Niskins contained water of the desired depth.

The CTD-Rosette was brought back on board the vessel and eDNA water sampling took place prior to any other water collection activities to prevent accidental contamination by other study team members. Latex gloves were used to collect three 1.5 L replicate samples from each collection depth in pre-labeled sterile 2 L Whirl-pak bags and one 24 L (triplicates at HiBioA) sample from the bottom depth in a sterile capped container. The 24 L sample was collected to compare the results obtained from large volumes compared to typical sample volumes (Objective 2). Filled Whirlpak bags were placed in sterilized containers that were decontaminated with 10% bleach solution prior to sampling.

Prior to sample filtering, the work space was decontaminated and a sample blank was prepared and filtered using 1.5 L of distilled water and a 4 head peristaltic pump. Once the blank was completed, the triplicate and 24 L samples from each depth were filtered using sterile and/or DNA-free-single-use consumables in sealed packaging. When water samples were filtered, filters were placed in individual whirl-pak bags and then stored at -20°C.Frozen samples will be sent to the Centre for Environmental Genomics Applications (CEGA) for analysis. The resulting data will augment pelagic and benthic community characterization data collected with conventional methods.

Table 12-1. List of Rosette Stations for eDNA Water Sampling for Leg 1 of the 2022 *Amundsen* Expedition.

Station Name	**Station Date (UTC)**	**Start, Bottom, and End Time (UTC)**	**Start Position**	**Bottom position**	**End position**	**Station Depth (m)**	**Depths sampled (m)**
Joey's Gully	2022/09/13	13:18:57 13:36:43 14:15:26	54.5741695 -56.2927048	54.5732743 -56.2930133	54.5704202 -56.2951015	543	Surface (2) and bottom (543)
Hopedale Saddle	2022/09/14	19:37:48 19:52:25 20:46:40	56.0933343 -57.4183607	56.0918918 -57.4206953	56.0912330 -57.4359883	365	Surface (2) and bottom (365)
Nachvak Fjord	2022/09/16	03:40:37 03:50:20 04:17:49	59.0763160 -63.5280987	59.0769572 -63.5284293	59.0769965 -63.5269827	205	Surface (2) and bottom (205)
Hebron Fjord	2022/09/17	22:08:22 22:18:56 22:53:06	58.1502855 -62.7998103	58.1498568 -62.7996545	58.1488952 -62.7979480	239	Surface (2) and bottom (239)
Sagbank	2022/09/20	10:12:13 10:34:48 11:12:36	59.3715023 -60.2971968	59.3696195 -60.2926923	59.3651817 -60.2811473	517	Surface (2) and bottom (517)

13 Characterizing nanoparticles in multiple environmental components

Project leaders: Julien Gigault[1] (email@email.ca) and Philippe Archambault[1] (email@email.ca)

Cruise participants – Leg 1 : Charlotte Carrier-Belleau[1]

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13.1 Introduction and Objectives

Microparticles (< 5mm) have been identified in Arctic ecosystems but only represent a small fraction of debris and their degradation can reach the nanometre, nanoparticles (NP, < 1 micron). Data regarding the abundance and distribution of NP in Nordic and Arctic ecosystems has been identified as a priority in these environments. Moreover, there is no available data regarding the tendency of NP to accumulate in different biological or physical compartment of marine ecosystems. The main objective of this research is to characterize NP (size, type, shape) in different biological (microphytobenthos, benthic organisms, zooplankton) and physical (sediments, surface water) compartments along the coast of Labrador and in Baffin Bay. This will provide the first data regarding NP distribution in this region and represents the first study attempting to characterize NP in multiple environmental compartments.

13.2 Methodology

Surface water (with rosette and surface pump), sediments and benthic organisms were collected throughout this mission (Table 13-1). Surface water was collected using the surface pump (Joey's Gully) or the Rosette (Hopedale Saddle, Hebron, Nachvak) at the different stations. 1 L plastic bottles were rinsed three times with surface water, filled and placed in the refrigerated back laboratory in a dark cooler to avoid phytoplankton growth.

Sediments and benthic organisms were collected using the box core. Only plastic tools were used to avoid any metal contamination. Benthic organisms included brittle stars, sponges, bivalves and urchins. Sediment samples (x4) were also collected for nanoparticles and pigments analysis (chlorophyll a, phaeopigments) to characterize microphytobenthos standing mass. Samples were collected using 10 mL cut-off syringes. All sample were frozen at -80°C for subsequent analysis.

Back at Laval University, samples will be lyophilized, digested and NP will be characterized by pyrolysis coupled with gas chromatography and a mass spectrometer coupled with and induced plasma to identify the nature a particle and for the determination of associated metals. Pigment concentrations will be analyzed by fluorescence.

Table 13-1: List of stations with operations and sampling

Station	Date	Position	Benthic organisms	Sediments	Zooplankton	Surface water
Joey's Gully	2022/09/13	54.5741695 -56.2927048	X	X		X
Hopedale Saddle	2022/09/14	56.0933343 -57.4183607	X	X		X
Nachvak Fjord	2022/09/16	59.0763160 -63.5280987	X	X	X	X
Hebron Fjord	2022/09/20	58.1502855 -62.7998103	X	X	X	X

13.3 **Preliminary Results**

No analyses were conducted on board during Leg 1 of the *CCGS Amundsen* 2022 expedition.

13.4 **Recommendations**

Having Nunatsiavut representation (Michelle and Carla) was an extremely positive experience for me. It was great to benefit from their knowledge and their experience, learn more about Nunatsiavut and have their input on project co-construction.

14 Carbon Exchange Dynamics, Air-Surface Fluxes and Surface Climate

Project leaders: Brent Else[1] (belse@ucalgary.ca), Tim Papakyriakou[2], Lisa Miller

Cruise participants – Leg 1 & 2: Gina Nickoloff[1]

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14.1 **Introduction and Objectives**

Oceanic uptake of atmospheric CO_2 has been the largest sink of anthropogenic emissions, and is responsible for mitigating atmospheric CO_2 by one third, greatly reducing climate impacts. Ocean carbon storage is vulnerable to the impacts of climate change, particularly in rapidly-changing polar seas. Arctic ocean warming, stratification, altered primary production and diminishing sea ice and changes to freshwater cycles all impact CO_2 uptake, yet the magnitude and direction of these changes, and their cumulative impact on air-sea fluxes is largely unknown. Further, these factors are causing acute ocean acidification of the Arctic surface layer, impacting carbon cycling. High-resolution surface pCO_2 datasets on a multi-year time-scale will improve current estimates of Arctic Ocean carbon storage potential and provide insight into physical, chemical, and biological processes impacting pCO_2.

Specific objectives of this research include:

- Develop a process-level understanding of the exchange of CO_2 between the sea surface and atmosphere.
- Continue a long-term monitoring program to understand how the Arctic marine CO_2 sink may be evolving as a result of climate change.
- Identify areas at-risk for anthropogenically-induced ocean acidification, and collect long-term data to track rates of ocean acidification in the Arctic.

14.2 **Methodology**

Multiple observation platforms have been utilized throughout the cruise to collect data pertaining to the atmosphere and surface ocean, including as a meteorological tower on the ship's foredeck, an underway pCO_2 system in the engine room. Table 14-1 lists the variables that are monitored, the location where the sensor is installed, the purpose for each variable, along with the sampling and averaging frequency (if applicable).

Table 14-1: Summary of variable inventory and application.

Variable	Instrumentation	Location	Purpose	Sample/Average Frequency
Air temperature (Ta)	HMP155A	foredeck tower	meteorological parameter	1 / 60 seconds
relative humidity (RH)	HMP155A	foredeck tower	meteorological parameter	1 / 60 seconds
wind speed (ws-2D)	RM Young 05106-10	foredeck tower	meteorological parameter	1 / 60 seconds
wind direction (wd- polar)	RM Young 05106-10	foredeck tower	meteorological parameter	1 / 60 seconds
water surface temperature	Apogee SI-111	foredeck starboard side	meteorological parameter	1 / 60 seconds
barometric pressure (Patm)	RM Young 61302V	foredeck tower	meteorological parameter	1 / 60 seconds
upper sea water temperature (Tsw)	General Oceanics 8050 *p*CO2	under-way system, foreward engine room	air-sea flux and ancillary information	1 / 3 minutes
sea water salinity (S)	General Oceanics 8050 *p*CO2	under-way system, foreward engine room	air-sea flux and ancillary information	1 / 3 minutes
dissolved CO2 in seawater	General Oceanics 8050 *p*CO2	under-way system, foreward engine room	air-sea flux and ancillary information	1 / 3 minutes
pH	General Oceanics 8050 *p*CO2	under-way system, foreward engine room	air-sea flux and ancillary information	1 / 3 minutes
dissolved O2 in seawater	General Oceanics 8050 *p*CO2	under-way system, foreward engine room	air-sea flux and ancillary information	1 / 3 minutes

14.2.1 Micrometeorology Tower

The micrometeorological tower located on the front deck of the *Amundsen* (Figure 14-1) provides continuous monitoring of meteorological variables. This year, the tower consisted of slow response sensors to record bulk meteorological conditions (air temperature, humidity, wind speed/direction, surface temperature, barometric pressure). The pressure sensor appeared to be recording artificially high values. All data was logged to a model CR1000 datalogger. The data logger was synchronized to UTC time using the ship's GPS system as a reference.

Figure 14-1. Micrometeorology tower

14.2.2 *Underway pCO2 System*

A General Oceanics 8050 pCO_2 system (Figure 14-2) was installed on the ship to measure dissolved CO_2 within the upper 7 m of the sea surface in near real time. The system is located in the engine room of the *Amundsen*, and draws sample water from the ship's clean water intake. The water is passed into a sealed container through a shower head, maintaining a constant headspace. This set up allows the air in the headspace to come into equilibrium with the CO_2 concentration of the seawater, and the air is then cycled from the container into an LI-7000 gas analyzer in a closed loop. A temperature probe is located in the equilibrator to provide the equilibration temperature. The system also passes subsample of the water stream through an Idronaut Ocean Seven CTD, which measures temperature, conductivity, pressure, dissolved oxygen, pH and redox, though water was not running through the CTD for a portion of the Leg due to insufficient water flow to equilibrator. All data is sent directly to a computer using software customized to the instrument. The LI-7000 gas analyzer is calibrated daily using ultra-high purity N_2 as a zero gas, and three gases of known CO_2 concentration as span gas. Spanning of the H_2O sensor is not necessary because a condenser removes H_2O from the air stream before passing into the sample cell.

Figure 14-2. General Oceanics 8050 pCO_2 system

14.2.3 Water Sampling

Leg 1

Discrete samples for Dissolved Inorganic Carbon (DIC)/Total Alkalinity (TA), and ^{18}O were taken from the rosette. DIC/TA samples were taken at standard depths following the protocol developed by Dickson *et al* (2007). Samples will be analyzed at the Institute of Ocean Sciences. O18 samples were taken at standard depths in 2 mL bottles and stored at 4°C. Samples will be analyzed at the University of Calgary. Stations sampled included Joey's Gully, Hopedale Saddle, Nachvak fjord, Hebron Fjord, SagBank and HiBio-A. Standard sampling depths: Bottom, 400 m, 250 m, 200 m, 150 m, 100 m, 70 m, 50 m, 30 m, 20 m, 7 m, Surface. 7 m samples were taken for comparison to underway data where seawater intake is at ~7 m.

Leg 2

Discrete samples for Dissolved Inorganic Carbon (DIC)/Total Alkalinity (TA), and ^{18}O were taken from the rosette. DIC/TA samples were taken at standard depths following the protocol developed by Dickson *et al* (2007). Samples will be analyzed at the Institute of Ocean Sciences. O18 samples were taken at standard depths in 2 mL bottles and stored at 4°C. Samples will be analyzed at the University of Calgary. Stations sampled at standard depths: 324_South, 323_East, 102_South, 105, 108, 115, 111, 353, 355, 356. 200 m and 250 m samples were excluded at station 356 due to limited bottle inventories. Stations sampled at 7 m and surface: 107, 110, 116, 113, 354. Standard sampling depths: Bottom, 600 m, 400 m, 250 m, 200 m, 150 m, 100 m, 70 m, 50 m, 30 m, 20 m, 7 m, Surface. 7 m samples were taken for comparison to underway data where seawater intake is at ~7 m. An intercalibration cast with the KEBABB team was performed at station A4 where depths bottom, 700 m, 500 m, 200 m, 150 m, 100 m, 80 m, 60 m, 50 m, 40 m, SCM, 7 m, and surface were sampled. 7 m samples were collected at KEBABB stations where this depth was not sampled: A1, A2, A3, A5, 196 and 198.

14.3 **Recommendations**

Leg 1

Cruise participation and steering by Michelle and Carla, representing Nunatsiavut, was an extremely positive and beneficial experience. Their knowledge and ideas greatly improved our science and gave context to the area and the people who benefit from these missions. In addition, our visit to Hebron fjord was an invaluable educational experience about the history of the area, was a great privilege, and was uniquely possible due to Carla and Michelle's steering of this mission. Having Inuit representation both on board and involved in the planning of future *Amundsen* cruises will greatly improve our science and its relevance to Northern communities, and should be a priority.

Leg 2

During this leg there were substantial issues with the underway system. Minor leaks were caused by rubbing of the LICOR's support structure on the plastic tubing entering the LICOR which occurs during upwards and downwards movement of the LICOR box in order to view the LICOR screen.

These minor leaks may have causes minor upward drift/inflation of pCO_2 data during this cruise, however this was not discovered until October 8th when leak was noticed. To rectify this, the impacted tubing was removed and the support structure was covered with tape to minimize rubbing. During this repair the scrubber was exposed to engine room air and became saturated and rendered un-usable for the remainder of the cruise. Future cruise packing should include back-up scrubber in case of such incidence. N_2 use as a zero was attempted to solve for the destroyed scrubber, however due to constant flow needed for this method the tank ran out ~24 hours after installation, operating from Oct 10 to Oct 11. Finally, the evening of Oct 11, the method of LICOR analysis was changed to "estimated" to remove the need of a zero and the machine was again operable. As a result of these events much of the data collected between Oct 8 to 11th will not be usable. See 'Underway Deployment Notes 2022' for detailed explanation of repairs and data usability.

14.4 **References**

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15 Marine productivity: Carbon and nutrients fluxes

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Cruise participants – Leg 2 : Jonathan Gagnon[1], Gabrièle Deslongchamps[1]

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15.1 **Introduction and Objectives**

The Arctic climate displays high inter-annual variability and decadal oscillations that modulate growth conditions for marine primary producers. Much deeper perturbations recently became evident in conjunction with globally rising CO_2 levels and temperatures (IPCC 2007). Environmental changes already observed include a decline in the volume and extent of the sea-ice cover (Johannessen et al. 1999, Comiso et al. 2008), an advance in the melt period (Overpeck et al. 1997, Comiso 2006), and an increase in river discharge to the Arctic Ocean (Peterson et al. 2002, McClelland et al. 2006) due to increasing precipitation and terrestrial ice melt (Peterson et al. 2006). Consequently a longer ice-free season was observed in both Arctic (Laxon et al. 2003) and subarctic (Stabeno & Overland 2001) environments. These changes entail a longer growth season associated with a greater penetration of light into surface waters, which is expected to favoring phytoplankton production (Rysgaard et al. 1999), food web productivity and CO_2 drawdown by the ocean. However, phytoplankton productivity is likely to be limited by light but also by allochtonous nitrogen availability. The supply of allochtonous nitrogen is influenced by climate-driven processes, mainly the large-scale circulation, river discharge, upwelling and regional mixing processes. In the global change context, it appears crucial to improve the knowledge of the environmental processes (i.e. mainly light and nutrient availability) interacting to control phytoplankton productivity in the Canadian Arctic. Also, changes in fatty acid proportions and concentrations will reflect shifts in phytoplankton dynamics including species composition and size structure, and will reveal changes in marine energy pathways and ecosystem stability.

15.2 **Methodology**

Samples for inorganic nutrients (ammonium, nitrite, nitrate, orthophosphate and orthosilicic acid) were taken at all stations (Table 15-1) to establish detailed vertical profiles. Samples were stored at 4°C in the dark and analyzed for nitrate, nitrite, orthophosphate and orthosilicic acid within a few hours on a Bran+Luebbe AutoAnalyzer 3 using standard colorimetric methods adapted for the analyzer (Grasshoff et al. 1999). Additional samples for ammonium determination were taken and processed immediately after collection using the fluorometric method of Holmes et al. (1999).

In order to examine the potential effects of environmental conditions on energy transfer through food chain, we also realized at targeted stations, filtrations with surface and SCM water to analyse the lipids composition, which is the densest form of energy, in particulate organic matter. At those stations, we also did additional filtrations for POC/PN, DON, POP, BSi, isotopic natural abundance of particulate matter, taxonomy and isotopes of nitrate.

15.3 **Preliminary Results**

No preliminary results available yet.

15.4 **Recommendations**

Again, this year, we realized that there were discrepancies between our database and Amundsen Science's for the name and locations of some stations (Hudson Strait) and also for the station type (CTD vs NUTS). We are willing to share our database metadata for inter-comparison.

15.5 **References**

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Stabeno & Overland (2001) EOS 82:317–321

Table 15-1. List of sampling stations and measurements during leg 2 2022

Stations	Nutrients	Nitrate isotopes	Ammonium	Stable isotopes	DOC/DON	POC/PN	BSi/POP	Fatty Acids	Total Lipids	Taxonomy	Chlorophyll
A1	X	X	X	X	X	X	X	X	X	X	X
A2	X	X									
A3	X	X									
A4	X	X									
A5	X	X	X	X	X	X	X	X	X	X	X
195	X	X									
196	X	X									
197	X	X									
198	X	X	X	X	X	X	X	X	X	X	X
B5	X	X	X	X	X	X	X	X	X	X	X
B4	X										
B3	X				X						
B2	X										
B1	X	X	X	X	X	X	X	X	X	X	X
C5	X	X	X	X	X	X	X	X	X	X	X
C4	X										
C3	X				X						
C2	X										
C1	X	X	X	X	X	X	X	X	X	X	X
BROUGHTON	X										
D1	X	X	X	X	X	X	X	X	X	X	X
D2	X										
D3	X				X						
D4	X										
D5	X	X	X	X	X	X	X	X	X	X	X
CLYDE	X										
SCOTT INLET SILL	X										
324_S	X	X	X	X	X	X	X	X	X	X	X
323	X										
102_S	X	X	X	X	X	X	X	X	X	X	X
105	X	X									
107	X	X									
108	X	X	X	X	X	X	X	X	X	X	X

Stations	Nutrients	Nitrate isotopes	Ammonium	Stable isotopes	DOC/DON	POC/PN	BSi/POP	Fatty Acids	Total Lipids	Taxonomy	Chlorophyll
110	X	X									
115	X	X									
116	X	X	X	X	X	X	X	X	X	X	X
113	X	X									
111	X	X									
BIO-ARGO_2022	X										
353	X	X	X	X	X	X	X	X	X	X	X
354	X	X									
355	X	X									
356	X	X	X	X	X	X	X	X	X	X	X

16 High resolution phytoplankton productivity and trace gas surveys in Baffin Bay

Project leaders: Philippe Tortell[1] (ptortell@eoas.ubc.ca)

Cruise participants – Leg 2 : Yayla Sezginer[1]

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16.1 **Introduction and Objectives**

During Leg 2 of the 2022 Amundsen Science expedition, we deployed several underway sensors in the PaleoLab to collect high resolution spatiotemporal datasets of surface gas concentrations (CH_4, N_2O and O_2/N_2) and phytoplankton photophysiological measurements. In addition to underway measurements, we collected water on-station from the Rosette for depth profiles of CH_4 and N_2O at sites of interest (in fjords and deep basins), and to conduct incubation experiments aimed at quantifying phytoplankton primary productivity. Our main objective is to combine our underway and on-station measurements to provide a high-resolution characterization of surface water properties and primary productivity spanning Arctic water bodies of diverse oceanographic origins.

16.1.1 *Underway Gas Analysis (CH_4 and N_2O)*

Atmospheric concentrations of CH_4 and N_2O have increased by 150% and 20%, respectively, from pre-industrial times, and currently exceed concentrations measured in ice cores throughout the past 800,000 years[1].The ocean plays an important regulatory role, acting as a both a sink and source, with a small net efflux to the atmosphere. Primary sources of oceanic CH_4 and N_2O result from microbial activity in low-oxygen waters[2]. Research has suggested that these low-oxygen zones are expanding in response to anthropogenic climate change[3], potentially increasing the net efflux of CH_4 and N_2O to the atmosphere, resulting in a positive climate warming feedback. Quantifying the fluxes of CH_4 and N_2O across the sea-air interface is associated with high uncertainty due to a combination of high spatial and temporal variability and limited observations

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[3] IPCC, 2019: Summary for Policymakers. In: IPCC Special Report on the Ocean and Cryosphere in a Changing Climate [H.- O. Pörtner et al.] In press.

over relevant scales[4]. One of the objectives of this cruise was to deploy an underway system to continuously measure methane and nitrous oxide, providing a dataset with high resolution to address the variability inherent in CH_4 and N_2O measurements.

16.1.2 *Underway phytoplankton photophysiology and productivity sampling*

We employed continuous flow-through measurements with a Fast Repetition Rate Fluorometer (FRRF) for high-resolution mapping of a suite of photophysiological diagnostics, including photosynthetic quantum yields and electron transport. We also conducted parallel incubation experiments with ^{14}C and ^{18}O tracers to measure rates of phytoplankton carbon fixation and oxygen evolution, respectively. The results will help elucidate spatial patterns in the stoichiometric relationships between photosynthetic electron transport, oxygen evolution, and carbon uptake, which can vary significantly from their theoretical values as a function of irradiance, nutrient concentrations, and phytoplankton taxonomic composition. Quantifying such variability is vital for the development and validation of underway fluorescence-based productivity algorithms, which can be used to quantify gross primary productivity at high resolution scales.

Another key objective of our underway gas sensor measurements is to expand the temporal and spatial coverage of an existing O_2/N_2 dataset (2019 Leg 3&4, 2021 Leg 3). Oxygen saturation is derived from O_2/N_2 measurements and provides information on the net community productivity (NCP) of water masses. NCP is a useful ecological metric that represents the balance between gross and community-wide (i.e. autotrophic and heterotrophic) aerobic respiration, and is equivalent to carbon export on annual timescales.

16.2 **Methodology**

16.2.1 *Underway Sampling*

Water was pumped continuously from the ocean surface (7 m) into the Paleo laboratory, and through respective gas analyzer and optical instruments (see below).

N_2O and CH_4 measurements

We deployed a cavity ring-down gas analyzer (CRDS; Los Gatos Instruments) for high resolution measurements of N_2O and CH_4 seawater concentrations. Surface water was prefiltered through sequential 20 and 5 micron cartridge filters before flowing through a gas permeable membrane at a rate of ~4 liters per minute against a counter-stream of dry N_2 gas to extract gasses from the seawater supply. The gas stream was plumbed directly into the CRDS for N_2O and CH_4 analysis.

To calibrate the CRDS, discrete samples were collected from the seawater line and from Niskin bottles fired at 7m. Samples were immediately poisoned using $HgCl_2$ to halt biological activity and

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[4] Fenwick, L., D. Capelle, E. Damm, S. Zimmermann, W. J. Williams, S. Vagle, and P. D. Tortell (2017), Methane and nitrous oxide distributions across the North American Arctic Ocean during summer, 2015, J. Geophys. Res. Oceans, 122, doi: 10.1002/2016JC012493.

preserve N_2O and CH_4 concentrations. Serum bottles were overfilled three times to rinse sample bottles and were capped and sealed with no headspace or bubbles.

Underway O_2/N_2

O_2/N_2 was measured using a paired O_2 optode and gas tension device (GTD) following the configuration described by Izett and Tortell (2020)[1]. Post-processing calibration of the optode will be completed based on discrete measurements of dissolved O_2 in the surface water, determined through winkler titration. Titrations were performed by Amundsen Science.

Underway photophysiology

A Fast Repetition Rate Fluorometer (FRRF; Soliense Inc.) was applied to analyze characteristic excitation/relaxation responses in chlorophyll *a* fluorescence by applying a series of rapid light flashes to a seawater sample. Fluorescence curves were measured by providing a flash sequence of 100 1 us flashes with a 1.5 us interval, designed to progressively saturate Photosystem II reaction centers (RCII) and induce an increase in fluorescence, followed by 127 flashes with an exponentially increasing interval to allow reoxidation of the electron carriers downstream of RCII and a return of fluorescence to basal levels. Resulting fluorescence curves were fit to the biophysical model described by Kolber et al., (1998)[2] to determine the functional absorption cross section of the (PSII) reaction center (σ_{PSII}), the photochemical efficiency of Photosystem II (F_v/F_m), and the turnover rate of the primary photosynthetic electron acceptor, Q_a (τ_{Qa}). From these derived photophysiological parameters, photosynthetic electron transport can be calculated as a metric of gross photosynthesis[3,4]. Electron transport rate measurements determined by FRRF were conducted at actinic light levels increasing from 0 – 850 μmol photons m^{-2} s^{-1} to describe photosynthesis – irradiance relationships of underway surface phytoplankton assemblages and incubated samples collected from the surface and sub-surface chlorophyll maximum. Fit parameters (F_v/F_m, τ_{Qa}, σ_{PSII}) are reported in real-time, determined by the instrument software (Soliense LIFT) from raw fluorescence data. Electron transport rates are further determined during post-processing.

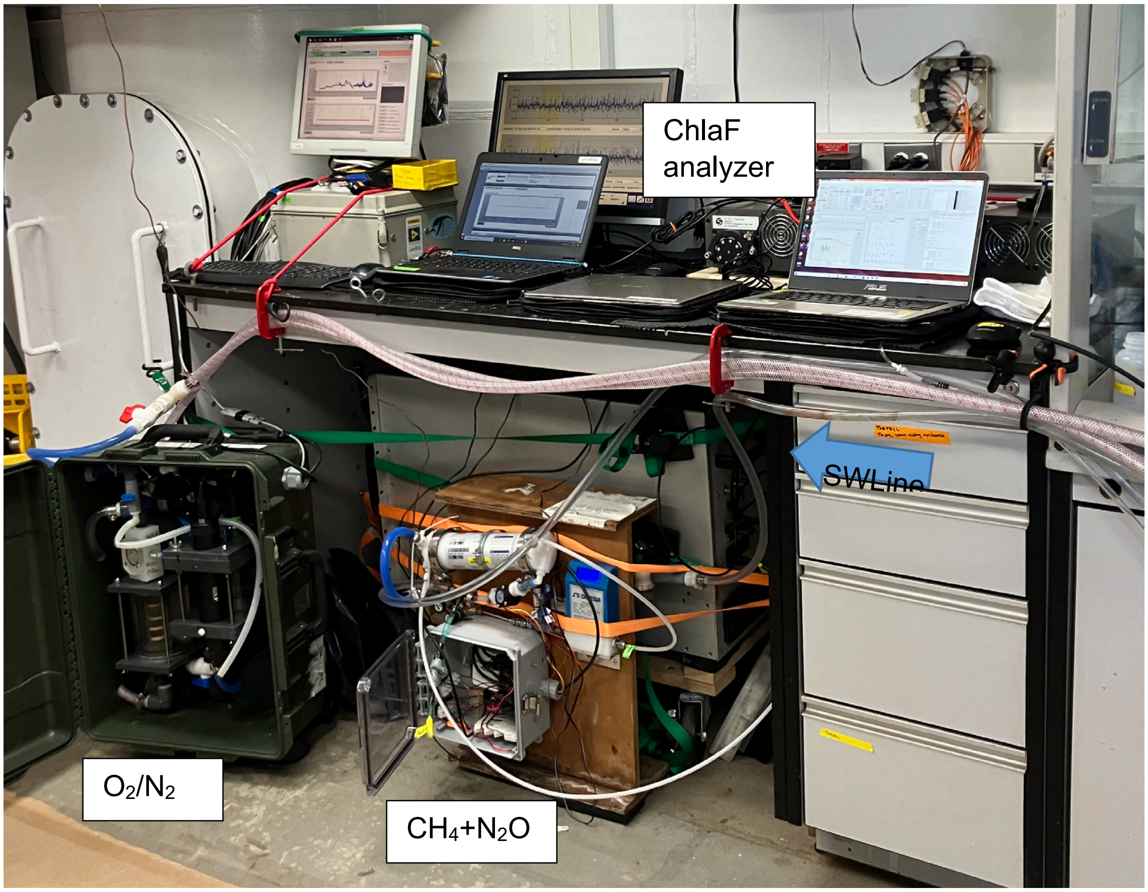

Figure 16-1. Underway instruments set-up in the PaleoLab.

16.2.2 *On-Station measurements*

Gas Profiles

At stations of interest, depth profiles of CH_4 and N_2O samples were collected from the rosette. For each profile, 8 sample depths were included in the profile: bottom, near bottom, 7m (to calibrate the underway system), and 5 additional depths evenly interspersed through the water column. Triplicate volume calibrated 80 mL serum vials were rinsed 3x, filled to overflow, poisoned with $HgCl_2$, and capped and crimped to exclude air bubbles. Samples will be analyzed at the University of British Columbia using mass spectrometry.

Primary productivity incubations

Carbon uptake and oxygen evolution were measured using $H^{14}CO_3$ and $H_2{}^{18}O$ tracers in water samples collected from the SCM and surface water. C-uptake and O-evolution samples were incubated in parallel in a homemade 'photosynthetron' device designed to control the temperature (maintained at 5°C) and light environment. Incubation samples were collected from Niskin bottles into 5L jugs, from which O-evolution and C-uptake samples were sub-sampled into volume calibrated 60mL glass serum bottles and 200 mL nalgenes, respectively.

Oxygen samples were spiked with 100 mL of $H_2{}^{18}O$ (Medical Isotopes, 99.8%) and immediately capped and sealed. Time zero bottles were immediately after poisoned with 50 uL of $HgCl_2$ with a gas-tight syringe pierced through the rubber cap. All bottles were placed in the Photosynthetron for 12 hours where they received a consistent light flux of 150 μmol photons m^{-2} s^{-1} over the full incubation period. At the end of the incubation, time-final bottles were poisoned with 50 uL of $HgCl_2$ with a gas-tight syringe pierced through the rubber cap. Oxygen evolution will be evaluated following Ferron et al. (2016) using membrane inlet mass spectrometry at the University of British Columbia to determine differences in $^{18}O^{16}O$ (amu 34) in time-zero and time-final bottles.

The C-uptake sample was spiked with 75 uCi of $H^{14}CO_3$ (Perkin Elmer; 1 uCi/uL). The Nalgene was shaken to homogenize the sample, then a 20 mL subsample was immediately filtered onto a 25mm GF/F filter for a time zero measurement. The sample was then further divided into 9 20mL subsamples incubated in the photosynthetron for 4 hours, at 9 unique light levels varying from 5 – 450 μmol photons m^{-2} s^{-1} for photosynthesis-irradiance relationship measurements. Following the incubation period, samples were filtered onto 25 mm GF/F filters. 100 uL of HCl were added to filters to remove dissolved inorganic carbon from filters and were fumed over 24 hrs in the fume hood. All incubation work was completed in the dark in the RadVan. Carbon uptake at each light level will be determined by counting disintegrations per minute using a liquid scintillation counter at the University of British Columbia.

Fluorescence based photosynthesis-irradiance curves were also measured in the FRRF for incubation samples. Incubation samples were additionally filtered through 47 mm GF/F filters for pigment-based taxonomic analysis. Pigment samples will be analyzed using high-performance liquid chromatography (HPLC) at the University of South Carolina.

During the long transit back to Quebec City from the North Water Line, water samples bucketed from station 110 were incubated over 72 hours in the on-deck incubators above the Rosette shack. Three 4 L cubitainers were enriched with $NaNO_3$ for a final concentration of 3E-4M NO_3^-. Three unamended 4 L cubitainers were kept as control treatments. C-uptake, O-evolution, and electron transport rates were measured daily from the six cubitainers following the protocols described above to describe changes in the stoichiometric relationships between photosynthetic electron transport, oxygen evolution, and carbon uptake in response to nutrient enrichment and bloom progression.

Table 16-1. Station Sampling Locations

cast	station	date_UTC	latitude	longitude	Depth (m)	Bottom (m)	SCM (m)	CH4 and N2O depth profile	Incubation
1	A1	2022-09-24T19:28:00	66.60666	-61.18852	99	109	19	1	1
2	A2	2022-09-25T01:17:00	66.6694	-60.4756	515	523	nan	1	0
3	A3	2022-09-25T06:26:00	66.73082	-59.608	864	873	nan	0	1
5	A5	2022-09-26T02:36:00	66.87664	-57.95712	819	829	27	0	1
8	197	2022-09-27T04:41:00	67.04428	-55.09574	61	70	nan	1	0
9	198	2022-09-27T14:03:00	67.08512	-54.2036	65	75	nan	1	0
11	B5	2022-09-28T14:04:00	67.58724	-59.02384	1188	1198	22	0	1
13	B3	2022-09-29T02:44:00	67.32946	-60.27714	1078	1087	27	0	1
14	B2	2022-09-29T10:31:00	67.19518	-60.89636	627	635	nan	1	0
15	B1	2022-09-29T14:38:00	67.06014	-61.50838	106	113	40	1	1
16	C5	2022-09-29T23:11:00	68.14592	-59.9731	1375	1385	25	0	1
18	C3	2022-09-30T12:56:00	67.74784	-61.26864	1555	1563	23	0	1
19	C2	2022-09-30T22:40:00	67.54752	-61.90764	413	420	nan	1	0
20	C1	2022-10-01T03:10:00	67.34838	-62.53066	137	146	25	1	1
21	Broughton_T	2022-10-01T17:57:00	67.39604	-63.84868	452	462	nan	1	0
22	D1	2022-10-02T07:10:00	67.47434	-63.68532	662	668	40	1	1
23	D2	2022-10-02T22:03:00	67.85626	-63.1448	255	265	nan	1	0
24	D3	2022-10-03T02:22:00	68.2449	-62.59526	1550	1559	24	0	1
26	D5	2022-10-03T18:42:00	69.00236	-61.4055	1826	1834	nan	0	1
27	Clyde	2022-10-04T19:03:00	70.34794	-68.45464	332	341	10	1	1
28	Scott Inlet sill	2022-10-05T15:09:00	71.15394	-71.26854	449	458	nan	1	0
29	Clark_fjord	2022-10-05T22:08:00	71.05054	-71.59096	669	678	nan	1	0
32	324_south	2022-10-08T06:11:00	73.8251	-79.60446	845	855	35	1	1
33	323_east	2022-10-08T10:12:00	74.15138	-79.30468	786	795	27	1	1

34	102_south	2022-10-09T07:56:00	76.17866	-76.9801	287	295	35	1	1
37	105	2022-10-09T15:22:00	76.1222	-75.76466	341	349	45	0	1
42	110	2022-10-10T07:18:00	76.29722	-73.61706	518	526	17	0	1
49	Bio-Argo_2022	2022-10-12T06:59:00	72.89636	-65.60316	2334	2342	nan	1	0

All gas depth profiles included 3 replicate 80mL samples collected from 8 depths. Incubation water was collected from the sub-surface chlorophyll maximum (SCM) and surface depths.

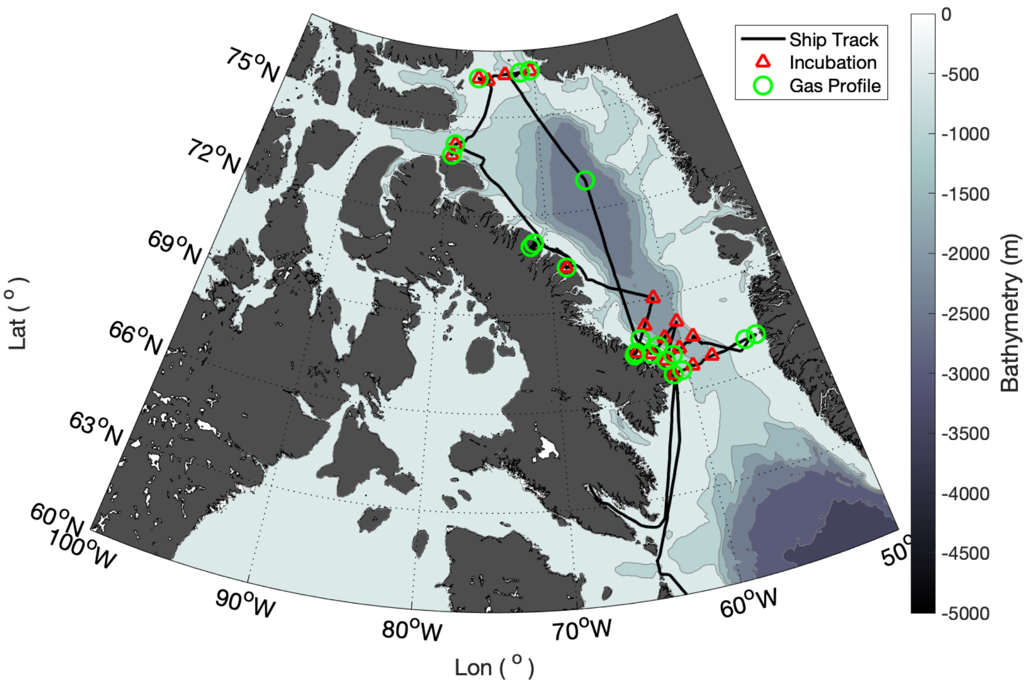

Figure 16-2. Cruise track and sampling station locations.

16.3 **Preliminary Results**

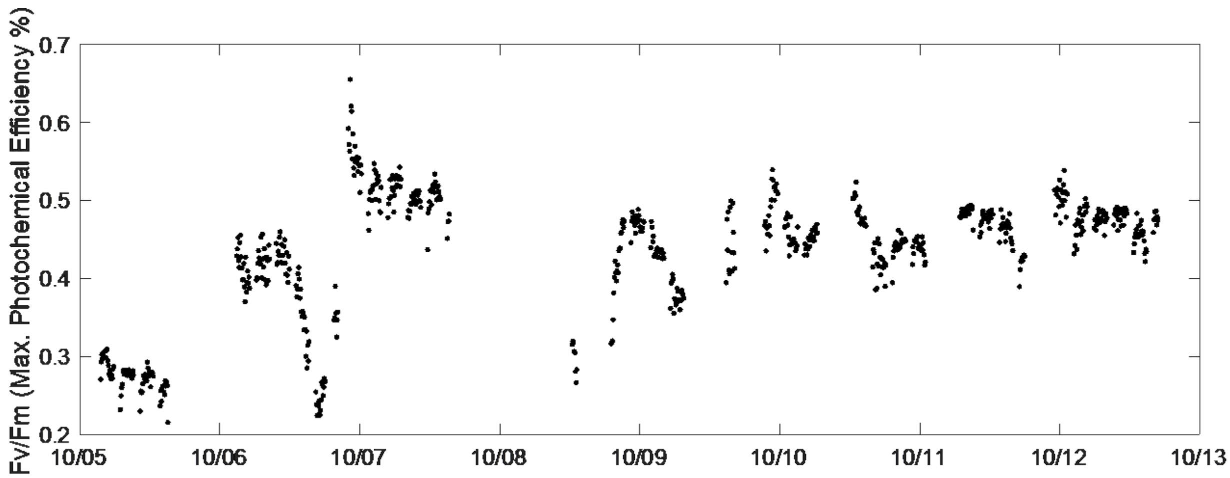

Figure 16-3. Maximum photochemical yield (Fv/Fm) recorded underway along the cruise track. Diel cycles are a notable feature as fluorescence and photochemistry are both quenched under high sunlight conditions. Amundsen Science PAR data will be an important explanatory variable.

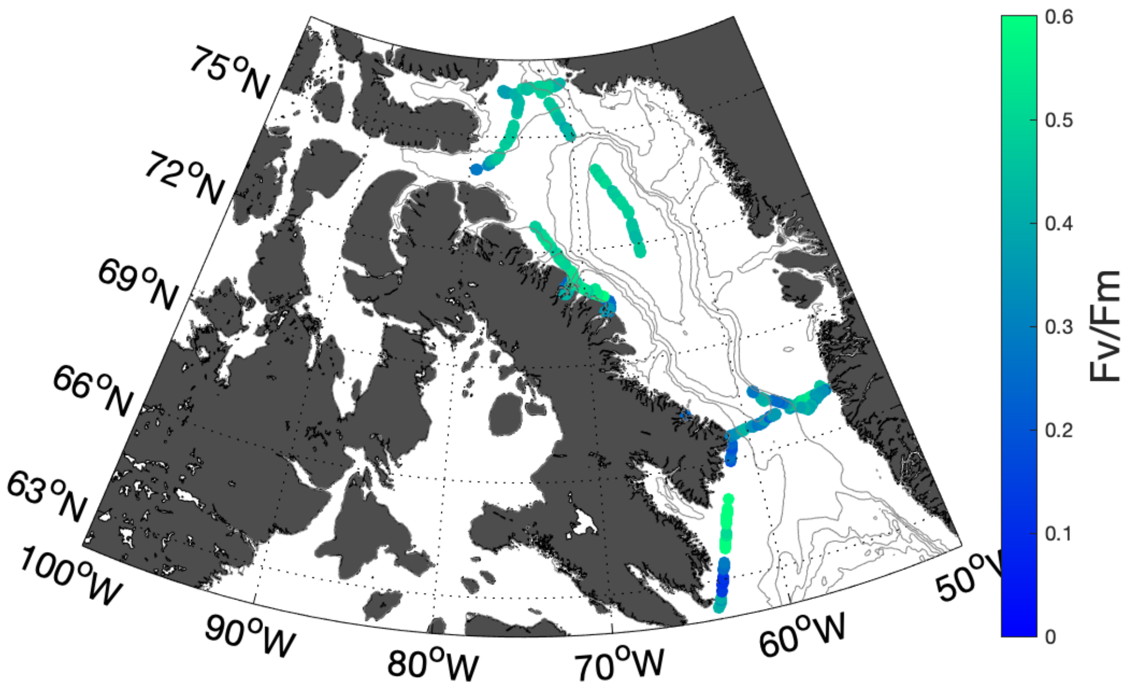

Figure 16-4. Data from Figure 2 presented in map form.

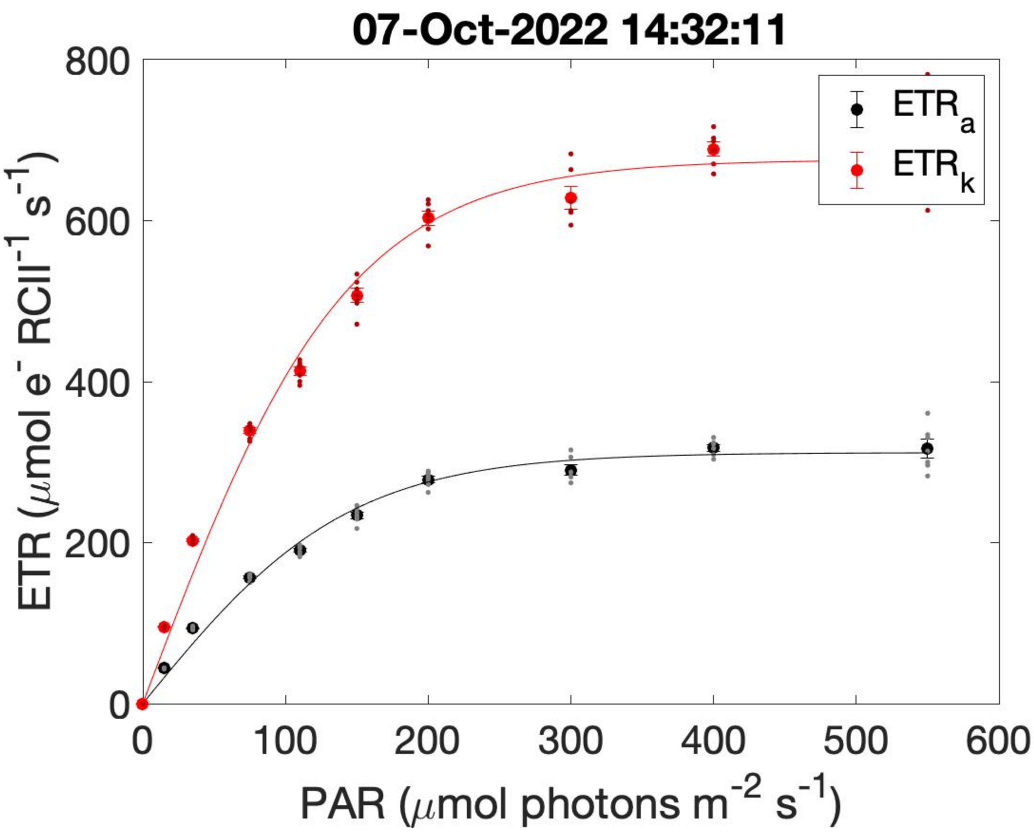

Figure 16-5. Example of a photosynthesis-irradiance curve obtained from an underway sample. Photosynthesis-irradiance data is fit with the model described by Webb et al. (1974)[5]. The derived photosynthesis-irradiance relationship can be used to estimate photosynthesis under various light levels. Electron transport rates are determined using two alternative fluorescence-based algorithms, ETR_a (black) and ETR_k (red). The oxygen-evolution rate measurements collected during incubations serve as a fluorescence-independent measure of PSII activity that will be used to validate the algorithms, which show considerable divergence from one another[6].

16.4 **Recommendations**

Overall, had a wonderful cruise, couldn't ask for more dedicated Amundsen Science team or coast guard crew. Below are a few issues I ran across that could be improved for future:

- Getting consistent liquid flow to the Paleolab is crucial for the gas measurement instruments and has been a persistent problem (2021 too). Observed periodic spikes in flow, up to 1 LPM changes, every 1 - 5 minutes. Periodic spikes were alleviated when the 100 micron filter was removed from the seawater line. Not sure this is a great long-term fix as the seawater line is now vulnerable to getting clogged.

- The liquid scintillation counter on board is not compatible with the scintillation vials I brought, necessitating shipment of radioactive samples back to UBC. It would be good to send a vial purchasing list to future radvan users.

General recommendations about the expedition (planning, equipment, life on board, etc.) should be provided in the ***User Survey***, available online: https://goo.gl/Cf7SA8. Receiving feedback from users of the *Amundsen* is very important in order to continue to provide a high level of support, and is required by the *Amundsen*'s main funding agency, the Canada Foundation for Innovation.

16.5 References

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17 Distribution of Trace Metals through the Canadian Arctic Archipelago and Baffin Bay

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17.1 **Introduction and Objectives**

This work will expand from the Canadian Arctic GEOTRACES Program executed in 2015, which resulted in publications on the distributions of Fe, Mn (Colombo et al., 2020), Cu (Nixon et al., 2019), and Pb (Colombo et al., 2019) in a transect from the Canada Basin to Baffin Bay. Moreover, the present research will contribute to the ArcticNet-supported project NTRAIN (Nutrient Transports and living marine Resources Across the Inuit Nunangat). NTRAIN aims to address how the distribution network of Arctic nutrients responds to the changing physical and chemical environment in the Canadian Arctic. By measuring the nutrient concentrations and transports across the major gateways of the Canadian Arctic, potential changes in the nutrition and availability of marine foods may be predicted.

The objectives of this study are threefold:

I. To use dissolved trace metals (Fe, Mn, Cu, Cd, Pb, Zn, Co, Ni) as ocean circulation tracers.

II. To assess the change in the aforementioned micronutrient trace metal concentrations over the course of several years (2019-2022), as may be expected with greater Arctic warming, and subsequent sea ice and glacial melt.

III. To gauge the change in trace metal concentrations in terms of anthropogenic contamination (e.g. Pb, Cu).

As opposed to other trace element methods of tracing water masses, such as the use of radionuclides (e.g. Ra, I) (Kipp et al. 2018, 2019; Karcher et al., 2012), the present work will use the measurements of dissolved micronutrients and potential toxins in conjunction with the Arctic and Northern Hemisphere Atlantic (ANHA) model (Hu et al., 2018) which is based on the Nucleus for European Modelling of the Ocean (NEMO) simulation (Madec et al., 2008). This portion of the project will expand on the tracing of dissolved Pb conducted by Colombo et al. (2019) and will be done in collaboration with Dr. Paul Myers of the University of Alberta.

In contrast to the Canadian GEOTRACES program of 2015, which covered an extensive transect from west to east through the Canadian Arctic Archipelago and into Baffin Bay, the current research covers a series of shorter transects between islands of the Archipelago (e.g. in Lancaster

Sound), as well as between Greenland and Canada (Baffin Island and Ellesmere Island). In turn, a detailed picture of the points of entry and exit of trace metals of interest will be presented. For instance, the research conducted in 2019 and 2021 demonstrated that greater concentrations of iron and manganese are observed on the eastern side of Baffin Bay, proximate to runoff from Greenland. These greater concentrations of iron in particular may have implications for future changes to primary productivity. On the western side of the bay, greater concentrations of nickel, copper, and cadmium are observed, due to Pacific-derived waters moving through the Canadian Arctic Archipelago and down through Baffin Bay with the Baffin Current. It is important to continue to measure and record temporal and seasonal changes to these concentrations with increased warming of the Arctic and the subsequent increase of various meltwaters, which are sources of trace metals.

17.2 **Methodology**

Sample Collection

Six trace-metal quality GO-FLO bottles were deployed on a Kevlar line at six depths per cast. Two casts were conducted per station for a total of 12 discrete depths from 12 m to a maximum of 180 m. Prior to attaching the GO-FLOs to the line, a weight was lowered to 12 m. This weight consisted of two plastic buckets filled with concrete and sealed in plastic wrapping. A depth sensor/beacon was attached directly above the weight. Teflon messengers were attached to the GO-FLOs with lanyards and twisted onto the Kevlar line under each GO-FLO bottle (except for the deepest bottle). Once all bottles were screwed to the line and lowered to the required depth, a final messenger was released to initiate a chain reaction. Once the messenger hit a lever at the top of the GO-FLO, the bottle would close and the messenger connected to this GO-FLO would be released. It would subsequently hit the lever on the GO-FLO bottle at the next depth, continuing the chain. After all bottles had closed, the bottles were brought up one at a time and carried to the "clean-room bubble."

Additionally, surface samples were collected from the zodiac at stations 196, 198, and 3.49 in Qikiqtarjuaq. Due to contamination from the ship, surface samples were collected 0.5 miles from the *Amundsen*. A pole sampler was used to dip 500 mL bottles into the water, as far from the zodiac as possible. The bottle was rinsed three times by this method, prior to final sampling. The bottle was then capped and double-bagged.

Dissolved trace metal samples were collected into 500 mL LDPE bottles (VWR International, Radnor, PA, USA), following gravity-filtration through 0.2 µm Acropak filters (Pall Corporation, Port Washington, NY, USA). Samples for total metal content were also taken direct to sample bottles, without filtration. All trace metal samples were then acidified to pH 1.7 using Seastar Baseline grade hydrochloric acid (Seastar Chemicals, Sidney, BC). Nutrient samples were filtered through 0.2 µm Acropak filters and collected into 15 mL vials for comparison to rosette samples. Subsampling and acidification were completed immediately in the "clean-room bubble" lab space which was constructed of a wooden frame and plastic sheeting, and filled with HEPA-filtered air. Sample bottles were double-bagged, then put together in a larger bag and placed in buckets for storage. All LDPE bottles used for sample collection and solution storage were cleaned prior to use according to GEOTRACES protocol (Cutter et al., 2010).

Trace Metal Analysis

Trace metal analysis of all collected samples will be conducted at the University of Victoria School of Earth and Ocean Science, following a method similar to that of Jackson et al. (2018). Samples and standards for trace metal analysis are extracted and preconcentrated offline via the seaFAST-pico SC-4 DX system (ESI, Omaha, NE, USA). 10 mL per sample is loaded onto the seaFAST column, made up of the Nobias PA-1 resin which contains the functional groups ethylenediaminetriacetic acid and iminodiacetic acid. The column is rinsed with 2 M ammonium acetate solution (pH 6.0 ± 0.2), which is prepared by mixing Seastar Baseline grade glacial acetic acid and ammonium hydroxide and diluting with double-deionised water (DDW). Samples are eluted in 800 µL of 1.6 M Baseline grade Seastar nitric acid spiked with an In or Rh internal standard. The preconcentrated samples are analysed on an Agilent 8800 ICP-MS/MS. All vials (VWR Metal-Free Centrifuge Tubes, VWR International, Radnor, PA, USA) used in trace-metal sample preparation are cleaned in 1N Instrument Quality grade Seastar nitric acid for at least one month and triple-rinsed with DDW prior to use. Sample preparation is completed in a class-100 clean room.

Table 17-1: List of Samples

Station	**Depths (m)**		
	Filtered (Dissolved TM)	**Unfiltered (Total TM)**	**Macronutrients**
A1 (190)	12, 24, 36, 48, 60, 84		12, 24, 36, 48, 60, 84
A4 (BB1)	12, 24, 36, 48, 60, 72, 84, 108, 120, 132, 156, 180		12, 24, 36, 48, 60, 72, 84, 108, 120, 132, 156, 180
196	12, 24, 36, 48, 60, 72, 84, 96, 108	0, 12, 24, 36, 48, 60, 72, 84, 96, 108	12, 24, 36, 48, 60, 72, 84, 96, 108
198	12, 24, 36, 48, 60	0, 12, 24, 36, 48, 60	12, 24, 36, 48, 60
D1	12, 24, 36, 48, 60, 72, 84, 108, 120, 132, 156, 180		12, 24, 36, 48, 60, 72, 84, 108, 120, 132, 156, 180
D3	12, 24, 36, 48, 60, 72, 84, 108, 120, 132, 156, 180		12, 24, 36, 48, 60, 72, 84, 108, 120, 132, 156, 180
D5	12, 24, 36, 48, 60, 72, 84, 108, 120, 132, 156, 180		12, 24, 36, 48, 60, 72, 84, 108, 120, 132, 156, 180
Qikiqtarjuaq (3.49)		0	0
Scott Inlet Sill	12, 24, 36, 48, 60, 72, 84, 108, 120, 132, 156, 180		12, 24, 36, 48, 60, 72, 84, 108, 120, 132, 156, 180
323 east	12, 24, 36, 48, 60, 72, 84, 108, 120, 132, 156, 180		12, 24, 36, 48, 60, 72, 84, 108, 120, 132, 156, 180
105	12, 24, 36, 48, 60, 72, 84, 108, 120, 132, 156, 180	12, 24, 36, 48, 60, 72, 84, 108, 120, 132, 156, 180	12, 24, 36, 48, 60, 72, 84, 108, 120, 132, 156, 180
108	12, 24, 36, 48, 60, 72, 84, 108, 120, 132, 156, 180	12, 24, 36, 48, 60, 72, 84, 108, 120, 132, 156, 180	12, 24, 36, 48, 60, 72, 84, 108, 120, 132, 156, 180
115	12, 24, 36, 48, 60, 72, 84, 108, 120, 132, 156, 180	12, 24, 36, 48, 60, 72, 84, 108, 120, 132, 156, 180	12, 24, 36, 48, 60, 72, 84, 108, 120, 132, 156, 180
Bio-Argo	12, 24, 36, 48, 60, 72, 108, 156, 180, 204, 300, 408		12, 24, 36, 48, 60, 72, 108, 156, 180, 204, 300, 408
354	12, 24, 36, 48, 60, 72		12, 24, 36, 48, 60, 72

17.3 Recommendations

It is again recommended to not use the moonpool for deployment of trace metal equipment by the bottle-on-a-line method. Reasons for this include:

1. **Large risk of breaking GO-FLO bottles**. This year, one GO-FLO bottle was broken beyond repair (the top of the GO-FLO was broken off when it hit the side of the moonpool during the upcast of station D5). This break was identical to the break of another bottle in 2021. Additionally, other bottles in 2021 had more minor breaks due to scraping against the moonpool. No bottles were broken or damaged in any way when GO-FLOs were deployed from the deck in 2019.

2. **Risk of breaking the Kevlar cable**. A Kevlar cable is used for trace metal sampling to avoid contamination. This year the cable caught on the edge of the moonpool at station 108 and was torn through on the upcast. Fortunately, the cable did not break completely which would have resulted in the loss of equipment. The line had to be cut and a new termination made (thank you to Marcia and Luiz). Additionally, the tear occurred near the end of the shallow cast, so only about 30 m of cable were lost; however, this again could have been a larger problem if this occurred during a deep cast (loss of a lot of line). At station 354, the second (deeper) cast was cancelled due to strong currents and difficulty in deploying and recovering bottles during the first cast (despite only being 84 m deep to the weights). The second cast was cancelled due to the strong possibility of breaking the cable or bottles.

3. **We cannot sample in icy conditions**. In 2019, it was not a problem to sample in icy conditions as the ship could be moved to make a hole for sampling from the deck. In the moonpool however, ice ends up trapped and is difficult to remove. In 2021 this was removed with a pump and wooden paddles to push the ice into the pump. This was a successful method but took significant time and extra manpower. This year, we instead ran hot water into the moonpool prior to and during the casts. Even in thin ice (i.e. station 105), we still encountered visibility problems by this method and a pole had to be used to push the ice around (with little effectiveness). This method would not be effective in thicker ice. It is recommended to use the water pump to remove ice and snow when visibility is limited in the moonpool. This is also preferred over running seawater directly into the moonpool since rusty, brown water was seen coming from this outlet. While it is understood that this contaminated water is diluted after entering the moonpool, due to the high temperature of the water it would create a surface layer of contamination which every bottle would have to pass through during deployment and recovery. Since a key goal in trace metal sampling is to keep all equipment as clean as possible (i.e. the GO-FLO bottles are not to touch dirty work gloves or the ship), it is counterintuitive to then pass them through rusty water during sampling. For instance, the stopcock of a bottle would be in contact with the contaminated water immediately prior to filtering. Rusty water would also then cover the exterior of the GO-FLO bottle and be brought into the clean lab, resulting in a contamination source for everything else in the clean lab. Analysis of samples at stations

323, 105, 108, and 115 will indicate if this contaminated samples at these stations. In any case, sampling in thicker ice is not possible if significant time (>1 hr) is not provided for ice removal. This greatly limits the number of stations that can be sampled in certain areas (i.e. Lancaster sound, NOW polynya, Nares Strait).

4. **We can only sample in 12 m increments**. The length of the line from point of attachment of a GO-FLO to the bottom of the moonpool is 10 m. Therefore, the GO-FLO bottle would hit the edge of the moonpool while the next bottle is being attached to the line, if the bottles were deployed in 10 m increments. To avoid this, the bottles were instead deployed in 12 m increments. Typically, nutrient and micronutrient samples are collected in 10 m increments, as was done in 2019 when trace metal samples were collected on deck. This results in more precise interannual comparison of data. Additionally, it is necessary to compare nutrient samples taken from the trace metal operation to the nutrient samples taken from the CTD rosette. This allows for extrapolation of the angle of the line. That is, since the bottles on the line are much lighter than the CTD rosette, and more prone to movement from currents, the angle of the line must be calculated based on comparisons of nutrient data. This process becomes more complicated when samples are in 12 m increments from the trace metal sampling, and 10 m increments from the CTD rosette.

Although the 2021 data demonstrated that contamination from the moonpool did not impact the samples, the above problems indicate that this operation is better suited for the front deck, as in 2019.

Use of the trace metal rosette, rather than the current bottle-on-a-line method, would be a faster operation overall and only require one cast to acquire 12 sample depths (as opposed to the 3 casts in 2019 and 2 casts in 2021 and 2022). In this case, the arms and rollers could be used to center the cable (if the operation is to be done in the moonpool again). Additional time would be needed for this operation in order to lower and raise the arms. More importantly, the arms are lowered down through the moonpool, resulting in the inability to see the rosette as it is recovered. The winch would need to read the length of the line to ensure the rosette is not smashed against the arms on the upcast (discussed in more detail below). The beacon/HIPAP experiences delays in communication and is unreliable at depths < 30 m. It would not be effective at detecting the final stages of the upcast. If the arms are raised during the upcast, we are likely to again experience problems in terms of equipment and cable hitting the edge of the moonpool, as this year the line was pulled against the moonpool even at shallow depths. In this case, it is too risky to deploy the trace metal rosette through the moonpool.

Ice in the moonpool is also still a problem for this operation. A better protocol for dealing with ice in the moonpool is needed in order to prevent future cancellations of trace metal sampling.

For these reasons, it is preferred to deploy the trace metal rosette from the front deck. It is understood that the ROV winch and ROV take up deck space. Since the trace metal sampling will not occur on the same Leg as the ROV for the foreseeable future, ideally the ROV and trace metal winch would trade places between Legs (that is, if there is not space for the trace metal winch to be stored on the deck beside the ROV winch.)

It is recommended to use a winch which can provide a length reading. Since the line would not trigger the pulley for proper length read-out, 12 m increments were manually measured up to 516 m and marked with tape in 2021. This method was used again this year. A different, longer line will need to be used for the trace metal rosette, which will require a winch with a length reading. In this case, we would no longer need to use the beacon/HIPAP.

If the trace metal rosette is to be used in the future, it will be necessary to change the bottle stand in the clean-lab. This stand currently fits six 12 L or 10 L bottles, but would need to accommodate twelve 5 L bottles from the trace metal rosette.

17.4 References

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18 Mooring Operations

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18.1 Introduction and Regional Setting

Sampling year 2022 was part of a fall campaign involving two Legs on board the vessel *Amundsen*. Legs 1 and 2 investigated the underwater sound ecology, ocean circulation variability and shelf sedimentation in the Labrador Sea.

Amundsen mooring operations (Sept 9 – Oct 19) were co-financed by Amundsen Science, DFO and the Marine Institute of Memorial University (MI) concerning the recovered HiBioA and SagBank moorings along with the new mooring deployment site on Hopedale Saddle (Hopedale-22). HiBioA-22 was deployed at 514 m while Hopedale-22 was deployed at 429m. This shelf mooring array should continue to provide baseline data for the establishment new Marine Protected Areas (MPAs) in the Labrador Sea from Hatton Basin to Hopedale Saddle. Two moorings were deployed for JASCO cofinanced by Amundsen Science (in-kind support) and ITTAQ Heritage and Research Centre (https://ittaq.ca/). These community-driven moorings were deployed to study the marine soundscape in the areas frequented by marine mammals.

Mooring operations to redeploy a benthic tripod (UluBluff-21) in collaboration with University of Victoria (UVic) and Wildlife Conservation Society Canada (WCS), were not attempted due to bad weather and a lack of time. Efforts to redeploy the lander will continue in 2023 from the *Amundsen*.

The total of the Amundsen Science managed mooring operations, on board the *Amundsen*, included two moorings recovered, five moorings deployed in the Labrador Sea and Baffin Bay (two were for the ITTAQ project).

18.2 **Areas of Focus**

18.2.1 *Labrador Sea*

A new mooring (Hopedale-22) was deployed to examine the water and acoustic properties on the shelf break on the eastern edge of Hopedale Saddle in the Labrador Sea, for DFO-Nfld. The mooring was equipped with a current profiler and current meter, Hydrophone, fish tag receivers, CTD sensors, WBAT fish and plankton echosounder and a sediment trap. The HiBioA-22 mooring was also equipped with a sediment trap, hydrophone, fish tag receiver and a semi-permeable membrane device (SPMD). Hydrophone recordings on the shelf area continue to monitor bioacoustics and anthropogenic noise throughout the year, in-order to better understand the soundscape that current and future fishing and transportation operations have in these potential marine protected areas. The redeployment of the SPMD to the HiBioA mooring was an addition from Environment Canada this year to collect persistent organic pollutants in the water throughout the year. The SPMD data will be used to help complete research of students supervised by Dr. Lissa Januesten (Env.Can.).

18.3 **Mooring Arrays**

18.3.1 *Labrador Sea*

The ISECOLD (HiBio, Hopedale) moorings are a continuation of a shelf – slope break mooring array started with HiBioA-17 in Hatton Basin all the way south to Hopedale Saddle, examining the water properties affecting invertebrate megafaunal settlement, marine mammal presence, shelf-slope carbon fluxes, persistent organic pollutants, zooplankton dynamics and submarine acoustics monitoring. The ISECOLD project was created to collect baseline studies of the area and processes needed to help DFO make an informed decision as to where to place the Marine Protected Area (MPA) in this part of the Labrador Sea. Emphasis on benthic marine life and the processes governing them along with the marine soundscape were the over-arching objective of these moorings.

18.3.2 *Baffin Bay*

The ITTAQ moorings are a continuation of an acoustic mooring array initiated by interest from the community of Clyde River. Where the investigation of the marine soundscape relative to marine mammal vocalizations is on-going.

18.4 **Regional Setting**

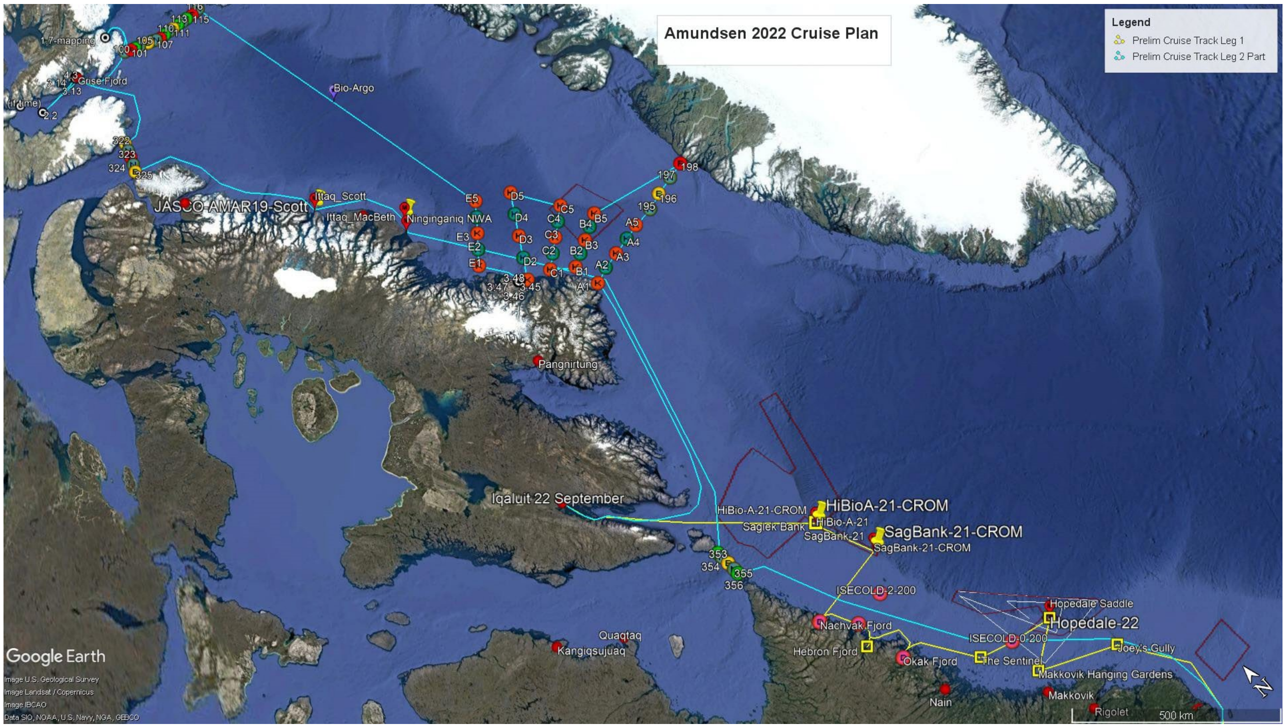

Figure 18-1. 2022 Amundsen Science Cruise Plan

Amundsen Science – DFO Individual Mooring Objectives (2022):

1. Moorings HiBioA-22 (514m) and HiBioA-22-CROM (514m) were redeployed along with new mooring Hopedale-22 (429m), as part of the continued ISECOLD mooring array investigating the effects on invertebrate megafaunal settlement, marine mammal presence and shelf-slope carbon fluxes for the eastern edge of Hatton Basin to Hopedale Saddle in the Labrador Sea (Figure 18-2).

2. ITTAQ moorings (MacBeth (89m) and Scott (245m)) are solitary hydrophones listening to marine noise and marine mammal vocalisations.

Table 18- 1: Mooring sites deployment and redeployment

Mooring ID	Deployment date	Latitude (DD)	Longitude (DD)	Depth (m)
HiBioA-22	September 21, 2022	60.46523	-61.26085	515
HiBioA-22-CROM	September 21, 2022	60.4723	-61.25993	514
ITTAQ-MacBeth-22	October 4, 2022	69.903616	-66.812483	89
ITTAQ-Scott-22	October 7, 2022	71.1345	-70.825083	245
Hopedale-22	September 14, 2022	56.06055	-57.43196	429

Table 18- 2 : Mooring sites recovery

Mooring ID	Deployment date	Latitude (DD)	Longitude (DD)	Depth (m)
HiBioA-21	July 25, 2021	60.460773	61.262178	500
SagBank-21	July 23, 2021	59.377714	60.300147	450

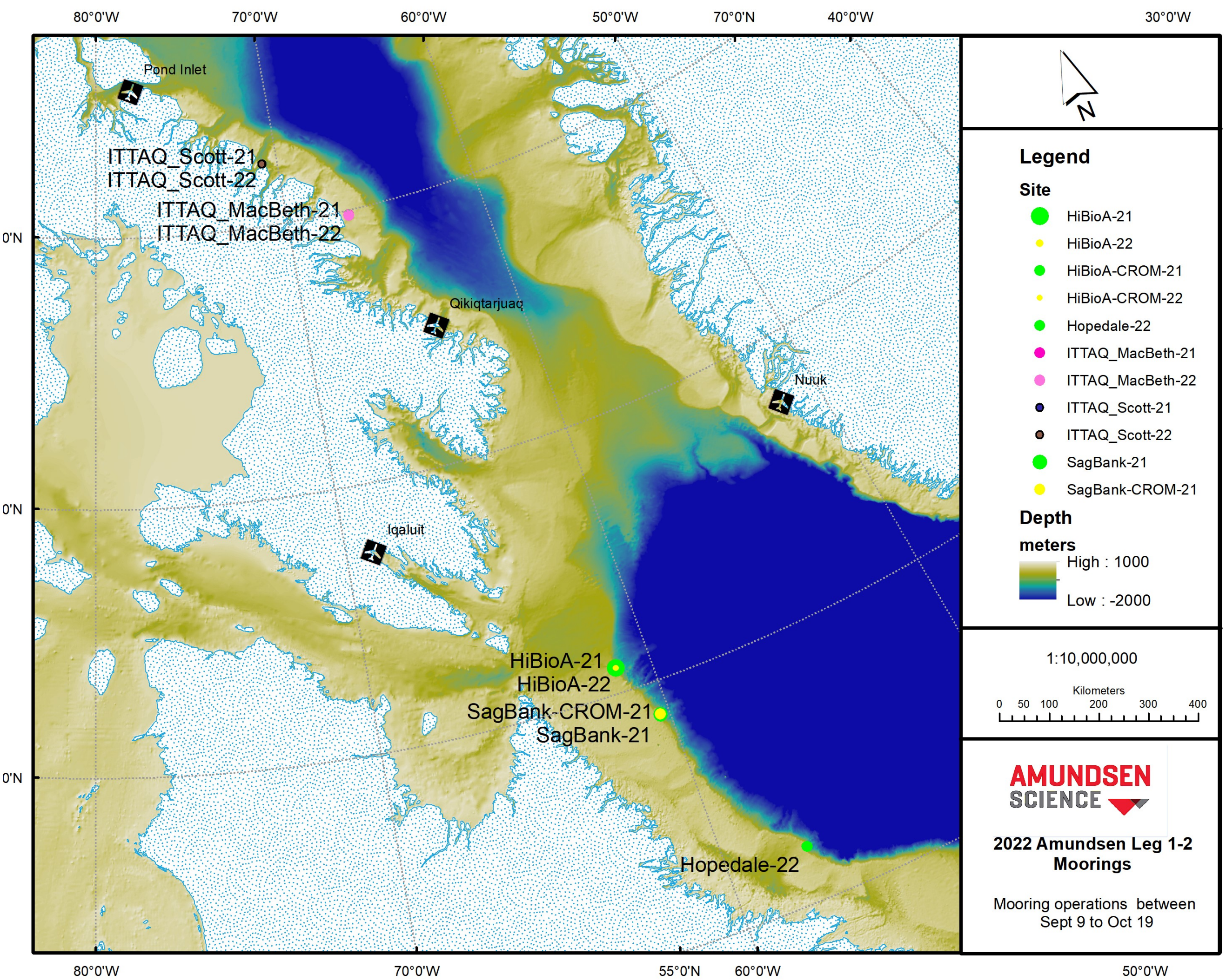

Figure 18-2. Amundsen Science managed oceanographic moorings in 2022

18.5 Sub-Surface Mooring Instrumentation

Typical mooring configuration for the ISECOLD program consisted of:

1. The ISECOLD-Amundsen Science moorings were designed to be of a taut-line configuration and consisted of the following key components:

    i. An AZFP / WBAT plankton size and quantifier unit was part of the top float solution within an ASL dual frame modified to have panther floats rather than vinyl trawl floats (depth rated increases from 200m to 800m).

    ii. SPMD* organic pollutant trap on the frame of the top-most buoy / instrument.

    iii. A Technicap PPS 3/3-24S 24 cup sequential sediment traps were deployed between the top float and JASCO Hydrophone to record the annual cycle in vertical carbon flux.

    iv. A JASCO AMAR G4/3 or an OceanInstruments SoundTrap hydrophone unit was installed in-line. This hydrophone was installed to listen for marine life and vessel traffic, within a Marine Protected Area (MPA) or government closure area.

    v. 32-inch spherical Mooring Systems International (MSI) syntactic foam float provided a low-mid water float solution.

    vi. Nine meters above the bottom, a high frequency short-range (<1m) Nortek

    Aquadopp Current Meter (AQD) was used to measure near-bottom water velocities.

    vii. RBR Temperature – Salinity sensors were mounted on the mooring with other current, hydrophone, sediment trap and plankton profiling sensors.

    viii. 2 x 19-inch Trawl floats (800m rated).

    ix. Tandem EdgeTech PORT LF acoustic releases were used as the primary recovery devices.

    x. Two train wheels were used as an anchor.

*The SPMDs are small passive water samplers that clamp directly to the mooring line or instrument cage (Figure 18-3). The goal of the SPMDs was to monitor concentrations of persistent organic pollutants (POPs) in the Labrador Sea.

Figure 18-3. SPMD POPs trap ready for deployment on SagBank-21 (example image)

ii. CROM mooring configuration for the ISECOLD program consisted of:

i. An OceanInstruments SoundTrap hydrophone (ST600) unit was installed to listen for marine life and vessel traffic, for this proposed Marine Protected Area (MPA), with less potential noise than the taught-line mooring.

ii. A high frequency short-range (<1m) Nortek Aquadopp (AQD) current meter was used to measure near-benthic water velocities.

iii. RBR XR-420 Temperature – Salinity sensor

iv. An EdgeTech CART acoustic release as the primary recovery device.

v. A NovaTech radio beacon / flasher as recovery aid.

vi. A manhole-cover with a CROM support stand used as an anchor.

18.6 **Mooring Operations**

18.6.1 *2021-2022 Mooring Recovery Summary*

The releases of all Amundsen Science managed moorings responded without major issues and the sea state was calm to wavy but manageable to throw a grappling hook to recover the top instrument / buoy from the foredeck. No zodiac was used during operations due to very poor performance over the last 10 years and good weather with manageable surface currents. The EdgeTech deckbox responses were not perfectly clear concerning the reception of the wake-up and release commands but the EdgeTech releases all functioned as expected.

The JASCO Benthos releases for the ITTAQ moorings didn't function as expected and were not able to be awakened nor forcibly released (Wake-up and Release button held simultaneously).

Mooring Recovery Procedure (CCGS Amundsen)

The recovery operations on board the *Amundsen* are done using the deck winch's cabestan which is in-line with the portside A-Frame. The moorings are grappled-for, and lifted up-to the deck whereby the 2.5 T winch on the A-Frame secures the ocean-side load. The instrument is then lifted up onto deck while the deck horn (under the A-Frame) ties-off the mooring line so that the instrument can be disconnected and that the cabestan can continue to real-in the mooring line and the next instrument in-line.

18.6.2 *Mooring Data Recovery Summary*

The moorings sites HiBioA and SagBank all performed well considering the intense currents that they are exposed to all year and only one instrument had a pressure sensor that stopped functioning after 5 months of operation, but the unit's other sensors functioned well. The hydrophone from HiBioA had a memory card malfunction and unfortunately, no data extraction was possible from this corrupted memory card.

Mooring SagBank-21 performed well and popped to the surface as expected. However, during recovery operations, the vessel drifted over the mooring instruments that were at the surface and the mooring glass spheres (orange) were sucked into the bowthruster's protective grating and one buoy of four was crushed while simultaneously cutting the mooring rope at two different locations (Figure 18-4). The cut on the mooring rope was a 'clean' cut that only a blade could make (Figure 18-5). Resulting in the loss of half of the mooring equipment. The equipment had fallen down to the ocean floor and the releases confirmed that they were horizontal and were thus disabled in preparation for next year's potential ROV recovery.

The CROM at SagBank was not attempted due to bad weather while the CROM at HiBioA was released and after 30min no instrumentation was seen at the surface. After the unit had confirmed that it had released itself, ranging continued for 5min without a problem. The vessel then repositioned to get closer to the instrument for recovery and once at the exact location, communications with the release of the CROM failed to respond to ranging. Time restrictions couldn't permit waiting longer than 30-40 min at the site to spot the equipment and since the CROM was shackled to the anchor via its recovery rope, the idea was that during the night's bathymetric mapping activities that the flasher beacon could be seen and the 2nd chance at recovery would be in the morning of the next day. No flasher nor CROM buoy was spotted and the unit's details were added to the Notice to Mariners to beware of a 1 m yellow buoy floating near or at the surface. It is most likely that the unit has been caught-up during release, or release damage has occurred. An ROV recovery in 2023 might be possible should the unit be visualized in the water column by the multibeam.

Figure 18-4. SagBank-21 glass sphere damage by bowthruster

Figure 18-5. SagBank-21 mooring rope bow thruster cut point

The ITTAQ moorings (ITTAQ-MacBeth-21, ITTAQ-Scott-21) weren't able to be recovered as they didn't respond to the wakeup calls, for well over 30 mins (10 tries each release). Concerning MacBeth fiord, a confusing situation occurred when JASCO was called after the first 30 min of no communications to the releases and a longer wakeup and listening time of 48 seconds was recommended and tried ten further times, without any success. JASCO technician Jason Hynes had mentioned that he wasn't sure if the units in the water, and the units to be deployed, had their batteries changed last year and this year. It was later confirmed, the day after trying to recover ITTAQ-MacBeth-21, that all releases had been prepared with new batteries. Further confusion occurred when communication couldn't be achieved with the newly deployed ITTAQ-MacBeth-22 mooring as well. Repositioning of the boat over top of the mooring still didn't help and after 2 hours of trying to communicate to the releases, recovery and deployment operations were halted. All echosounders were off and the conditions were calm and there were no strong surface currents (dunker cable was straight) at the MacBeth fiord site.

The Scott Inlet site had rough waters but the surface currents were negligible and the dunker cable was straight in the water. Due to timing (no daylight) and adverse weather (storm conditions) a recovery was not attempted but rather a verification of the mooring's presence and orientation was done with a multibeam pass. It was visualised and extended efforts were made to wake-up the releases but to no avail.

18.7 **Conclusion**

The 2022 Amundsen Science - DFO (Integrated Studies and Ecosystem Characterization of the Labrador Sea Deep Ocean - ISECOLD) – ITTAQ mooring operations in the Labrador Sea and Baffin Bay were productive but plagued by adverse weather and severe time constraints. The CCGS *Amundsen* mission saw 29% equipment recovery and 72 % data recovery. Legs 1 and 2 mooring operations on board the *Amundsen* had 2 mildly successful recoveries (SagBank-21, HiBioA-21) and 5 successful deployments (Hopedale-22, HiBioA-22, HiBioA-22-CROM, ITTAQ-MacBeth-22, ITTAQScott-22) for the ISECOLD and ITTAQ programs. Leg 2 mooring operations also included the successful deployment of two ARGO floating profilers for TAKUVIK in NE Baffin Bay.

Appendix 1 - List of stations sampled during the 2022 *Amundsen* Expedition

Leg	Station ID	Station Type	Date (UTC)	Latitude (N)	Longitude (W)	Depth (m)
Leg 1						
1	Joey's Gully	CTD-Rosette / mooring	2022-09-13	54.57354	-56.29338	536
1	Hopedale Saddle	Full / Mooring	2022-09-14	56.09288	-57.4199	510
1	Nachvak Fjord	Full	2022-09-16	59.07666	-63.52804	202
1	Hebron Fjord	Full	2022-09-17	58.15008	-62.79964	241
1	SagBank	Basic / mooring	2022-09-20	59.37102	-60.2962	521
1	HiBioA (1)	Mooring	2022-09-20	60.47144	-61.24986	572
1	HiBioA (2)	Mooring	2022-09-21	60.45024	-61.226	726
Leg 2						
2	A1	Full	2022-09-24	66.60666	-61.18852	109
2	A2	Basic	2022-09-25	66.6694	-60.4756	523
2	A3	Full	2022-09-25	66.73082	-59.608	873
2	A4	Basic	2022-09-25	66.79768	-58.73792	887
2	A5	Full	2022-09-26	66.87664	-57.95712	829
2	195	Basic	2022-09-26	66.88712	-56.93088	662
2	196	Full	2022-09-26	66.98324	-56.06718	129
2	197	Basic	2022-09-27	67.04428	-55.09574	70
2	198	Full	2022-09-27	67.08512	-54.2036	75
2	B6	Basic	2022-09-28	67.28522	-58.43684	1135
2	B5	Full	2022-09-28	67.58724	-59.02384	1198
2	B4	CTD-Rosette	2022-09-28	67.46662	-59.63544	1437
2	B3	Full	2022-09-29	67.32946	-60.27714	1087
2	B2	Basic	2022-09-29	67.19518	-60.89636	635
2	B1	Basic	2022-09-29	67.06014	-61.50838	113
2	C5	Full	2022-09-29	68.14592	-59.9731	1385
2	C4	Basic	2022-09-30	67.9579	-60.62494	1605
2	C3	Full	2022-09-30	67.74784	-61.26864	1563
2	C2	CTD-Rosette	2022-09-30	67.54752	-61.90764	420
2	C1	Basic	2022-10-01	67.34838	-62.53066	146
2	Broughton_T	CTD-Rosette	2022-10-01	67.39604	-63.84868	462
2	D1	Full	2022-10-02	67.47434	-63.68532	668
2	D2	Basic	2022-10-02	67.85626	-63.1448	265
2	D3	Full	2022-10-03	68.2449	-62.59526	1559
2	D4	CTD-Rosette	2022-10-03	68.62838	-61.98124	1803
2	D5	Full	2022-10-03	69.00236	-61.4055	1834
	Ittaq_Macbeth	Mooring	2022-10-04	69.9032903	-66.812053	
2	Clyde	Basic	2022-10-04	70.34794	-68.45464	341
2	Scott Inlet sill	Full	2022-10-05	71.15394	-71.26854	458
2	Clark_fjord	CTD-Rosette	2022-10-05	71.05054	-71.59096	678
	SI_coring1	Basic	2022-10-06	71.0413772	-71.5561897	
2	SI_coring2	Basic	2022-10-06	70.96496	-71.3233	663
2	SI_coring3	Basic	2022-10-06	70.87536	-71.66164	683
2	Ittaq_Scott	Mooring	2022-10-07	71.134276	-70.8242365	
2	324_south	Basic	2022-10-08	73.8251	-79.60446	855
2	323_east	Full	2022-10-08	74.15138	-79.30468	795
2	102_south	Basic	2022-10-09	76.17866	-76.9801	295
2	103_south	CTD-Rosette	2022-10-09	76.08736	-76.59422	260
2	104_south	CTD-Rosette	2022-10-09	76.11012	-76.16374	296
2	105	Full	2022-10-09	76.1222	-75.76466	349
2	106_south	CTD-Rosette	2022-10-09	76.20942	-75.37534	353
2	107	Basic	2022-10-09	76.27246	-74.99742	431

2	108	Full	2022-10-09	76.26452	-74.61174	445
2	109	CTD-Rosette	2022-10-10	76.28758	-74.10964	446
2	110	Basic	2022-10-10	76.29722	-73.61706	526
2	115	Full	2022-10-10	76.33378	-71.20374	666
2	116	Basic	2022-10-11	76.38166	-70.51848	134
2	114	CTD-Rosette	2022-10-11	76.32732	-71.79374	609
2	113	Basic	2022-10-11	76.32284	-72.20088	553
2	112	CTD-Rosette	2022-10-11	76.31514	-72.69986	557
2	111	Basic	2022-10-11	76.30568	-73.20742	588
2	Bio-Argo_2022	Bio-Argo / Full	2022-10-12	72.89636	-65.60316	2342
2	353	Basic	2022-10-14	61.154	-64.78216	387
2	354	Full	2022-10-14	61.00472	-64.72826	510
2	355	CTD-Rosette	2022-10-15	60.85378	-64.71846	428
2	356	CTD-Rosette	2022-10-15	60.7407	-64.71442	288

Appendix 2 - CTD Logbook for the 2022 *Amundsen* Expedition

Leg	Cast #	Station	Start date UTC	Time UTC	Latitude (N)	Longitude (W)	Cast depth (m)	Bottom depth (m)
Leg 1								
Leg 1	001	Joey's Gully	2022-09-13	13:26:00	54.57354	-56.29338	526	536
Leg 1	002	Multibeam 1.1	2022-09-13	21:24:00	55.55932	-56.49144	498	1891
Leg 1	003	Multibeam 1.2	2022-09-13	21:54:00	55.5523	-56.48588	1870	1891
Leg 1	004	Multibeam 2	2022-09-14	04:51:00	55.95538	-56.83462	1973	2100
Leg 1	005	Hopedale	2022-09-14	19:42:00	56.09288	-57.4199	502	510
Leg 1	006	Nachvak Fjord	2022-09-16	03:45:00	59.07666	-63.52804	193	202
Leg 1	007	Hebron	2022-09-17	22:13:00	58.15008	-62.79964	231	241
Leg 1	008	Hebron	2022-09-19	08:37:00	58.14872	-62.78758	237	245
Leg 1	009	SagBank	2022-09-20	10:19:00	59.37102	-60.2962	508	521
Leg 1	010	HiBioA (1)	2022-09-20	19:27:00	60.47144	-61.24986	564	572
Leg 1	011	HiBioA (2)	2022-09-21	12:57:00	60.45024	-61.226	709	726
Leg 2								
Leg 2	001	A1	2022-09-24	19:28:00	66.60666	-61.18852	99	109
Leg 2	002	A2	2022-09-25	01:17:00	66.6694	-60.4756	515	523
Leg 2	003	A3	2022-09-25	06:26:00	66.73082	-59.608	864	873
Leg 2	004	A4	2022-09-25	19:26:00	66.79768	-58.73792	877	887
Leg 2	005	A5	2022-09-26	02:36:00	66.87664	-57.95712	819	829
Leg 2	006	195	2022-09-26	13:03:00	66.88712	-56.93088	654	662
Leg 2	007	196	2022-09-26	20:17:00	66.98324	-56.06718	119	129
Leg 2	008	197	2022-09-27	04:41:00	67.04428	-55.09574	61	70
Leg 2	009	198	2022-09-27	14:03:00	67.08512	-54.2036	65	75
Leg 2	010	B6	2022-09-28	08:51:00	67.28522	-58.43684	1125	1135
Leg 2	011	B5	2022-09-28	14:04:00	67.58724	-59.02384	1188	1198
Leg 2	012	B4	2022-09-28	23:05:00	67.46662	-59.63544	1428	1437
Leg 2	013	B3	2022-09-29	02:44:00	67.32946	-60.27714	1078	1087
Leg 2	014	B2	2022-09-29	10:31:00	67.19518	-60.89636	627	635
Leg 2	015	B1	2022-09-29	14:38:00	67.06014	-61.50838	106	113
Leg 2	016	C5	2022-09-29	23:11:00	68.14592	-59.9731	1375	1385
Leg 2	017	C4	2022-09-30	07:06:00	67.9579	-60.62494	1595	1605
Leg 2	018	C3	2022-09-30	12:56:00	67.74784	-61.26864	1555	1563
Leg 2	019	C2	2022-09-30	22:40:00	67.54752	-61.90764	413	420
Leg 2	020	C1	2022-10-01	03:10:00	67.34838	-62.53066	137	146
Leg 2	021	Broughton_T	2022-10-01	17:57:00	67.39604	-63.84868	452	462
Leg 2	022	D1	2022-10-02	07:10:00	67.47434	-63.68532	662	668
Leg 2	023	D2	2022-10-02	22:03:00	67.85626	-63.1448	255	265
Leg 2	024	D3	2022-10-03	02:22:00	68.2449	-62.59526	1550	1559
Leg 2	025	D4	2022-10-03	13:52:00	68.62838	-61.98124	1794	1803
Leg 2	026	D5	2022-10-03	18:42:00	69.00236	-61.4055	1826	1834
Leg 2	027	Clyde	2022-10-04	19:03:00	70.34794	-68.45464	332	341
Leg 2	028	Scott Inlet sill	2022-10-05	15:09:00	71.15394	-71.26854	449	458
Leg 2	029	Clark_fjord	2022-10-05	22:08:00	71.05054	-71.59096	669	678
Leg 2	030	SI_coring2	2022-10-06	02:52:00	70.96496	-71.3233	653	663
Leg 2	031	SI_coring3	2022-10-06	06:29:00	70.87536	-71.66164	674	683
Leg 2	032	324_south	2022-10-08	06:11:00	73.8251	-79.60446	845	855
Leg 2	033	323_east	2022-10-08	10:12:00	74.15138	-79.30468	786	795

Leg 2	034	102_south	2022-10-09	07:56:00	76.17866	-76.9801	287	295
Leg 2	035	103_south	2022-10-09	12:40:00	76.08736	-76.59422	251	260
Leg 2	036	104_south	2022-10-09	13:41:00	76.11012	-76.16374	287	296
Leg 2	037	105	2022-10-09	15:22:00	76.1222	-75.76466	341	349
Leg 2	038	106	2022-10-09	19:33:00	76.20942	-75.37534	343	353
Leg 2	039	107	2022-10-09	20:37:00	76.27246	-74.99742	421	431
Leg 2	040	108	2022-10-09	23:15:00	76.26452	-74.61174	435	445
Leg 2	041	109	2022-10-10	06:03:00	76.28758	-74.10964	437	446
Leg 2	042	110	2022-10-10	07:18:00	76.29722	-73.61706	518	526
Leg 2	043	115	2022-10-10	16:40:00	76.33378	-71.20374	657	666
Leg 2	044	116	2022-10-11	02:01:00	76.38166	-70.51848	126	134
Leg 2	045	114	2022-10-11	04:43:00	76.32732	-71.79374	599	609
Leg 2	046	113	2022-10-11	06:02:00	76.32284	-72.20088	544	553
Leg 2	047	112	2022-10-11	08:16:00	76.31514	-72.69986	548	557
Leg 2	048	111	2022-10-11	09:25:00	76.30568	-73.20742	579	588
Leg 2	049	Bio-Argo_2022	2022-10-12	06:59:00	72.89636	-65.60316	2334	2342
Leg 2	050	353	2022-10-14	17:15:00	61.154	-64.78216	384	387
Leg 2	051	354	2022-10-14	20:38:00	61.00472	-64.72826	499	510
Leg 2	052	355	2022-10-15	00:40:00	60.85378	-64.71846	417	428
Leg 2	053	356	2022-10-15	02:47:00	60.7407	-64.71442	279	288

Appendix 3 - List of participants on the 2022 *Amundsen* Expedition

Leg	Name	Position	Affiliation	Network Investigator/Supervisor	Embark place	Embark date	Disembark place	Disembark date
Leg 1	Adey, Jane	Media/Artist	CBC	Forest, Alexandre	Quebec City	2022-09-22	Iqaluit	2022-09-22
Leg 1, 2	Amirault, Daniel	Professional	Amundsen Science	Forest, Alexandre	Quebec City	2022-09-22	Quebec City	2022-10-19
Leg 2	Anderlini, Tia	PhD Student	University of Victoria	Cullen, Jay	Iqaluit	2022-09-22	Quebec City	2022-10-19
Leg 1	Armstrong, Maria	Research Staff	Dalhousie University	Algar, Christopher	Quebec City	2022-09-22	Iqaluit	2022-09-22
Leg 1	Atkinson, Margaret	MSc Student	University of New Brunswick	Limoges, Audrey	Quebec City	2022-09-22	Iqaluit	2022-09-22
Leg 1	Bennett, James Robert (Robbie	Research Staff	Natural Resources Canada	Normandeau, Alexandre	Quebec City	2022-09-22	Iqaluit	2022-09-22
Leg 2	Bracquart, Élodie	PhD Student	Université du Québec à Rimouski - ISMER	Montero-Serrano, Jean-Carlos	Iqaluit	2022-09-22	Quebec City	2022-10-19
Leg 2	Brice, Camille	PhD Student	Université du Québec à Rimouski - ISMER	Montero-Serrano, Jean-Carlos	Iqaluit	2022-09-22	Quebec City	2022-10-19
Leg 1	Broom, Laura	Research Staff	Natural Resources Canada	Normandeau, Alexandre	Quebec City	2022-09-22	Iqaluit	2022-09-22
Leg 2	Capelle, David	Research Staff	Fisheries and Oceans Canada - FWI	Capelle, David	Iqaluit	2022-09-22	Quebec City	2022-10-19
Leg 1, 2	Carrier Belleau, Charlotte	Postdoctoral Fellow	Université Laval	Gigault, Julien / Archambault, P	Quebec City	2022-09-22	Quebec City	2022-10-19
Leg 1	Carson, Thomas	Research Staff	Natural Resources Canada	Normandeau, Alexandre	Quebec City	2022-09-22	Iqaluit	2022-09-22
Leg 2	Christie, Graham Andrew	BSc Student	University of New Brunswick	Church, Ian	Iqaluit	2022-09-22	Quebec City	2022-10-19
Leg 2	Ciastek, Stephen	Professional	University of Manitoba	Kuzyk, Zou Zou	Iqaluit	2022-09-22	Quebec City	2022-10-19
Leg 1	Clark, Hannah Poppy	PhD Student	University of Edinburgh	De Clippele, Laurence / Cote, D	Quebec City	2022-09-22	Iqaluit	2022-09-22
Leg 1	Cote, David	Chief Scientist	Fisheries and Oceans Canada - NL	Cote, David	Quebec City	2022-09-22	Iqaluit	2022-09-22
Leg 1	de Froe, Evert	Postdoctoral Fellow	Memorial University	Geoffroy, Maxime	Quebec City	2022-09-22	Iqaluit	2022-09-22
Leg 1	Desforges, Jessica	Research Staff	Fisheries and Oceans Canada - NL	Cote, David	Quebec City	2022-09-22	Iqaluit	2022-09-22
Leg 2	Deslongchamps, Gabrièle	Research Staff	Université Laval	Tremblay, Jean-Éric	Iqaluit	2022-09-22	Quebec City	2022-10-19
Leg 1	Desmarais, Amélie	Professional	Amundsen Science	Forest, Alexandre	Quebec City	2022-09-22	Iqaluit	2022-09-22
Leg 1	Dezutter, Thibaud	Professional	Amundsen Science	Forest, Alexandre	Quebec City	2022-09-22	Iqaluit	2022-09-22
Leg 1	Dove, Rachel	Research Staff	Fisheries and Oceans Canada - NL	Neves, Barbara	Quebec City	2022-09-22	Iqaluit	2022-09-22
Leg 1	England, Whitney	Research Staff	University of Calgary	Hubert, Casey	Quebec City	2022-09-22	Iqaluit	2022-09-22
Leg 2	Fernandes, Luiz Filipe	Professional	Amundsen Science	Forest, Alexandre	Iqaluit	2022-09-22	Quebec City	2022-10-19
Leg 1	Forbes, Rachel	MSc Student	Memorial University	Fisher, Jonathan	Quebec City	2022-09-22	Iqaluit	2022-09-22
Leg 2	Gagnon, Jonathan	Professional	Université Laval	Tremblay, Jean-Éric	Iqaluit	2022-09-22	Quebec City	2022-10-19
Leg 1	Geizer, Haley	MSc Student	Dalhousie University	Algar, Christopher	Quebec City	2022-09-22	Iqaluit	2022-09-22
Leg 2	Geoffroy, Maxime	Chief Scientist	Marine Institute of Memorial University of	Geoffroy, Maxime	Iqaluit	2022-09-22	Quebec City	2022-10-19
Leg 2	Guillot, Pascal	Professional	Amundsen Science	Forest, Alexandre	Iqaluit	2022-09-22	Quebec City	2022-10-19
Leg 2	Hammett, Devin	MSc Student	University of Manitoba	Kuzyk, Zou Zou	Iqaluit	2022-09-22	Quebec City	2022-10-19
Leg 1	Hannaford, Michael Patrick	Professional	Canadian Scientific Submersible Facility	Shepherd, Keith	Quebec City	2022-09-22	Iqaluit	2022-09-22
Leg 1	Harald Sandland, Bjorn	Professional	Kongsberg	Forest, Alexandre	Quebec City	2022-09-22	Iqaluit	2022-09-22
Leg 1	Hayes (Wareham), Vonda	Professional	Fisheries and Oceans Canada - NL	Neves, Barbara	Quebec City	2022-09-22	Iqaluit	2022-09-22
Leg 2	Herbig, Jennifer	PhD Student	Memorial University	Geoffroy, Maxime	Iqaluit	2022-09-22	Quebec City	2022-10-19
Leg 1	Hubert, Casey	Researcher/Professor	University of Calgary	Hubert, Casey	Quebec City	2022-09-22	Iqaluit	2022-09-22
Leg 1, 2	Jacobsen, Eugenie	MSc Student	Memorial University	Geoffroy, Maxime	Quebec City	2022-09-22	Quebec City	2022-10-19

Leg	Name	Position	Affiliation	Network Investigator/Supervisor	Embark place	Embark date	Disembark place	Disembark date
Leg 1	Ji, Meng	Professional	University of Calgary	Hubert, Casey	Quebec City	2022-09-22	Iqaluit	2022-09-22
Leg 2	Kitching, Elizabeth	MSc Student	Fisheries and Oceans Canada - FWI	Michel, Christine	Iqaluit	2022-09-22	Quebec City	2022-10-19
Leg 2	Koerner, Kelsey	PhD Student	Université du Québec à Rimouski - ISMER	Rochon, André / Limoges, Aud	Iqaluit	2022-09-22	Quebec City	2022-10-19
Leg 2	Marcil, Catherine	Research Staff	Fisheries and Oceans Canada - FWI	Michel, Christine	Iqaluit	2022-09-22	Quebec City	2022-10-19
Leg 2	McPherson, Alyssa	Research Staff	Environment and Climate Change Canada	Jantunen, Liisa	Iqaluit	2022-09-22	Quebec City	2022-10-19
Leg 1, 2	Meredyk, Shawn	Professional	Amundsen Science	Forest, Alexandre	Quebec City	2022-09-22	Quebec City	2022-10-19
Leg 1	Morisset, Simon	Professional	Amundsen Science	Forest, Alexandre	Quebec City	2022-09-22	Iqaluit	2022-09-22
Leg 1, 2	Morrissey, Christopher	Professional	Amundsen Science	Forest, Alexandre	Quebec City	2022-09-22	Quebec City	2022-10-19
Leg 2	Nakashuk, Charlie	Technician	Environment and Climate Change Canada	Michel, Christine	Iqaluit	2022-09-22	Quebec City	2022-10-19
Leg 1	Neves, Barbara	Professional	Fisheries and Oceans Canada - NL	Neves, Barbara	Quebec City	2022-09-22	Iqaluit	2022-09-22
Leg 1, 2	Nickoloff, Gina	MSc Student	University of Calgary	Else, Brent	Quebec City	2022-09-22	Quebec City	2022-10-19
Leg 2	Oates, Ashley	MSc Student	Memorial University	Geoffroy, Maxime	Iqaluit	2022-09-22	Quebec City	2022-10-19
Leg 1	Pamak, Carla	Wildlife/Bird Observer	Nunatsiavut Government	Saunders, Michelle	Quebec City	2022-09-22	Iqaluit	2022-09-22
Leg 2	Pearson, Marcia	Professional	Amundsen Science	Forest, Alexandre	Iqaluit	2022-09-22	Quebec City	2022-10-19
Leg 1	Pickett, David Paul	Media/Artist	CBC	Forest, Alexandre	Quebec City	2022-09-22	Iqaluit	2022-09-22
Leg 2	Pierrejean, Marie	Postdoctoral Fellow	Université Laval	Archambault, Philippe	Iqaluit	2022-09-22	Quebec City	2022-10-19
Leg 1	Roul, Sheena	Research Staff	Fisheries and Oceans Canada - NL	Cote, David	Quebec City	2022-09-22	Iqaluit	2022-09-22
Leg 1	Saunders, Michelle	Professional	Nunatsiavut Government	Saunders, Michelle	Quebec City	2022-09-22	Iqaluit	2022-09-22
Leg 2	Sezginer, Yayla	MSc Student	University of British Columbia	Tortell, Philippe	Iqaluit	2022-09-22	Quebec City	2022-10-19
Leg 1	Sharpe, Hannah	MSc Student	University of New Brunswick	Limoges, Audrey	Quebec City	2022-09-22	Iqaluit	2022-09-22
Leg 1	Shepherd, Trevor	Professional	Canadian Scientific Submersible Facility	Shepherd, Keith	Quebec City	2022-09-22	Iqaluit	2022-09-22
Leg 2	Soetaert, Grayson	MSc Student	University of Victoria	Cullen, Jay	Iqaluit	2022-09-22	Quebec City	2022-10-19
Leg 1	Sutton, Jordan	Research Staff	Fisheries and Oceans Canada - NL	Cote, David	Quebec City	2022-09-22	Iqaluit	2022-09-22
Leg 2	Vandenbyllaardt, Lenore	Professional	Fisheries and Oceans Canada - FWI	Hedges, Kevin	Iqaluit	2022-09-22	Quebec City	2022-10-19
Leg 2	Villeneuve, Vincent	Research Staff	Fisheries and Oceans Canada - FWI	Michel, Christine	Iqaluit	2022-09-22	Quebec City	2022-10-19
Leg 2	Vogt, Judith	Postdoctoral Fellow	St. Francis Xavier University	Sherwood, Owen	Iqaluit	2022-09-22	Quebec City	2022-10-19
Leg 1	Wallace, Kim	Professional	Canadian Scientific Submersible Facility	Shepherd, Keith	Quebec City	2022-09-22	Iqaluit	2022-09-22
Leg 2	Yu, Jasmine Thea	Research Staff	University of Toronto	Jantunen, Liisa	Iqaluit	2022-09-22	Quebec City	2022-10-19

Appendix 4 - Scientific log of science activities conducted during the 2022 *Amundsen* Expedition

Leg	Station ID	Station Type	UTC Date	UTC time	Latitude	Longitude	Activity	Event	Depth (m)	Wind		Air (°C)	Water (°C)	Surface Salinity	Pr Baro	Hum (%)	Ice
										Dir	Speed						
Leg 1																	
1	Joeys Gully	Full	2022-09-12	17:21	54,6194245	-56,443439	Drop Camera	Deployment		29	0,2	9,4	10,42	30,64	1011,06	95	
1	Joeys Gully	Full	2022-09-12	17:36	54,6178995	-56,445342	Drop Camera	Bottom		83	3,6	10	10,79	30,58	1010,78	89	
1	Joeys Gully	Full	2022-09-12	17:56	54,6159957	-56,4463755	Drop Camera	Recovery		195	0,6	9,5	10,78	30,58	1010,67	92	
1	Joeys Gully	Full	2022-09-12	18:56	54,6211828	-56,452998	ROV	Deployment		80	6,7	10,1	10,45	30,69	1010,62	87	
1	Joeys Gully	Full	2022-09-12	23:09	54,6188827	-56,453693	ROV	Recovery		33	8	8,4	10,74	30,51	1010,66	94	
1	Joeys Gully	Full	2022-09-13	0:24	54,6181245	-56,445519	Hydrobios	Deployment		40	5,3	9	10,71	30,49	1010,58	94	
1	Joeys Gully	Full	2022-09-13	0:35	54,6176412	-56,4460927	Hydrobios	Bottom		39	1,7	9,1	10,54	30,58	1010,50	93	
1	Joeys Gully	Full	2022-09-13	0:51	54,6161988	-56,447726	Hydrobios	Recovery					10,72	30,50			
1	Joeys Gully	Full	2022-09-13	1:25	54,6145648	-56,4485862	IKMT	Deployment		17	2,3	8,1	10,68	30,50	1010,56	94	
1	Joeys Gully	Full	2022-09-13	1:39	54,6092203	-56,4423627	IKMT	Bottom		7	7,6	8,1	10,68	30,50	1010,60	96	
1	Joeys Gully	Full	2022-09-13	2:28	54,6139127	-56,4511065	IKMT	Recovery		23	5,5	8,1	10,67	30,51	1010,49	94	
1	Joeys Gully	Full	2022-09-13	2:48	54,6160367	-56,445652	Tucker	Deployment		0	3,2	9	10,62	30,57	1010,30	94	
1	Joeys Gully	Full	2022-09-13	2:58	54,611692	-56,4417812	Tucker	Bottom		56	5,3	8,4	10,68	30,49	1010,11	94	
1	Joeys Gully	Full	2022-09-13	3:11	54,6156328	-56,4353037	Tucker	Recovery		84	1,5	8,7	10,66	30,49	1010,18	94	
1	Joeys Gully	Full	2022-09-13	3:35	54,6186208	-56,4436407	Box Core	Deployment		336	0,2	8,4	10,69	30,49	1010,06	94	
1	Joeys Gully	Full	2022-09-13	3:47	54,6181995	-56,4450825	Box Core	Bottom		324	4,6	8,4	10,64	30,50	1010,15	95	
1	Joeys Gully	Full	2022-09-13	3:56	54,6180317	-56,4453848	Box Core	Recovery		357	2,5	8,6	10,63	30,52	1010,13	94	
1	Joeys Gully	Full	2022-09-13	7:36	54,5868558	-56,3008147	Drop Camera	Deployment		352	4,8	7,6	9,98	31,09	1009,61	99	
1	Joeys Gully	Full	2022-09-13	7:58	54,5868803	-56,3007303	Drop Camera	Bottom		352	4,4	7,4	10,22	30,95	1009,79	99	
1	Joeys Gully	Full	2022-09-13	8:43	54,5863757	-56,3012288	Drop Camera	Recovery		321	5,5	7,3	10,23	30,93	1010,10	99	
1	Joeys Gully	Full	2022-09-13	9:23	54,5986023	-56,3207883	Baited Camera	Deployment		326	7	7	9,73	31,10	1010,39	99	
1	Joeys Gully	Full	2022-09-13	9:44	54,59817	-56,320358	Baited Camera	Bottom		317	7	7	10,47	30,81	1010,35	99	
1	Joeys Gully	Full	2022-09-13	9:48	54,5975542	-56,3200877	Baited Camera	Recovery		312	7,4	6,9	9,48	31,21	1010,35	99	
1	Joeys Gully	Full	2022-09-13	10:39	54,589398	-56,3217718	AUV	Deployment		347	4,8	6,9	10,35	30,91	1010,47	99	
1	Joeys Gully	Full	2022-09-13	12:02	54,5912805	-56,3283425	AUV	Recovery		31	5,3	7,5	10,64	30,52	1010,64	99	
1	Joeys Gully	Full	2022-09-13	13:18	54,5741695	-56,2927048	CTD Rosette	Deployment		15	2,5	7,8	9,97	31,10	1011,28	99	
1	Joeys Gully	Full	2022-09-13	13:36	54,5732743	-56,2930133	CTD Rosette	Bottom		282	1,5	8,9	9,84	31,09	1011,23	99	
1	Joeys Gully	Full	2022-09-13	14:15	54,5704202	-56,2951015	CTD Rosette	Recovery		290	1,3	9,7	9,70	31,17	1011,12	96	
1	Joeys Gully	Full	2022-09-13	16:08	54,5987412	-56,3161233	Baited Camera	Recovery		314	3,6	8,5	10,87	30,57	1011,17	98	
1		Mapping	2022-09-13	21:03	55,5676547	-56,4956828	CTD Rosette	Deployment		201	3,6	8,9	7,38	31,66	1011,23	99	
1		Mapping	2022-09-13	21:33	55,5570783	-56,491004	CTD Rosette	Bottom		175	3,8	8,7	7,61	31,69	1011,45	99	
1		Mapping	2022-09-13	21:44	55,5554857	-56,4884783	CTD Rosette	Recovery		191	3,8	9	7,54	31,66	1011,40	98	
1		Mapping	2022-09-13	21:52	55,5528743	-56,4862668	CTD Rosette	Deployment		187	4,8	8,8	7,19	31,71	1011,39	99	
1		Mapping	2022-09-13	22:32	55,5447803	-56,481808	CTD Rosette	Bottom		156	1,5	8,8	7,64	31,62	1011,54	98	
1		Mapping	2022-09-13	23:07	55,5408225	-56,479163	CTD Rosette	Recovery		243	0	8,9	7,70	31,66	1011,56	97	
1		Mapping	2022-09-14	4:45	55,9553163	-56,835481	CTD Rosette	Deployment		129	5,7	7,5	5,90	32,37	1010,57	99	0

1		Mapping	2022-09-14	5:27	55,955724	-56,8284263	CTD Rosette	Bottom		160	8,4	7,5	6,25	32,15	1010,82	99	0
1		Mapping	2022-09-14	6:05	55,9543905	-56,825619	CTD Rosette	Recovery		127	7,8	7	6,00	32,40	1010,74	99	0
1	Hopedale Saddle	Full	2022-09-14	12:44	56,0256325	-57,4380787	Drop Camera	Deployment		138	15,8	8,2	8,56	31,57	1007,89	99	0
1	Hopedale Saddle	Full	2022-09-14	12:45	56,0257833	-57,4374648	Drop Camera	Bottom		146	17,3	10,4	8,63	31,54	1007,99	86	0
1	Hopedale Saddle	Full	2022-09-14	13:41	56,0246507	-57,4270118	Drop Camera	Recovery		131	21,7	11,3	8,47	31,55	1007,64	80	0
1	Hopedale Saddle	Full	2022-09-14	14:25	56,0285857	-57,4203602	Baited Camera	Deployment		133	16,6	7,6	8,50	31,59	1007,08	99	0
1	Hopedale Saddle	Full	2022-09-14	15:00	56,0281905	-57,4039023	Baited Camera	Recovery		137	15,4	9,1	7,11	31,78	1007,17	99	0
1	Hopedale Saddle	Full	2022-09-14	17:53	56,0656588	-57,4276852	Mooring	Deployment		130	12,4	11	7,07	32,00	1005,84	83	0
1	Hopedale Saddle	Full	2022-09-14	18:31	56,0609588	-57,4346978	Mooring	Bottom		137	18,8	7,3	7,82	31,82	1005,65	99	0
1	Hopedale Saddle	Full	2022-09-14	19:37	56,0933343	-57,4183607	CTD Rosette	Deployment		114	11,6	11,8	5,70	32,09	1005,12	84	0
1	Hopedale Saddle	Full	2022-09-14	19:52	56,0918918	-57,4206953	CTD Rosette	Bottom		139	10,1	11,3	5,67	32,09	1005,23	81	0
1	Hopedale Saddle	Full	2022-09-14	20:46	56,091233	-57,4359883	CTD Rosette	Recovery		118	17,9	7	6,13	32,05	1004,90	99	0
1	Hopedale Saddle	Full	2022-09-14	21:10	56,0932547	-57,4431372	Phytoplankton Net	Deployment		126	18,5	8,1	6,31	32,03	1004,84	99	0
1	Hopedale Saddle	Full	2022-09-14	21:14	56,0931058	-57,4433177	Phytoplankton Net	Bottom		124	17,3	7,8	6,30	32,03	1004,65	99	0
1	Hopedale Saddle	Full	2022-09-14	21:18	56,0929588	-57,4433653	Phytoplankton Net	Recovery		126	16,9	7,7	6,25	32,04	1004,87	99	0
1	Hopedale Saddle	Full	2022-09-14	21:47	56,0656268	-57,4603663	Box Core	Deployment					7,27	31,88			0
1	Hopedale Saddle	Full	2022-09-14	21:59	56,0661132	-57,4604798	Box Core	Bottom		119	9,7	11,4	7,35	31,88	1004,41	80	0
1	Hopedale Saddle	Full	2022-09-14	22:08	56,0660813	-57,4597773	Box Core	Recovery		115	22,7	9,6	7,23	31,92	1004,34	86	0
1	Nachvak Fjord	Full	2022-09-15	19:52	59,1032495	-63,4165587	Gravity Core	Deployment		221	2,5	6,3	3,94	31,44	1012,17	87	0
1	Nachvak Fjord	Full	2022-09-15	19:56	59,1033245	-63,4163318	Gravity Core	Bottom		214	1,9	6,5	3,25	32,02	1012,18	85	0
1	Nachvak Fjord	Full	2022-09-15	20:01	59,1035202	-63,4160685	Gravity Core	Recovery		234	1,1	6,9	3,22	32,02	1012,29	86	0
1	Nachvak Fjord	Full	2022-09-15	21:23	59,1098182	-63,4302285	Gravity Core	Deployment		215	8,6	6,4	3,42	31,94	1011,68	84	0
1	Nachvak Fjord	Full	2022-09-15	21:32	59,109796	-63,4303615	Gravity Core	Bottom		210	8,4	6,7	3,19	31,98	1011,70	84	0
1	Nachvak Fjord	Full	2022-09-15	21:35	59,1098737	-63,430184	Gravity Core	Recovery		210	7,6	6,6	3,29	31,98	1011,71	85	0
1	Nachvak Fjord	Full	2022-09-15	22:40	59,076821	-63,5004077	Hydrobios	Deployment		250	7,2	5,9	3,93	31,52	1011,06	91	0
1	Nachvak Fjord	Full	2022-09-15	22:46	59,076792	-63,5000182	Hydrobios	Bottom		241	8	5,8	3,06	31,94	1011,02	90	0
1	Nachvak Fjord	Full	2022-09-15	22:54	59,0769783	-63,499272	Hydrobios	Recovery		226	8,8	5,9	3,38	31,82	1010,92	89	0
1	Nachvak Fjord	Full	2022-09-15	23:22	59,074462	-63,520842	Beam	Deployment		256	1,5	5,5	4,93	30,88	1011,03	93	0
1	Nachvak Fjord	Full	2022-09-15	23:36	59,0797365	-63,5110283	Beam	Bottom		291	8	6,1	4,18	31,35	1010,83	84	0
1	Nachvak Fjord	Full	2022-09-15	23:52	59,0886132	-63,4966342	Beam	Recovery		262	13,1	6,7	3,70	31,51	1010,86	80	0
1	Nachvak Fjord	Full	2022-09-16	1:24	59,0683243	-63,5269117	Tucker	Deployment					4,37	31,66			0
1	Nachvak Fjord	Full	2022-09-16	1:30	59,069541	-63,5217725	Tucker	Bottom					4,79	30,55			0
1	Nachvak Fjord	Full	2022-09-16	1:37	59,0723637	-63,5157088	Tucker	Recovery					5,17	30,41			0
1	Nachvak Fjord	Full	2022-09-16	1:55	59,0758865	-63,5003138	Phytoplankton Net	Deployment		278	11,4	6,8	4,19	31,52	1010,48	76	0
1	Nachvak Fjord	Full	2022-09-16	2:00	59,0756772	-63,4996363	Phytoplankton Net	Bottom		283	12,8	7,5	3,31	31,82	1010,65	76	0
1	Nachvak Fjord	Full	2022-09-16	2:02	59,0756103	-63,4994815	Phytoplankton Net	Recovery		264	6,5	8,4	3,29	31,96	1010,79	72	0
1	Nachvak Fjord	Full	2022-09-16	2:36	59,0759132	-63,5285903	Drop Camera	Deployment		304	2,1	6,9	3,43	31,72	1011,12	83	0
1	Nachvak Fjord	Full	2022-09-16	2:46	59,0760725	-63,5282477	Drop Camera	Bottom		228	4,8	5,9	3,44	31,73	1010,94	91	0
1	Nachvak Fjord	Full	2022-09-16	3:23	59,0743145	-63,5254143	Drop Camera	Recovery		141	0	6,3	3,77	31,59	1010,58	92	0
1	Nachvak Fjord	Full	2022-09-16	3:40	59,076316	-63,5280987	CTD Rosette	Deployment		223	2,7	5,7	3,21	31,91	1010,42	94	0

1	Nachvak Fjord	Full	2022-09-16	3:50	59,0769572	-63,5284293	CTD Rosette	Bottom		184	5,1	5,7	3,19	31,88	1010,30	94	0
1	Nachvak Fjord	Full	2022-09-16	4:17	59,0769965	-63,5269827	CTD Rosette	Recovery		312	7,2	6,1	3,21	31,83	1010,41	79	0
1	Nachvak Fjord	Full	2022-09-16	5:11	59,074136	-63,4832493	Drop Camera	Deployment		219	11,8	6,7	3,19	31,87	1010,89	83	0
1	Nachvak Fjord	Full	2022-09-16	5:17	59,0744418	-63,483343	Drop Camera	Bottom		218	10,3	6,8	3,33	31,81	1010,76	82	0
1	Nachvak Fjord	Full	2022-09-16	5:50	59,0772775	-63,4795647	Drop Camera	Recovery		209	9,3	6,4	3,78	31,49	1010,48	85	0
1	Nachvak Fjord	Full	2022-09-16	6:16	59,0905088	-63,4294152	Drop Camera	Deployment		295	5,7	6,9	3,36	31,92	1009,90	77	0
1	Nachvak Fjord	Full	2022-09-16	6:24	59,0909207	-63,4291022	Drop Camera	Bottom		293	2,5	6,9	3,53	31,80	1009,90	75	0
1	Nachvak Fjord	Full	2022-09-16	6:59	59,0937132	-63,4285045	Drop Camera	Recovery		322	5,9	7	3,73	31,78	1010,26	72	0
1	Nachvak Fjord	Full	2022-09-16	7:55	59,0761305	-63,5304165	Box Core	Deployment		308	11,2	6,3	3,10	31,95	1009,04	76	0
1	Nachvak Fjord	Full	2022-09-16	8:02	59,0761075	-63,5302938	Box Core	Bottom		312	7,8	6,2	3,12	31,96	1009,07	77	0
1	Nachvak Fjord	Full	2022-09-16	8:09	59,0760185	-63,5296482	Box Core	Recovery		289	5,9	6	3,13	31,94	1009,01	77	0
1	Nachvak Fjord	Full	2022-09-16	9:39	59,0874712	-63,4863538	Baited Camera	Deployment		297	14,1	6,3	3,56	31,67	1009,67	78	0
1	Nachvak Fjord	Full	2022-09-16	9:42	59,0871175	-63,4853777	Baited Camera	Bottom		266	10,3	6,1	3,29	31,89	1009,73	78	0
1	Nachvak Fjord	Full	2022-09-16	10:26	59,0955175	-63,4251655	Gravity Core	Deployment		211	0	6,6	3,47	31,90	1009,59	79	0
1	Nachvak Fjord	Full	2022-09-16	10:30	59,0954943	-63,4248063	Gravity Core	Bottom		192	2,5	6,6	3,32	31,98	1009,51	79	0
1	Nachvak Fjord	Full	2022-09-16	10:34	59,0955358	-63,4245795	Gravity Core	Recovery		144	2,1	6,5	3,39	31,98	1009,48	79	0
1	Nachvak Fjord	Full	2022-09-16	12:36	59,0943858	-63,4227618	AUV	Deployment		264	8,6	8,7	3,70	31,46	1009,81	69	0
1	Nachvak Fjord	Full	2022-09-16	14:27	59,0880997	-63,4854858	Baited Camera	Recovery		281	12,2	8,5	3,64	31,70	1009,24	64	0
1	Nachvak Fjord	Full	2022-09-16	15:29	59,0987542	-63,4163418	AUV	Recovery					3,41	31,92			0
1	Nachvak Fjord	Full	2022-09-16	16:59	59,0863097	-63,4854877	ROV	Deployment		311	9,9	9,6	3,06	31,90	1006,71	63	0
1	Nachvak Fjord	Full	2022-09-16	17:16	59,0855497	-63,4853622	ROV	Recovery		284	8,6	9,6	3,48	31,80	1006,69	63	0
1	Nachvak Fjord	Full	2022-09-16	17:32	59,0855927	-63,4855543	ROV	Deployment		273	7,4	9,5	3,46	31,87	1006,52	62	0
1	Nachvak Fjord	Full	2022-09-16	17:55	59,0864205	-63,4842443	ROV	Bottom		295	7,8	9,8	3,15	31,96	1006,52	62	0
1	Nachvak Fjord	Full	2022-09-16	20:34	59,0747033	-63,4832968	ROV	Recovery		259	16,6	9,6	5,01	30,25	1005,75	57	0
1	Hebron Fjord	Full	2022-09-17	6:08	58,1488455	-62,7888952	Baited Camera	Deployment		287	4	7,6	5,29	30,88	1002,14	68	0
1	Hebron Fjord	Full	2022-09-17	6:08	58,1488213	-62,788733	Baited Camera	Bottom		288	2,7	7,6	5,12	30,98	1002,14	68	0
1	Hebron Fjord	Full	2022-09-17	6:41	58,1511335	-62,802736	Hydrobios	Deployment		7	4	7,5	4,78	31,26	1001,94	75	0
1	Hebron Fjord	Full	2022-09-17	6:49	58,1511312	-62,8021843	Hydrobios	Bottom		48	0	7	5,00	31,16	1001,97	75	0
1	Hebron Fjord	Full	2022-09-17	6:57	58,1510245	-62,8011587	Hydrobios	Recovery		27	2,7	7,2	4,59	31,39	1001,96	72	0
1	Hebron Fjord	Full	2022-09-17	7:30	58,1505538	-62,8022457	Hydrobios	Deployment		41	0	7,6	5,30	30,94	1001,79	69	0
1	Hebron Fjord	Full	2022-09-17	7:36	58,150437	-62,8020353	Hydrobios	Bottom		49	0	7,5	5,30	30,94	1001,77	71	0
1	Hebron Fjord	Full	2022-09-17	7:46	58,1507298	-62,8004788	Hydrobios	Recovery		34	0	7,4	5,29	30,94	1001,75	71	0
1	Hebron Fjord	Full	2022-09-17	8:16	58,1509105	-62,7994912	Tucker	Deployment		50	1	7,2	5,23	30,97	1001,64	71	0
1	Hebron Fjord	Full	2022-09-17	8:21	58,1511528	-62,7939852	Tucker	Bottom		18	2,9	7,1	5,28	30,98	1001,62	69	0
1	Hebron Fjord	Full	2022-09-17	8:29	58,1518845	-62,7863332	Tucker	Recovery		6	2,1	7	5,29	30,97	1001,60	71	0
1	Hebron Fjord	Full	2022-09-17	8:49	58,1504388	-62,802121	Phytoplankton Net	Deployment		15	4,8	7,4	5,30	30,72	1001,66	70	0
1	Hebron Fjord	Full	2022-09-17	8:55	58,1506363	-62,8015995	Phytoplankton Net	Bottom		11	4,8	7,3	5,25	30,82	1001,64	70	0
1	Hebron Fjord	Full	2022-09-17	8:56	58,1506382	-62,8015217	Phytoplankton Net	Recovery		15	4,4	7,3	5,26	30,84	1001,64	69	0
1	Hebron Fjord	Full	2022-09-17	9:57	58,15012	-62,7591217	Beam Trawl	Deployment		332	5,1	7	5,27	31,05	1001,47	71	0
1	Hebron Fjord	Full	2022-09-17	10:13	58,1542328	-62,7439295	Beam Trawl	Bottom		336	9,5	6,9	4,62	31,08	1001,38	71	0

1	Hebron Fjord	Full	2022-09-17	10:34	58,1626212	-62,7504683	Beam Trawl	Recovery		308	8,4	7,3	4,37	31,33	1001,45	71	0
1	Hebron Fjord	Full	2022-09-17	12:41	58,148677	-62,7863357	Baited Camera	Recovery		245	2,7	6,6	5,36	30,62	1001,42	79	0
1	Hebron Fjord	Full	2022-09-17	13:27	58,1487777	-62,7869837	ROV	Deployment					5,07	30,99			0
1	Hebron Fjord	Full	2022-09-17	13:50	58,1483495	-62,7860882	ROV	Bottom		68	1,9	6,9	5,38	30,52	1001,05	83	0
1	Hebron Fjord	Full	2022-09-17	16:13	58,1469868	-62,7889812	ROV	Recovery					5,26	30,93			0
1	Hebron Fjord	Full	2022-09-17	16:55	58,1492052	-62,7774127	Box Core	Deployment		95	9,5	6,8	5,07	30,93	1000,33	77	0
1	Hebron Fjord	Full	2022-09-17	17:03	58,1490125	-62,7769717	Box Core	Bottom		79	4,2	7	5,30	30,68	1000,35	76	0
1	Hebron Fjord	Full	2022-09-17	17:11	58,1491147	-62,776284	Box Core	Recovery		26	5,7	7	5,21	30,66	1000,32	77	0
1	Hebron Fjord	Full	2022-09-17	17:31	58,1494992	-62,7761965	Box Core	Deployment		93	6,5	6,7	5,23	30,82	1000,33	77	0
1	Hebron Fjord	Full	2022-09-17	17:37	58,1495975	-62,7763392	Box Core	Bottom		68	5,7	6,1	5,24	30,73	1000,42	79	0
1	Hebron Fjord	Full	2022-09-17	17:44	58,1494468	-62,776027	Box Core	Recovery		86	6,1	6,2	4,76	30,90	1000,45	79	0
1	Hebron Fjord	Full	2022-09-17	18:16	58,1491333	-62,7765578	Box Core	Deployment					5,27	30,52			0
1	Hebron Fjord	Full	2022-09-17	18:22	58,14928	-62,7756167	Box Core	Bottom					4,65	31,13			0
1	Hebron Fjord	Full	2022-09-17	18:28	58,1490052	-62,7765338	Box Core	Recovery					5,34	30,47			0
1	Hebron Fjord	Full	2022-09-17	19:48	58,1508715	-62,8010293	ROV	Deployment		321	6,7	6,6	4,72	31,09	1000,17	78	0
1	Hebron Fjord	Full	2022-09-17	20:16	58,1511528	-62,801154	ROV	Bottom		327	5,5	7,2	5,27	30,18	1000,04	72	0
1	Hebron Fjord	Full	2022-09-17	21:36	58,1507708	-62,8014177	ROV	Recovery		344	10,9	6,6	5,14	30,67	999,89	74	0
1	Hebron Fjord	Full	2022-09-17	22:08	58,1502855	-62,7998103	CTD Rosette	Deployment		345	11,8	6,5	5,04	30,64	999,88	73	0
1	Hebron Fjord	Full	2022-09-17	22:18	58,1498568	-62,7996545	CTD Rosette	Bottom		8	10,9	6,3	5,05	30,67	999,83	74	
1	Hebron Fjord	Full	2022-09-17	22:53	58,1488952	-62,797948	CTD Rosette	Recovery		326	9,1	6,4	5,00	30,72	999,77	72	
1	Hebron Fjord	Full	2022-09-17	23:46	58,1452558	-62,7434297	Drop camera	Deployment		42	3,2	4,8	5,39	30,36	999,83	83	
1	Hebron Fjord	Full	2022-09-17	23:50	58,1452728	-62,7427538	Drop camera	Bottom		32	3,6	4,9	5,38	30,30	999,74	83	
1	Hebron Fjord	Full	2022-09-18	0:25	58,1464295	-62,736523	Drop camera	Recovery		344	3,8	4,7	5,13	30,66	999,30	80	
1	Hebron Fjord	Full	2022-09-18	1:39	58,11966	-63,0006727	Box Core	Deployment		74	4,2	5,6	4,42	30,76	999,28	83	
1	Hebron Fjord	Full	2022-09-18	1:46	58,1194075	-63,0009273	Box Core	Bottom		79	9,3	5,5	4,78	30,55	999,24	83	
1	Hebron Fjord	Full	2022-09-18	1:55	58,119162	-63,0018053	Box Core	Recovery		62	11,6	5,1	4,59	30,69	999,17	85	
1	Hebron Fjord	Full	2022-09-18	2:08	58,1192867	-63,001823	Box Core	Deployment		58	13,7	4,9	4,57	30,68	999,12	84	
1	Hebron Fjord	Full	2022-09-18	2:13	58,119277	-63,0018422	Box Core	Bottom		50	14,1	5	4,41	30,86	999,26	82	
1	Hebron Fjord	Full	2022-09-18	2:20	58,1191175	-63,0021867	Box Core	Recovery					4,61	30,64			
1	Hebron Fjord	Full	2022-09-18	2:59	58,1342258	-62,9653573	Drop camera	Deployment		76	6,7	5,1	4,27	30,49	999,06	82	
1	Hebron Fjord	Full	2022-09-18	3:02	58,134149	-62,9654582	Drop camera	Bottom		60	7	5	4,13	30,75	999,09	81	
1	Hebron Fjord	Full	2022-09-18	3:34	58,1330562	-62,969133	Drop camera	Recovery		103	5,7	5,8	4,94	30,32	998,93	80	
1	Hebron Fjord	Full	2022-09-18	4:42	58,1488018	-62,7882128	Hydrobios	Deployment		355	24	4,7	4,06	31,46	998,54	78	
1	Hebron Fjord	Full	2022-09-18	4:49	58,1489	-62,7884608	Hydrobios	Bottom		357	23,4	4,6	4,36	31,37	998,97	80	
1	Hebron Fjord	Full	2022-09-18	4:58	58,1489377	-62,7886755	Hydrobios	Recovery		340	22,3	5,2	4,35	31,33	998,87	81	
1	Hebron Fjord	Full	2022-09-18	5:29	58,1485107	-62,7892075	Hydrobios	Deployment		347	24,8	4,7	4,34	31,24	998,09	80	
1	Hebron Fjord	Full	2022-09-18	5:35	58,1486073	-62,7896108	Hydrobios	Bottom		346	19,4	4,2	4,26	31,40	997,94	82	
1	Hebron Fjord	Full	2022-09-18	5:44	58,1484242	-62,7900123	Hydrobios	Recovery		341	26,8	5	4,40	31,30	997,92	80	
1	Hebron Fjord	Full	2022-09-18	7:14	58,151491	-62,8778988	Drop camera	Deployment		333	9,9	5	4,54	31,41	999,97	79	
1	Hebron Fjord	Full	2022-09-18	7:20	58,1514053	-62,8768567	Drop camera	Bottom					4,44	31,59			

1	Hebron Fjord	Full	2022-09-18	7:56	58,1497785	-62,8732717	Drop camera	Recovery		359	20,4	4,8	4,62	31,03	1000,03	78	
1	Hebron Fjord	Full	2022-09-18	8:47	58,1375998	-62,9692708	Drop camera	Deployment		328	15	7	4,63	30,12	1000,87	68	
1	Hebron Fjord	Full	2022-09-18	8:49	58,1374255	-62,969158	Drop camera	Bottom		353	16	6,2	4,26	30,65	1000,94	69	
1	Hebron Fjord	Full	2022-09-18	9:22	58,1347708	-62,9656962	Drop camera	Recovery		287	8,2	6	4,48	30,46	1001,29	71	
1	Hebron Fjord	Full	2022-09-18	10:32	58,1486823	-62,788007	ROV	Deployment		339	18,7	6,3	4,44	30,98	1001,75	68	
1	Hebron Fjord	Full	2022-09-18	11:18	58,14916	-62,78553	ROV	Recovery									
1	Hebron Fjord	Full	2022-09-19	3:00	58,150612	-62,8785858	Baited camera	Deployment					4,81	28,25			
1	Hebron Fjord	Full	2022-09-19	3:00	58,150567	-62,87837	Baited camera	Bottom		298	11,4	7,5	4,77	28,25	1008,40	56	
1	Hebron Fjord	Full	2022-09-19	3:56	58,1516807	-62,650087	Box Core	Deployment		320	10,9	8,1	5,03	28,25	1008,13	52	
1	Hebron Fjord	Full	2022-09-19	4:05	58,1515828	-62,6502515	Box Core	Bottom		319	11	8,1	5,07	28,25	1008,26	52	
1	Hebron Fjord	Full	2022-09-19	4:13	58,1515033	-62,6501852	Box Core	Recovery		312	9,1	7,9	5,00	28,25	1008,23	53	
1	Hebron Fjord	Full	2022-09-19	4:27	58,1519832	-62,6503462	Box Core	Deployment		311	9,7	7,8	5,00	28,25	1008,27	52	
1	Hebron Fjord	Full	2022-09-19	4:34	58,1518647	-62,650424	Box Core	Bottom		317	8,9	7,7	5,03	28,25	1008,28	53	
1	Hebron Fjord	Full	2022-09-19	4:40	58,1518642	-62,6499795	Box Core	Recovery		309	8,9	7,8	4,98	28,25	1008,29	52	
1	Hebron Fjord	Full	2022-09-19	5:55	58,1487018	-62,7889867	Hydrobios	Deployment		250	10,1	6,3	4,38	28,27	1008,98	63	
1	Hebron Fjord	Full	2022-09-19	6:01	58,148384	-62,7883418	Hydrobios	Bottom		263	7,2	6,1	4,71	28,28	1009,01	63	
1	Hebron Fjord	Full	2022-09-19	6:09	58,148137	-62,7879382	Hydrobios	Recovery		243	6,1	7	4,68	28,28	1009,18	62	
1	Hebron Fjord	Full	2022-09-19	6:38	58,1491377	-62,7903155	Hydrobios	Deployment		280	6,3	7,1	4,69	28,29	1009,34	57	
1	Hebron Fjord	Full	2022-09-19	6:43	58,1491063	-62,790247	Hydrobios	Bottom		266	5	6,7	4,64	28,29	1009,42	65	
1	Hebron Fjord	Full	2022-09-19	6:54	58,1491408	-62,7898542	Hydrobios	Recovery		281	7,2	5,9	4,72	28,29	1009,46	64	
1	Hebron Fjord	Full	2022-09-19	7:24	58,1488305	-62,7893542	Hydrobios	Deployment		259	7,6	7,1	4,64	28,30	1009,73	61	
1	Hebron Fjord	Full	2022-09-19	7:30	58,1488477	-62,7892527	Hydrobios	Bottom		250	9,3	7,2	4,73	28,30	1009,82	63	
1	Hebron Fjord	Full	2022-09-19	7:39	58,1487013	-62,7890933	Hydrobios	Recovery		274	9,1	8,3	4,63	28,30	1009,95	61	
1	Hebron Fjord	Full	2022-09-19	8:32	58,1489278	-62,788608	CTD Rosette	Deployment		271	12,6	5,9	4,59	28,30	1010,21	59	
1	Hebron Fjord	Full	2022-09-19	8:42	58,1485893	-62,7871432	CTD Rosette	Bottom		279	11,2	5,8	4,61	28,30	1010,34	55	
1	Hebron Fjord	Full	2022-09-19	8:47	58,1485118	-62,7868252	CTD Rosette	Recovery		271	11,6	6,4	4,49	28,30	1010,40	60	
1	Hebron Fjord	Full	2022-09-19	17:01	58,1519027	-62,8754352	Baited camera	Recovery		241	25,9	10,6	4,45	30,20	1009,38	56	
1	Hebron Fjord	Full	2022-09-19	20:47	58,1297733	-62,9894718	Calibration SPAR	Start		264	4	13,8	4,35	30,69	1010,80	40	
1	Hebron Fjord	Full	2022-09-19	21:01	58,1299908	-62,9875895	Calibration SPAR	End		258	10,7	14,1	4,60	30,14	1010,88	41	
1	SagBank	Mooring	2022-09-20	8:23	59,3666543	-60,3197987	IKMT	Deployment		286	1,1	5,9	3,85	33,27	1011,86	80	
1	SagBank	Mooring	2022-09-20	8:52	59,3622962	-60,2897452	IKMT	Bottom		273	10,9	4,8	3,43	33,20	1011,82	83	
1	SagBank	Mooring	2022-09-20	9:37	59,3800812	-60,26062	IKMT	Recovery		278	4,8	5,5	4,00	33,22	1012,38	83	
1	SagBank	Mooring	2022-09-20	10:12	59,3715023	-60,2971968	CTD Rosette	Deployment		267	7,8	6	3,96	33,23	1012,70	80	
1	SagBank	Mooring	2022-09-20	10:34	59,3696195	-60,2926923	CTD Rosette	Bottom		299	7,8	5,7	3,82	33,22	1012,72	82	
1	SagBank	Mooring	2022-09-20	11:12	59,3651817	-60,2811473	CTD Rosette	Recovery		245	3,8	5,3	3,69	33,22	1012,80	86	
1	SagBank	Mooring	2022-09-20	12:10	59,3734492	-60,3053748	Mooring	Recovery		254	6,9	5,4	3,94	33,19	1012,75	84	
1	HiBioA	Mooring	2022-09-20	19:23	60,4713628	-61,24885	CTD Rosette	Deployment		209	6,3	6,5	4,05	33,35	1010,91	82	
1	HiBioA	Mooring	2022-09-20	19:38	60,4719618	-61,251268	CTD Rosette	Bottom		201	5,9	6,2	4,08	33,34	1010,94	84	
1	HiBioA	Mooring	2022-09-20	20:12	60,4739585	-61,2548867	CTD Rosette	Recovery		181	9,7	5,6	4,15	33,32	1010,69	87	
1	HiBioA	Mooring	2022-09-20	20:32	60,4774583	-61,2662732	Mooring	Recovery		166	8,9	5,4	4,15	33,32	1010,54	87	

1	HiBioA	Mooring	2022-09-21	11:04	60,4614678	-61,2624067	Mooring	Deployment		190	12,6	6	3,90	33,33	1001,70	81	
1	HiBioA	Mooring	2022-09-21	11:23	60,46503	-61,2637018	Mooring	Bottom		190	9,7	5,6	3,91	33,33	1001,40	81	
1	HiBioA	Mooring	2022-09-21	11:55	60,4724713	-61,260182	Mooring	Deployment		185	10,1	5,8	3,91	33,33	1001,40	80	
1	HiBioA	Mooring	2022-09-21	12:08	60,4725228	-61,2602302	Mooring	Bottom		195	11,8	6,3	3,92	33,33	1001,37	78	
1	HiBioA	Mooring	2022-09-21	12:51	60,4490322	-61,228947	CTD Rosette	Deployment		160	10,1	5	4,01	33,33	1001,34	87	
1	HiBioA	Mooring	2022-09-21	13:10	60,4511312	-61,2186448	CTD Rosette	Bottom		173	7,8	5	3,94	33,33	1001,34	88	
1	HiBioA	Mooring	2022-09-21	13:27	60,4534188	-61,2148297	CTD Rosette	Recovery		197	9,1	5	3,93	33,33	1001,31	86	
Leg 2																	
2			2022-10-16	10:38	55,0564482	-57,2595813	CPR	Deployment		156	22,8	6,4	2,98	32,09	1016,39	89	
2			2022-10-16	10:15	55,0863085	-57,3694212	CPR	Recovery		148	21,9	5,8	3,04	32,07	1016,37	92	
2	356	CTD	2022-10-15	3:29	60,7441105	-64,760833	CTD Rosette	Recovery		113	14,1	3,8	2,13	32,26	1019,70	87	0
2	356	CTD	2022-10-15	2:53	60,7411417	-64,7227703	CTD Rosette	Bottom		129	23,6	3	2,18	32,22	1019,83	94	0
2	356	CTD	2022-10-15	2:47	60,7406525	-64,7143657	CTD Rosette	Deployment		120	21,5	2,4	2,20	32,20	1019,87	99	0
2	355	CTD	2022-10-15	1:35	60,8649762	-64,7655093	CTD Rosette	Recovery		66	2,9	2	2,05	32,02	1020,57	99	0
2	355	CTD	2022-10-15	0:48	60,8547992	-64,7256832	CTD Rosette	Bottom		113	29,5	1,6	1,90	32,00	1020,06	99	0
2	355	CTD	2022-10-15	0:40	60,8537535	-64,7183612	CTD Rosette	Deployment					1,89	31,99			0
2	354	CTD	2022-10-14	23:10	61,022217	-64,7580835	Monster Net	Recovery		152	3,6	1,8	0,68	32,69	1021,53	99	1
2	354	CTD	2022-10-14	22:56	61,0230502	-64,753095	Monster Net	Bottom		130	26,7	1,2	0,63	32,73	1021,16	99	1
2	354	CTD	2022-10-14	22:45	61,0231912	-64,7518905	Monster Net	Deployment		133	26,1	1,2	0,66	32,74	1021,63	99	1
2	354	CTD	2022-10-14	22:13	61,0159877	-64,7382525	Tucker Net	Recovery		123	21,9	1,1	0,65	32,71	1021,28	97	1
2	354	CTD	2022-10-14	22:03	61,014741	-64,7272682	Tucker Net	Bottom		117	19,8	1,2	0,65	32,70	1021,23	96	1
2	354	CTD	2022-10-14	21:52	61,0118188	-64,7142425	Tucker Net	Deployment		131	23,2	2	0,65	32,69	1021,68	95	1
2	354	CTD	2022-10-14	21:34	61,0058997	-64,6963588	CTD Rosette	Recovery		124	20,2	3	0,70	32,67	1022,06	92	1
2	354	CTD	2022-10-14	20:49	61,0056103	-64,7163263	CTD Rosette	Bottom		130	17,7	4,4	0,67	32,72	1022,36	86	1
2	354	CTD	2022-10-14	20:38	61,0048183	-64,7279242	CTD Rosette	Deployment		127	25,1	1,4	0,65	32,72	1022,27	97	1
2	354	CTD	2022-10-14	20:04	61,0122993	-64,7018513	Trace Metals Rosette	Recovery		129	24,4	1,3	0,59	32,73	1022,49	96	1
2	354	CTD	2022-10-14	19:52	61,0098863	-64,715101	Trace Metals Rosette	Bottom		134	26,1	1,6	0,58	32,73	1022,32	94	1
2	354	CTD	2022-10-14	19:34	61,0054302	-64,728329	Trace Metals Rosette	Deployment		99	15,2	3,9	0,62	32,72	1022,47	85	1
2	353	CTD	2022-10-14	18:15	61,1681178	-64,7876288	Plankton Net	Recovery		108	13,1	1,8	0,32	32,33	1023,05	93	1
2	353	CTD	2022-10-14	18:13	61,1673473	-64,7874948	Plankton Net	Bottom		105	14,5	1,8	0,20	32,33	1022,92	93	1
2	353	CTD	2022-10-14	18:11	61,1657792	-64,7883818	Plankton Net	Deployment		104	16	2	0,22	32,34	1022,85	93	1
2	353	CTD	2022-10-14	17:58	61,1594747	-64,7879808	CTD Rosette	Recovery		113	11,4	3	0,18	32,37	1023,20	88	1
2	353	CTD	2022-10-14	17:23	61,1538985	-64,7844757	CTD Rosette	Bottom		139	16	2,1	0,19	32,34	1023,29	92	1
2	353	CTD	2022-10-14	17:15	61,1539837	-64,7821137	CTD Rosette	Deployment		144	13,7	1,8	0,20	32,29	1023,20	93	1
2			2022-10-14	15:41	61,2732553	-64,6017978	CPR	Recovery		164	21,5	1,9	0,98	31,62	1023,38	90	1
2			2022-10-13	5:27	69,1558818	-63,9670998	CPR	Deployment		303	9,9	-1,6	0,41	31,34	1014,15	73	1
2			2022-10-13	5:15	69,1886085	-63,9792162	CPR	Recovery		326	1,3	-1,7	0,46	31,35	1014,02	72	1
2	Bio-Argo_2022	Bio Argo	2022-10-12	11:10	72,869597	-65,588316	CPR	Deployment		305	3,2	-2,5	-0,30	31,14	1006,80	74	1
2	Bio-Argo_2022	Bio Argo	2022-10-12	10:56	72,8928478	-65,5950202	Bio Argo	Bottom		317	18,8	-3,5	-0,33	31,21	1006,29	76	1
2	Bio-Argo_2022	Bio Argo	2022-10-12	10:49	72,894225	-65,6002357	Bio Argo	Bottom		325	21,5	-3,2	-0,22	31,28	1006,28	78	1

2	Bio-Argo_2022	Bio Argo	2022-10-12	10:38	72,8953897	-65,5984765	Bongo Net	Recovery		317	22,3	-3,5	-0,22	31,44	1006,20	80	1
2	Bio-Argo_2022	Bio Argo	2022-10-12	10:34	72,8957762	-65,598044	Bongo Net	Bottom		330	22,7	-3,4	-0,18	31,35	1006,14	81	1
2	Bio-Argo_2022	Bio Argo	2022-10-12	10:29	72,8961597	-65,5976987	Bongo Net	Deployment		322	21,3	-3,4	-0,22	31,29	1006,05	82	1
2	Bio-Argo_2022	Bio Argo	2022-10-12	10:11	72,8966767	-65,6017782	Trace Metals Rosett	Recovery		324	20,2	-3,5	-0,29	31,25	1006,02	84	1
2	Bio-Argo_2022	Bio Argo	2022-10-12	9:57	72,8966655	-65,6037128	Trace Metals Rosett	Bottom		333	22,1	-3,3	-0,30	31,40	1005,82	83	1
2	Bio-Argo_2022	Bio Argo	2022-10-12	9:43	72,8968767	-65,6046793	Trace Metals Rosett	Deployment		333	21,5	-3,1	-0,28	31,28	1005,58	80	1
2	Bio-Argo_2022	Bio Argo	2022-10-12	9:21	72,8884617	-65,578706	CTD Rosette	Recovery		335	16,6	-2,7	-0,27	31,20	1005,47	75	1
2	Bio-Argo_2022	Bio Argo	2022-10-12	7:43	72,8947802	-65,5968073	CTD Rosette	Bottom		351	18,7	-2,2	-0,29	31,24	1004,48	74	1
2	Bio-Argo_2022	Bio Argo	2022-10-12	6:59	72,8964155	-65,6032095	CTD Rosette	Deployment		336	19,2	-2,2	-0,28	31,24	1003,94	67	1
2	Bio-Argo_2022	Bio Argo	2022-10-12	6:37	72,8967957	-65,5786472	Trace Metals Rosett	Recovery		315	14,7	-1,1	-0,15	31,22	1003,89	67	1
2	Bio-Argo_2022	Bio Argo	2022-10-12	6:23	72,8977328	-65,5844485	Trace Metals Rosett	Bottom		321	21,3	-1,1	-0,30	31,15	1003,48	66	1
2	Bio-Argo_2022	Bio Argo	2022-10-12	6:01	72,898796	-65,59867	Trace Metals Rosett	Deployment		335	22,7	-2,3	-0,35	31,17	1003,29	68	1
2	Bio-Argo_2022	Bio Argo	2022-10-12	5:35	72,9198938	-65,6423667	CPR	Recovery		332	16,4	-3	-0,21	31,17	1003,27	76	1
2	111	Basic	2022-10-11	11:50	76,2849928	-73,2069543	CPR	Deployment		110	11	-4,2	-1,17	32,25	998,78	63	1
2	111	Basic	2022-10-11	11:17	76,3060398	-73,2165082	Box Core	Recovery		104	5	-3,7	-0,98	32,21	998,78	62	1
2	111	Basic	2022-10-11	11:00	76,3066542	-73,2150083	Box Core	Bottom		78	7,6	-3,8	-0,79	32,21	998,60	62	1
2	111	Basic	2022-10-11	10:43	76,3066308	-73,2146242	Box Core	Deployment		56	4,6	-3,9	-0,86	32,21	998,53	59	1
2	111	Basic	2022-10-11	10:24	76,2995088	-73,2100598	CTD Rosette	Recovery		80	5,7	-3,9	-0,91	32,21	998,43	61	1
2	111	Basic	2022-10-11	9:37	76,3046757	-73,2073837	CTD Rosette	Bottom		101	6,3	-4	-0,95	32,21	998,25	62	1
2	111	Basic	2022-10-11	9:25	76,3056973	-73,2072842	CTD Rosette	Deployment		84	7,2	-4,2	-0,57	32,20	998,07	59	1
2	112	CTD	2022-10-11	8:39	76,3128628	-72,7008025	CTD Rosette	Recovery		92	5,9	-4,2	-1,34	32,55	997,86	62	1
2	112	CTD	2022-10-11	8:28	76,3140812	-72,699473	CTD Rosette	Bottom		92	7,4	-4,4	-1,28	32,55	997,72	62	1
2	112	CTD	2022-10-11	8:17	76,31515	-72,699935	CTD Rosette	Deployment		88	6,3	-4,3	-1,35	32,55	997,73	59	1
2	113	Nutrient	2022-10-11	7:17	76,3228318	-72,1756473	Bongo Net	Recovery		48	5	-4,8	-1,52	32,08	997,50	60	1
2	113	Nutrient	2022-10-11	7:15	76,322899	-72,1758403	Bongo Net	Bottom		57	6,3	-4,7	-1,53	32,08	997,43	60	1
2	113	Nutrient	2022-10-11	7:12	76,3230238	-72,1763998	Bongo Net	Deployment		69	4,2	-4,8	-1,54	32,08	997,40	59	1
2	113	Nutrient	2022-10-11	7:02	76,3228365	-72,1792647	CTD Rosette	Recovery		52	4,6	-4,8	-1,56	32,10	997,43	57	1
2	113	Nutrient	2022-10-11	6:14	76,3228977	-72,2021375	CTD Rosette	Bottom		75	7,2	-4,8	-1,51	32,17	996,98	54	1
2	113	Nutrient	2022-10-11	6:02	76,3228323	-72,2008787	CTD Rosette	Deployment		87	8,9	-4,8	-1,46	32,18	996,82	54	1
2	114	CTD	2022-10-11	5:05	76,3272407	-71,8026342	CTD Rosette	Recovery		139	1,1	-4,6	-0,87	31,77	996,48	55	1
2	114	CTD	2022-10-11	4:54	76,3275558	-71,7963535	CTD Rosette	Bottom		81	6,9	-4,9	-0,85	31,76	996,53	54	1
2	114	CTD	2022-10-11	4:43	76,3273158	-71,7937322	CTD Rosette	Deployment		89	5,9	-5,1	-0,85	31,76	996,33	50	1
2	116	Nutrient	2022-10-11	2:44	76,3914758	-70,5598925	Bongo Net	Recovery		35	8,4	-5,6	0,46	31,44	995,89	48	1
2	116	Nutrient	2022-10-11	2:41	76,390826	-70,5570893	Bongo Net	Bottom		39	9,1	-5,7	0,46	31,44	995,86	53	1
2	116	Nutrient	2022-10-11	2:38	76,3901403	-70,5539515	Bongo Net	Deployment		62	8,9	-5,6	0,58	31,49	995,83	52	1
2	116	Nutrient	2022-10-11	2:28	76,3873562	-70,5381752	CTD Rosette	Recovery		55	5,3	-5,5	0,62	31,51	995,90	47	1
2	116	Nutrient	2022-10-11	2:04	76,3822988	-70,5218878	CTD Rosette	Bottom					0,53	31,50			1
2	116	Nutrient	2022-10-11	2:00	76,3814493	-70,5179303	CTD Rosette	Deployment		64	5,5	-5,7	0,80	31,56	995,80	47	1
2	115	Full	2022-10-11	0:07	76,3298492	-71,2263538	Box Core	Recovery		81	7	-4,9	0,23	32,27	995,15	58	0
2	115	Full	2022-10-10	23:50	76,3289365	-71,2216905	Box Core	Bottom		96	7,8	-5	0,28	32,29	994,82	57	0

2	115	Full	2022-10-10	23:33	76,3291768	-71,2176257	Box Core	Deployment					0,31	32,28			0
2	115	Full	2022-10-10	23:02	76,3466055	-71,2927232	IKMT	Recovery		109	10,9	-5	-0,26	32,12	994,44	58	0
2	115	Full	2022-10-10	22:15	76,3273283	-71,2729145	IKMT	Bottom		103	14,5	-4,7	-0,22	32,14	993,96	58	0
2	115	Full	2022-10-10	21:55	76,3348302	-71,2629837	IKMT	Deployment		132	3	-5	-0,17	32,16	993,80	58	0
2	115	Full	2022-10-10	21:15	76,3321653	-71,207505	Hydrobios	Recovery		96	12	-5	0,11	32,27	993,13	63	0
2	115	Full	2022-10-10	20:50	76,332773	-71,1997038	Hydrobios	Bottom		116	11,6	-5	0,03	32,25	992,72	65	0
2	115	Full	2022-10-10	20:33	76,333381	-71,1981863	Hydrobios	Deployment		107	13,5	-4,9	0,25	32,26	992,62	65	0
2	115	Full	2022-10-10	20:05	76,3337947	-71,1931633	Trace Metals Rosett	Recovery		107	14,5	-4,7	0,33	32,27	992,31	66	0
2	115	Full	2022-10-10	19:53	76,334907	-71,1884478	Trace Metals Rosett	Bottom		121	12,8	-4,5	0,32	32,28	992,21	66	0
2	115	Full	2022-10-10	19:42	76,3355582	-71,1894907	Trace Metals Rosett	Deployment		122	13,9	-4,5	0,26	32,29	991,97	65	0
2	115	Full	2022-10-10	19:07	76,3222767	-71,2616702	Tucker Net	Recovery		121	13,1	-4,3	0,12	32,25	991,48	69	0
2	115	Full	2022-10-10	18:55	76,32786	-71,2431538	Tucker Net	Bottom		126	17,3	-4,2	0,20	32,24	991,32	69	0
2	115	Full	2022-10-10	18:45	76,3318715	-71,2257918	Tucker Net	Deployment		123	16,9	-4,1	0,36	32,27	991,22	70	0
2	115	Full	2022-10-10	18:25	76,3311722	-71,1943308	Trace Metals Rosett	Recovery		130	19,4	-4,2	0,34	32,27	991,02	69	0
2	115	Full	2022-10-10	18:18	76,3311933	-71,1945843	Trace Metals Rosett	Bottom		136	19	-4,2	0,34	32,26	991,13	71	0
2	115	Full	2022-10-10	18:12	76,3312027	-71,194024	Trace Metals Rosett	Deployment		119	15	-4,1	0,34	32,26	990,98	72	0
2	115	Full	2022-10-10	17:40	76,336933	-71,2377183	CTD Rosette	Recovery		131	5,3	-2	0,31	32,24	990,69	66	0
2	115	Full	2022-10-10	16:53	76,3347162	-71,2118698	CTD Rosette	Bottom		161	2,3	-2,8	0,26	32,23	990,54	73	0
2	115	Full	2022-10-10	16:40	76,3337297	-71,2036957	CTD Rosette	Deployment		194	0,4	-3,2	0,28	32,23	990,53	67	0
2	110	Nutrient	2022-10-10	8:33	76,2830005	-73,6049198	Bongo Net	Recovery		337	28,9	-4,6	-1,73	32,09	996,55	61	0
2	110	Nutrient	2022-10-10	8:31	76,2833652	-73,6037347	Bongo Net	Bottom		340	30,1	-4,5	-1,73	32,10	996,58	66	0
2	110	Nutrient	2022-10-10	8:24	76,2853233	-73,5998798	Bongo Net	Deployment		345	27,6	-4,7	-1,55	32,13	996,64	64	0
2	110	Nutrient	2022-10-10	8:14	76,2877987	-73,6028617	CTD Rosette	Recovery		333	29,1	-4,8	-1,70	32,10	996,75	62	0
2	110	Nutrient	2022-10-10	7:28	76,2961618	-73,6133243	CTD Rosette	Bottom		345	27	-4,4	-1,72	32,09	997,90	63	0
2	110	Nutrient	2022-10-10	7:17	76,2973833	-73,6176503	CTD Rosette	Deployment		338	26,7	-4,3	-1,73	32,10	997,91	58	0
2	109	CTD	2022-10-10	6:20	76,2852252	-74,1071762	CTD Rosette	Recovery					-1,69	32,07			0
2	109	CTD	2022-10-10	6:11	76,2861387	-74,1061505	CTD Rosette	Bottom		359	22,1	-3,7	-1,70	32,06	998,94	58	0
2	109	CTD	2022-10-10	6:03	76,2876072	-74,1094295	CTD Rosette	Deployment		353	18,1	-3,8	-1,65	32,06	999,02	60	0
2	108	Full	2022-10-10	3:56	76,234611	-74,609355	Beam trawl	Recovery		5	11,6	-3,3	-1,33	31,96	1001,03	67	0
2	108	Full	2022-10-10	3:29	76,2517172	-74,6357065	Beam trawl	Bottom		358	10,3	-3,3	-1,27	32,00	1001,52	65	0
2	108	Full	2022-10-10	3:05	76,2648165	-74,6180963	Beam trawl	Deployment		340	4,6	-2,3	-1,35	31,99	1001,93	75	0
2	108	Full	2022-10-10	2:40	76,2654355	-74,611814	Hydrobios	Recovery		34	10,9	-3,2	-1,39	31,96	1002,19	74	0
2	108	Full	2022-10-10	2:25	76,2647122	-74,608839	Hydrobios	Bottom		60	9,3	-3,2	-1,39	31,96	1002,30	72	0
2	108	Full	2022-10-10	2:14	76,2639487	-74,6063125	Hydrobios	Deployment		63	9,1	-3,1	-1,39	31,96	1002,56	71	0
2	108	Full	2022-10-10	1:36	76,2600388	-74,653044	Tucker Net	Recovery		55	7,6	-3,3	-1,31	31,97	1002,99	73	0
2	108	Full	2022-10-10	1:27	76,2638893	-74,6373983	Tucker Net	Bottom		58	8,6	-3,3	-1,37	31,96	1003,04	71	0
2	108	Full	2022-10-10	1:18	76,2675318	-74,620946	Tucker Net	Deployment		49	8,6	-3,3	-1,29	32,15	1003,13	70	0
2	108	Full	2022-10-10	0:59	76,2671927	-74,6098443	Trace metals Rosett	Recovery		50	12,8	-3	-1,38	32,14	1003,26	72	0
2	108	Full	2022-10-10	0:45	76,2655488	-74,608116	Trace metals Rosett	Bottom		70	12,8	-2,8	-1,23	32,17	1003,40	74	0
2	108	Full	2022-10-10	0:31	76,2641782	-74,6038298	Trace metals Rosett	Deployment		61	14,9	-2,8	-1,04	32,21	1003,50	74	0

2	108	Full	2022-10-10	0:08	76,2693648	-74,6295302	CTD Rosette	Recovery		61	12,8	-3	-1,46	32,12	1003,84	80	0
2	108	Full	2022-10-09	23:23	76,265065	-74,6131193	CTD Rosette	Bottom		76	14,3	-3,3	-1,13	32,19	1004,19	88	0
2	108	Full	2022-10-09	23:15	76,2645208	-74,6118452	CTD Rosette	Deployment		84	17,1	-3,2	-1,02	32,19	1004,33	92	0
2	108	Full	2022-10-09	22:50	76,2640293	-74,6066723	Trace Metals Rosette	Recovery		87	17,7	-3,1	-1,00	32,23	1004,33	93	0
2	108	Full	2022-10-09	22:41	76,2639607	-74,6070317	Trace Metals Rosette	Bottom		89	14,3	-3,1	-0,95	32,23	1004,58	91	0
2	108	Full	2022-10-09	22:32	76,2641705	-74,6048647	Trace Metals Rosette	Deployment		113	6,7	-3,1	-1,12	32,19	1004,79	90	0
2	107	Nutrient	2022-10-09	21:47	76,267666	-75,0353953	Bongo Net	Recovery		102	7	-2,8	-1,61	30,06	1004,99	87	0
2	107	Nutrient	2022-10-09	21:44	76,2678455	-75,0310695	Bongo Net	Bottom		113	7,8	-2,9	-1,62	30,06	1004,97	87	0
2	107	Nutrient	2022-10-09	21:39	76,2679275	-75,0257628	Bongo Net	Deployment		113	8,9	-3	-1,62	30,09	1004,97	88	0
2	107	Nutrient	2022-10-09	21:27	76,2679502	-75,0175592	CTD Rosette	Recovery		90	6,1	-3	-1,68	31,44	1005,19	90	0
2	107	Nutrient	2022-10-09	20:46	76,271705	-75,0006995	CTD Rosette	Bottom					-1,69	31,92			0
2	107	Nutrient	2022-10-09	20:37	76,2724547	-74,9974857	CTD Rosette	Deployment		82	3,2	-2,9	-1,68	31,98	1005,55	83	0
2	106_south	CTD	2022-10-09	19:48	76,2071573	-75,3855933	CTD Rosette	Recovery		262	4,8	-3,8	-1,62	30,37	1005,60	89	0
2	106_south	CTD	2022-10-09	19:40	76,2078143	-75,3788575	CTD Rosette	Bottom		235	7,4	-3,6	-1,63	30,63	1005,61	87	0
2	106_south	CTD	2022-10-09	19:32	76,2094723	-75,3751828	CTD Rosette	Deployment		268	9,7	-3,4	-1,56	30,96	1005,72	89	0
2	105_south	Basic	2022-10-09	18:24	76,1199633	-75,7573833	Monster Net	Recovery		18	3,4	-2,6	-1,63	31,52	1006,40	73	0
2	105_south	Basic	2022-10-09	18:11	76,120979	-75,753016	Monster Net	Bottom		46	4,2	-3,1	-1,61	31,55	1006,41	76	0
2	105_south	Basic	2022-10-09	17:58	76,1217023	-75,7538333	Monster Net	Deployment		64	5,3	-2,8	-1,61	31,57	1006,52	77	0
2	105_south	Basic	2022-10-09	17:39	76,1159527	-75,7494457	Tucker Net	Recovery		76	7,4	-2,8	-1,62	31,49	1006,58	77	0
2	105_south	Basic	2022-10-09	17:30	76,1191743	-75,7658155	Tucker Net	Bottom		82	6,9	-2,8	-1,60	31,52	1006,61	76	0
2	105_south	Basic	2022-10-09	17:18	76,1247267	-75,7563262	Tucker Net	Deployment		84	5,7	-2,5	-1,60	31,62	1006,64	74	0
2	105_south	Basic	2022-10-09	17:05	76,1225405	-75,7513662	Trace Metals Rosette	Recovery		87	8,9	-2,5	-1,50	31,66	1006,63	77	0
2	105_south	Basic	2022-10-09	16:55	76,1228105	-75,7521845	Trace Metals Rosette	Bottom		98	8,6	-2,2	-1,37	31,68	1006,64	76	0
2	105_south	Basic	2022-10-09	16:42	76,122841	-75,755237	Trace Metals Rosette	Deployment		103	9,7	-2,8	-1,47	31,66	1006,67	75	0
2	105_south	Basic	2022-10-09	16:02	76,1213837	-75,7725737	CTD Rosette	Recovery		115	9,7	-2,7	-1,04	32,11	1006,81	74	0
2	105_south	Basic	2022-10-09	15:29	76,1224938	-75,7632727	CTD Rosette	Bottom		102	11,8	-2,8	-1,33	31,79	1006,98	74	0
2	105_south	Basic	2022-10-09	15:22	76,122158	-75,7644625	CTD Rosette	Deployment		109	10,1	-2,7	-1,37	31,70	1007,02	75	0
2	105	Basic	2022-10-09	14:54	76,1203208	-75,7462295	Trace Metals Rosette	Recovery		111	14,7	-2,8	-1,16	31,93	1007,02	78	0
2	105	Basic	2022-10-09	14:48	76,1198717	-75,7462855	Trace Metals Rosette	Bottom		115	11,8	-2,8	-1,29	31,72	1007,06	75	0
2	105	Basic	2022-10-09	14:38	76,1195055	-75,7485003	Trace Metals Rosette	Deployment		115	11,4	-2,8	-1,53	31,63	1007,06	76	0
2	104_south	CTD	2022-10-09	13:54	76,110022	-76,1696888	CTD Rosette	Recovery		119	12,6	-3	-1,65	31,14	1007,25	77	1
2	104_south	CTD	2022-10-09	13:47	76,1099735	-76,1670562	CTD Rosette	Bottom		110	12,4	-3,2	-1,58	31,37	1007,26	86	1
2	104_south	CTD	2022-10-09	13:41	76,1100943	-76,1635903	CTD Rosette	Deployment		93	12	-3,4	-1,64	31,39	1007,31	87	1
2	103_south	CTD	2022-10-09	12:51	76,0876125	-76,6002078	CTD Rosette	Recovery		112	16,6	-2,9	-1,56	32,12	1007,21	78	2
2	103_south	CTD	2022-10-09	12:45	76,087544	-76,5968283	CTD Rosette	Bottom		121	12,9	-2,9	-1,57	32,13	1007,39	82	2
2	103_south	CTD	2022-10-09	12:40	76,0873632	-76,5942668	CTD Rosette	Deployment		110	15	-2,9	-1,57	32,13	1007,35	79	2
2	102_south	Nutrient	2022-10-09	8:59	76,1749027	-77,012334	Bongo Net	Recovery		123	11,4	-3,7	-1,54	29,93	1007,80	76	1
2	102_south	Nutrient	2022-10-09	8:57	76,1749297	-77,0113797	Bongo Net	Bottom		129	12,8	-3,6	-1,62	29,97	1007,67	75	1
2	102_south	Nutrient	2022-10-09	8:54	76,1749583	-77,0105113	Bongo Net	Deployment		114	10,9	-3,6	-1,61	29,95	1007,78	76	1
2	102_south	Nutrient	2022-10-09	8:43	76,1755102	-77,001167	CTD Rosette	Recovery		171	4,6	-3	-1,62	29,93	1007,78	77	1

2	102_south	Nutrient	2022-10-09	8:03	76,1775553	-76,9844525	CTD Rosette	Bottom		147	12,6	-3,7	-1,61	30,07	1007,68	78	1
2	102_south	Nutrient	2022-10-09	7:56	76,1785172	-76,9804557	CTD Rosette	Deployment		134	11,4	-4,1	-1,60	30,08	1007,75	84	1
2	323_east	Full	2022-10-08	17:24	74,1373343	-79,3395185	Box Core	Recovery		202	10,7	-5,4	-0,51	31,86	1009,60	71	1
2	323_east	Full	2022-10-08	17:00	74,1370052	-79,338702	Box Core	Bottom					-0,52	31,85			1
2	323_east	Full	2022-10-08	16:40	74,1361188	-79,3408128	Box Core	Deployment		223	16,4	-5,4	-0,52	31,85	1009,71	72	1
2	323_east	Full	2022-10-08	15:56	74,1870262	-79,2647518	IKMT	Recovery		213	16,8	-5,7	-0,36	32,04	1009,52	71	1
2	323_east	Full	2022-10-08	14:57	74,1461227	-79,296271	IKMT	Bottom		222	18,8	-6,2	-0,60	31,86	1009,55	73	1
2	323_east	Full	2022-10-08	14:31	74,1310962	-79,3079518	IKMT	Deployment		210	15,6	-4,6	-0,53	31,87	1010,08	67	1
2	323_east	Full	2022-10-08	14:08	74,1324028	-79,3564262	Hydrobios	Recovery		234	21,1	-5,5	-0,32	31,92	1009,97	72	1
2	323_east	Full	2022-10-08	13:40	74,1307148	-79,3556113	Hydrobios	Bottom		233	22,1	-5,6	-0,36	31,90	1010,07	73	1
2	323_east	Full	2022-10-08	13:19	74,1291033	-79,3519308	Hydrobios	Deployment		239	18,8	-5,5	-0,32	31,90	1009,95	74	1
2	323_east	Full	2022-10-08	12:33	74,1258265	-79,3593873	Trace Metals Rosette	Recovery		234	16,6	-5,3	-0,32	31,91	1010,16	77	1
2	323_east	Full	2022-10-08	12:24	74,1257598	-79,35914	Trace Metals Rosette	Bottom		231	21,3	-5,4	-0,28	31,90	1010,09	77	1
2	323_east	Full	2022-10-08	12:11	74,1260697	-79,359757	Trace Metals Rosette	Deployment		243	23,2	-5,3	-0,34	31,89	1009,91	77	1
2	323_east	Full	2022-10-08	11:21	74,1531943	-79,3025818	CTD Rosette	Recovery		241	18,8	-5,1	-0,22	31,94	1010,24	78	0
2	323_east	Full	2022-10-08	10:27	74,1521293	-79,3053977	CTD Rosette	Bottom		225	19,6	-5	-0,45	31,86	1010,22	79	0
2	323_east	Full	2022-10-08	10:12	74,1514797	-79,3047585	CTD Rosette	Deployment		232	16,4	-5,1	-0,48	31,86	1010,25	81	0
2	323_east	Full	2022-10-08	9:55	74,1495767	-79,3022542	Trace Metals Rosette	Recovery		232	21,1	-5,1	-0,37	31,91	1010,36	80	0
2	323_east	Full	2022-10-08	9:46	74,1496598	-79,302228	Trace Metals Rosette	Bottom		232	23,8	-5,1	-0,60	31,84	1010,20	78	0
2	323_east	Full	2022-10-08	9:35	74,1488387	-79,3015433	Trace Metals Rosette	Deployment		227	18,7	-5	-0,63	31,83	1010,49	79	0
2	324_south	Nutrient	2022-10-08	7:41	73,8181612	-79,5191393	Bongo Net	Recovery		253	11,4	-7,4	-0,31	31,90	1011,03	77	0
2	324_south	Nutrient	2022-10-08	7:39	73,818189	-79,5219732	Bongo Net	Bottom		246	12,2	-7,4	-0,32	31,89	1011,05	77	0
2	324_south	Nutrient	2022-10-08	7:36	73,8186527	-79,5261968	Bongo Net	Deployment		272	11,6	-7,2	-0,33	31,90	1011,10	78	0
2	324_south	Nutrient	2022-10-08	7:26	73,8194712	-79,539615	CTD Rosette	Recovery		251	10,1	-7,3	-0,35	31,90	1011,05	80	0
2	324_south	Nutrient	2022-10-08	6:26	73,823828	-79,596963	CTD Rosette	Bottom		231	13,9	-7	-0,68	31,91	1010,89	79	0
2	324_south	Nutrient	2022-10-08	6:11	73,8251093	-79,6046142	CTD Rosette	Deployment		233	12,4	-7	-0,54	31,91	1010,97	78	0
2	Ittaq_Scott	Mooring	2022-10-07	5:03	71,171787	-70,8447222	CPR	Deployment		329	12,8	-4,2	1,16	29,23	1007,50	65	0
2	Ittaq_Scott	Mooring	2022-10-07	4:41	71,134276	-70,8242365	Mooring	Deployment		317	8,9	-4,3	1,07	29,24	1007,66	66	0
2	SI_coring 3	Coring	2022-10-06	7:43	70,8753498	-71,6605717	Box Core	Recovery		111	2,9	-3,4	1,35	29,28	1004,77	70	0
2	SI_coring 3	Coring	2022-10-06	7:26	70,8745955	-71,6607957	Box Core	Bottom		124	2,3	-3,4	1,33	29,29	1004,75	73	0
2	SI_coring 3	Coring	2022-10-06	7:09	70,8742493	-71,6600733	Box Core	Deployment		225	3,8	-3,1	1,71	29,47	1004,74	69	0
2	SI_coring 3	Coring	2022-10-06	6:56	70,8761617	-71,6599217	CTD Rosette	Recovery		229	0,2	-2,4	1,50	29,38	1004,68	61	0
2	SI_coring 3	Coring	2022-10-06	6:42	70,87556	-71,661104	CTD Rosette	Bottom		187	4,2	-2,6	1,54	29,42	1004,66	62	0
2	SI_coring 3	Coring	2022-10-06	6:29	70,8752817	-71,6615143	CTD Rosette	Deployment		197	1,9	-2,7	1,55	29,31	1004,64	61	0
2	SI_coring2	Coring	2022-10-06	4:58	70,9663543	-71,3241863	Box Core	Recovery		197	6,7	-3,6	1,38	29,20	1004,27	75	0
2	SI_coring2	Coring	2022-10-06	4:41	70,966361	-71,3224957	Box Core	Bottom		187	5,9	-3,5	1,31	29,16	1004,24	76	0
2	SI_coring2	Coring	2022-10-06	4:26	70,966459	-71,3220467	Box Core	Deployment		213	5,7	-3,6	1,34	29,18	1004,30	73	0
2	SI_coring2	Coring	2022-10-06	4:10	70,9664225	-71,3235513	Gravity Core	Recovery		194	5	-3,7	1,33	29,16	1004,32	72	0
2	SI_coring2	Coring	2022-10-06	3:54	70,9664787	-71,3224063	Gravity Core	Bottom		233	2,9	-3	1,41	29,23	1004,27	69	0
2	SI_coring2	Coring	2022-10-06	3:42	70,966842	-71,3211092	Gravity Core	Deployment		172	2,1	-3,1	1,36	29,17	1004,20	74	0

2	SI_coring2	Coring	2022-10-06	3:19	70,9632683	-71,3270717	CTD Rosette	Recovery		27	2,3	-3,2	1,57	29,24	1004,25	68	0
2	SI_coring2	Coring	2022-10-06	3:06	70,9648998	-71,3256852	CTD Rosette	Bottom		297	4,4	-3,5	1,54	29,24	1004,31	72	0
2	SI_coring2	Coring	2022-10-06	2:52	70,964953	-71,3232803	CTD Rosette	Deployment		348	5	-3,5	1,55	29,22	1004,36	69	0
2	SI_coring1	Coring	2022-10-06	1:39	71,0411082	-71,5555075	Gravity Core	Recovery		272	11	-3	1,31	29,10	1003,97	64	0
2	SI_coring1	Coring	2022-10-06	1:23	71,0414063	-71,554755	Gravity Core	Bottom		287	7,8	-2,9	1,32	29,08	1004,00	65	0
2	SI_coring1	Coring	2022-10-06	1:08	71,0411162	-71,5552205	Gravity Core	Deployment		262	8,9	-3	1,33	29,08	1003,86	63	0
2	SI_coring1	Coring	2022-10-06	0:45	71,0413172	-71,5572117	Box Core	Recovery		267	10,1	-2,8	1,35	29,08	1003,88	64	0
2	SI_coring1	Coring	2022-10-06	0:29	71,0405855	-71,5574532	Box Core	Bottom		278	2,1	-3	1,37	29,09	1003,84	65	0
2	SI_coring1	Coring	2022-10-06	0:12	71,0413772	-71,5561897	Box Core	Deployment		164	7,6	-2,6	1,36	29,08	1003,60	66	0
2	Clark_fjord	CTD	2022-10-05	23:09	71,0520642	-71,5999622	CTD Rosette	Recovery		174	1,9	-2,4	1,40	29,04	1003,41	62	0
2	Clark_fjord	CTD	2022-10-05	22:20	71,0508183	-71,5930352	CTD Rosette	Bottom		143	5,7	-2,5	1,51	29,15	1003,21	64	0
2	Clark_fjord	CTD	2022-10-05	22:08	71,0505345	-71,5912012	CTD Rosette	Deployment		141	9,5	-2,9	1,38	29,05	1003,10	63	0
2	Scott Inlet sill	Full	2022-10-05	20:39	71,1515367	-71,2573635	Box Core	Recovery		304	5,3	-3,6	1,33	29,29	1002,84	64	0
2	Scott Inlet sill	Full	2022-10-05	20:27	71,1523907	-71,2587285	Box Core	Bottom		336	6,9	-3,6	1,34	29,28	1002,73	65	0
2	Scott Inlet sill	Full	2022-10-05	20:13	71,153531	-71,2594623	Box Core	Deployment		354	14,7	-3,5	1,32	29,23	1002,49	67	0
2	Scott Inlet sill	Full	2022-10-05	19:48	71,1681518	-71,1555478	Beam Trawl	Recovery		298	11,8	-3,2	1,26	29,28	1002,17	63	0
2	Scott Inlet sill	Full	2022-10-05	19:14	71,1512998	-71,2166178	Beam Trawl	Bottom		291	12	-3,6	1,28	29,34	1002,10	67	0
2	Scott Inlet sill	Full	2022-10-05	18:47	71,1501358	-71,2599022	Beam Trawl	Deployment		320	13,9	-2,7	1,34	29,29	1001,95	64	0
2	Scott Inlet sill	Full	2022-10-05	18:21	71,15099	-71,2570635	Monster Net	Recovery		317	19,8	-3,2	1,32	29,27	1001,26	59	0
2	Scott Inlet sill	Full	2022-10-05	18:01	71,1520453	-71,2617453	Monster Net	Bottom		324	20,9	-3,2	1,34	29,29	1001,10	62	0
2	Scott Inlet sill	Full	2022-10-05	17:47	71,1528115	-71,2646533	Monster Net	Deployment		352	19,4	-3,3	1,32	29,22	1001,20	66	0
2	Scott Inlet sill	Full	2022-10-05	17:24	71,142991	-71,2379818	Tucker Net	Recovery		328	16,4	-3,3	1,31	29,29	1001,14	66	0
2	Scott Inlet sill	Full	2022-10-05	17:14	71,142888	-71,2559082	Tucker Net	Bottom		345	19,4	-3,2	1,30	29,28	1001,11	67	0
2	Scott Inlet sill	Full	2022-10-05	17:03	71,1488502	-71,2645483	Tucker Net	Deployment		337	13,5	-0,5	1,31	29,23	1000,83	65	0
2	Scott Inlet sill	Full	2022-10-05	16:50	71,1520725	-71,2707213	Bongo Net	Recovery		338	22,8	-3,4	1,42	29,18	1000,49	69	0
2	Scott Inlet sill	Full	2022-10-05	16:47	71,1526115	-71,2707165	Bongo Net	Bottom		352	18,5	-3,3	1,30	29,18	1000,77	70	0
2	Scott Inlet sill	Full	2022-10-05	16:44	71,1529995	-71,2702063	Bongo Net	Deployment		335	18,3	-3,2	1,29	29,18	1000,80	72	0
2	Scott Inlet sill	Full	2022-10-05	16:31	71,153328	-71,2660112	Trace Metals Rosett	Recovery		331	12,4	-2,8	1,30	29,19	1000,85	66	0
2	Scott Inlet sill	Full	2022-10-05	16:21	71,1534955	-71,2665382	Trace Metals Rosett	Bottom		286	9,3	-3,3	1,31	29,19	1000,75	68	0
2	Scott Inlet sill	Full	2022-10-05	16:10	71,153329	-71,2689707	Trace Metals Rosett	Deployment		298	5,3	-3,5	1,30	29,18	1000,80	69	0
2	Scott Inlet sill	Full	2022-10-05	15:54	71,1519857	-71,2721597	CTD Rosette	Recovery		302	6,1	-3,6	1,29	29,18	1000,69	70	0
2	Scott Inlet sill	Full	2022-10-05	15:18	71,1538598	-71,2675892	CTD Rosette	Bottom		312	10,3	-3,6	1,31	29,23	1000,57	72	0
2	Scott Inlet sill	Full	2022-10-05	15:09	71,1539635	-71,2684918	CTD Rosette	Deployment		297	8,9	-3,3	1,28	29,18	1000,60	65	0
2	Scott Inlet sill	Full	2022-10-05	14:47	71,1525977	-71,2646703	Trace Metals Rosett	Recovery		281	11,4	-3,3	1,35	29,28	1000,64	64	0
2	Scott Inlet sill	Full	2022-10-05	14:42	71,1528088	-71,2643962	Trace Metals Rosett	Bottom		293	8,6	-3,3	1,34	29,26	1000,58	64	0
2	Scott Inlet sill	Full	2022-10-05	14:31	71,1528637	-71,2628717	Trace Metals Rosett	Deployment		302	9,5	-3,4	1,36	29,25	1000,68	65	0
2	Clyde	Basic	2022-10-04	20:06	70,348175	-68,4685858	Bongo Net	Recovery		343	16,6	-2,7	1,68	29,22	997,79	84	0
2	Clyde	Basic	2022-10-04	20:02	70,3488117	-68,4674987	Bongo Net	Bottom		341	15,2	-2,7	1,67	28,98	997,76	86	0
2	Clyde	Basic	2022-10-04	19:59	70,3492253	-68,4656002	Bongo Net	Deployment		345	17,9	-2,9	1,65	28,97	997,69	89	0
2	Clyde	Basic	2022-10-04	19:45	70,3452128	-68,4649558	CTD Rosette	Recovery		328	21,1	-2,7	1,66	28,95	997,58	88	0

2	Clyde	Basic	2022-10-04	19:09	70,3478297	-68,4561667	CTD Rosette	Bottom		343	21,7	-2,5	1,67	28,91	997,44	77	0
2	Clyde	Basic	2022-10-04	19:03	70,348007	-68,454675	CTD Rosette	Deployment		349	17,9	-2,6	1,71	28,95	997,52	77	0
2	Ittaq_Macbeth	Mooring	2022-10-04	12:13	69,9032675	-66,8121467	Mooring	Bottom		23	13,5	-0,4	1,29	29,78	993,91	92	0
2	Ittaq_Macbeth	Mooring	2022-10-04	12:13	69,9032903	-66,812053	Mooring	Deployment		24	13,5	-0,4	1,31	29,74	993,89	91	0
2	KEBABB D5	Full	2022-10-04	1:46	68,9614045	-61,4375842	CPR	Deployment		29	1,7	-0,7	0,65	31,16	992,23	79	0
2	KEBABB D5	Full	2022-10-04	1:27	68,9600308	-61,4194687	IKMT	Recovery		57	10,9	-1,5	0,62	31,18	992,17	79	0
2	KEBABB D5	Full	2022-10-04	0:33	68,9936612	-61,4654447	IKMT	Bottom		95	7,4	-1,6	0,73	31,15	992,62	79	0
2	KEBABB D5	Full	2022-10-04	0:09	69,0053025	-61,4484525	IKMT	Deployment		89	8	-1,3	0,73	31,17	992,76	77	0
2	KEBABB D5	Full	2022-10-03	23:47	69,0047177	-61,4347005	Hydrobios	Recovery		72	8,8	-1,4	0,70	31,19	992,92	81	0
2	KEBABB D5	Full	2022-10-03	22:58	69,0040228	-61,4272917	Hydrobios	Bottom		88	12,9	-1,5	0,69	31,18	992,92	80	0
2	KEBABB D5	Full	2022-10-03	22:20	69,003865	-61,417879	Hydrobios	Deployment		65	8	-1,3	0,72	31,18	993,28	80	0
2	KEBABB D5	Full	2022-10-03	21:53	68,9983977	-61,3995415	Tucker Net	Recovery		60	1,5	-1,3	0,71	31,18	993,57	80	0
2	KEBABB D5	Full	2022-10-03	21:43	68,996872	-61,404566	Tucker Net	Bottom		105	6,1	-1,9	0,73	31,16	993,57	80	0
2	KEBABB D5	Full	2022-10-03	21:33	69,0028933	-61,4045202	Tucker Net	Deployment		98	9,1	-2	0,77	31,16	993,53	80	0
2	KEBABB D5	Full	2022-10-03	21:21	68,9989088	-61,4230165	Bongo Net	Recovery		76	2,1	-1,4	0,79	31,16	993,51	80	0
2	KEBABB D5	Full	2022-10-03	20:59	69,0018973	-61,4105985	Trace Metals Rosett	Recovery		48	5,3	-1,6	0,77	31,16	993,77	81	0
2	KEBABB D5	Full	2022-10-03	20:51	69,0023318	-61,4082523	Trace Metals Rosett	Bottom		91	4,8	-1,4	0,78	31,16	993,89	80	0
2	KEBABB D5	Full	2022-10-03	20:39	69,0034843	-61,4033155	Trace Metals Rosett	Deployment		110	5	-1,3	0,76	31,15	993,98	79	0
2	KEBABB D5	Full	2022-10-03	20:21	68,9973497	-61,4252785	CTD Rosette	Recovery		86	3,6	-1,5	0,96	31,20	994,01	79	0
2	KEBABB D5	Full	2022-10-03	19:15	69,0015453	-61,4068447	CTD Rosette	Bottom		54	7,6	-1,7	0,97	31,20	994,56	79	0
2	KEBABB D5	Full	2022-10-03	18:41	69,0024608	-61,405429	CTD Rosette	Deployment		139	1,9	-1,3	0,98	31,21	994,73	78	0
2	KEBABB D5	Full	2022-10-03	18:19	68,9980995	-61,4021035	Trace Metals Rosett	Recovery		33	2,1	-1,2	0,96	31,20	994,91	77	0
2	KEBABB D5	Full	2022-10-03	18:13	68,999196	-61,4020067	Trace Metals Rosett	Bottom		140	2,3	-1,4	0,96	31,21	994,84	78	0
2	KEBABB D5	Full	2022-10-03	18:04	69,0006717	-61,4039795	Trace Metals Rosett	Deployment		71	4,6	-1,8	0,79	31,30	994,84	77	0
2	KEBABB D4	KEBABB	2022-10-03	15:35	68,6280447	-61,9638517	CTD Rosette	Recovery		171	1	0,5	1,02	31,24	995,31	73	0
2	KEBABB D4	KEBABB	2022-10-03	14:24	68,6286875	-61,9758503	CTD Rosette	Bottom		56	2,9	-0,1	1,05	31,21	995,75	77	0
2	KEBABB D4	KEBABB	2022-10-03	13:52	68,6283753	-61,981279	CTD Rosette	Deployment		109	5,5	-0,2	1,01	31,20	996,19	80	0
2	KEBABB D3	Full	2022-10-03	10:54	68,2408323	-62,5955702	Box Core	Recovery		257	4,2	-0,7	0,68	31,22	998,10	74	0
2	KEBABB D3	Full	2022-10-03	10:18	68,2412127	-62,594092	Box Core	Bottom		250	5	-0,6	0,65	31,24	998,30	77	0
2	KEBABB D3	Full	2022-10-03	9:37	68,2413408	-62,5949702	Box Core	Deployment		243	5,7	-0,7	0,63	31,25	998,38	76	0
2	KEBABB D3	Full	2022-10-03	9:11	68,2260982	-62,543019	IKMT	Recovery		299	8	-0,2	0,49	31,34	998,46	77	0
2	KEBABB D3	Full	2022-10-03	8:18	68,2498825	-62,5792233	IKMT	Bottom		283	8,6	-0,2	0,58	31,27	998,70	74	0
2	KEBABB D3	Full	2022-10-03	7:53	68,238813	-62,5751952	IKMT	Deployment		281	7	-0,3	0,50	31,33	998,86	77	0
2	KEBABB D3	Full	2022-10-03	7:28	68,2380413	-62,5647363	Monster Net	Recovery		285	7,8	-0,2	0,59	31,32	998,96	75	0
2	KEBABB D3	Full	2022-10-03	6:28	68,2402538	-62,577439	Monster Net	Bottom		279	5,7	-0,3	0,58	31,33	999,43	75	0
2	KEBABB D3	Full	2022-10-03	5:52	68,241026	-62,5845073	Monster Net	Deployment		289	7,4	-0,2	0,59	31,31	999,63	77	0
2	KEBABB D3	Full	2022-10-03	5:28	68,2431888	-62,5532427	Tucker Net	Recovery		326	10,7	-0,4	0,50	31,35	999,64	73	0
2	KEBABB D3	Full	2022-10-03	5:21	68,2414952	-62,562272	Tucker Net	Bottom		321	6,3	-0,4	0,47	31,38	999,75	76	0
2	KEBABB D3	Full	2022-10-03	5:14	68,2414413	-62,5723415	Tucker Net	Deployment		314	9,1	-0,6	0,57	31,33	999,72	75	0
2	KEBABB D3	Full	2022-10-03	4:53	68,2435165	-62,5853243	Trace Metals Rosett	Recovery		323	8	-0,2	0,58	31,33	999,95	75	0

2	KEBABB D3	Full	2022-10-03	4:38	68,2429738	-62,5861755	Trace Metals Rosette	Bottom		328	13,5	-0,1	0,56	31,33	1000,00	76	0
2	KEBABB D3	Full	2022-10-03	4:20	68,2421013	-62,5887018	Trace Metals Rosette	Deployment		335	10,3	0,3	0,49	31,37	1000,19	76	0
2	KEBABB D3	Full	2022-10-03	4:02	68,2484788	-62,5899103	CTD Rosette	Recovery		317	11,6	-0,2	0,52	31,38	1000,28	74	0
2	KEBABB D3	Full	2022-10-03	2:52	68,2458677	-62,5940813	CTD Rosette	Bottom		327	13,5	-0,3	0,50	31,37	1000,83	77	0
2	KEBABB D3	Full	2022-10-03	2:22	68,244885	-62,5952662	CTD Rosette	Deployment		317	14,9	-0,4	0,45	31,42	1001,12	76	0
2	KEBABB D3	Full	2022-10-03	2:03	68,2431698	-62,5961388	Trace Metals Rosette	Recovery		323	14,7	-0,3	0,49	31,37	1001,20	77	0
2	KEBABB D3	Full	2022-10-03	1:49	68,242674	-62,5922047	Trace Metals Rosette	Bottom		315	12,6	-0,3	0,50	31,37	1001,27	78	0
2	KEBABB D3	Full	2022-10-03	1:40	68,2425107	-62,5919557	Trace Metals Rosette	Deployment		303	11,2	-0,5	0,60	31,36	1001,49	76	0
2	KEBABB D2	KEBABB	2022-10-02	23:02	67,857488	-63,147582	Bongo Net	Recovery		333	12	-0,4	1,25	30,97	1002,78	75	0
2	KEBABB D2	KEBABB	2022-10-02	23:00	67,8578403	-63,147672	Bongo Net	Bottom					1,25	30,97			0
2	KEBABB D2	KEBABB	2022-10-02	22:57	67,8580515	-63,1474463	Bongo Net	Deployment		337	9,7	-0,3	1,24	30,97	1002,80	77	0
2	KEBABB D2	KEBABB	2022-10-02	22:45	67,8497432	-63,1372118	CTD Rosette	Recovery		328	9,3	-0,4	1,34	30,93	1002,88	76	0
2	KEBABB D2	KEBABB	2022-10-02	22:09	67,8555825	-63,1432262	CTD Rosette	Bottom		322	10,9	-0,2	1,34	30,87	1003,14	76	0
2	KEBABB D2	KEBABB	2022-10-02	22:04	67,8561408	-63,1446705	CTD Rosette	Deployment		330	11,4	-0,3	1,33	30,87	1003,22	73	0
2			2022-10-02	13:32	67,5329947	-64,0539152	Zodiac	Deployment		134	5,9	-0,1	1,91	28,25	1005,27	65	0
2	KEBBAB D1	Full	2022-10-02	12:25	67,4993285	-63,6638598	Beam trawl	Recovery		302	8,2	0,1	1,86	28,68	1005,21	68	0
2	KEBBAB D1	Full	2022-10-02	11:41	67,4830305	-63,7170913	Beam trawl	Bottom		272	9,3	-1,2	1,83	28,59	1005,15	66	0
2	KEBBAB D1	Full	2022-10-02	11:17	67,474456	-63,7412503	Beam trawl	Deployment		305	5	-1,7	1,87	28,62	1005,53	71	0
2	KEBBAB D1	Full	2022-10-02	10:48	67,4730968	-63,6749062	Monster Net	Recovery		273	9,7	-0,8	1,82	28,77	1005,46	66	0
2	KEBBAB D1	Full	2022-10-02	10:28	67,4738695	-63,6782377	Monster Net	Bottom		268	9,5	-0,9	1,83	28,77	1005,39	67	0
2	KEBBAB D1	Full	2022-10-02	10:11	67,474649	-63,6834028	Monster Net	Deployment		276	10,3	-0,9	1,83	28,90	1005,56	64	0
2	KEBBAB D1	Full	2022-10-02	9:31	67,4743287	-63,636766	Tucker Net	Recovery		274	11,6	-0,7	1,77	29,01	1005,16	70	0
2	KEBBAB D1	Full	2022-10-02	9:23	67,4735445	-63,6496372	Tucker Net	Bottom		263	9,7	-0,7	1,85	28,85	1005,33	69	0
2	KEBBAB D1	Full	2022-10-02	9:13	67,4729617	-63,6647998	Tucker Net	Deployment		262	11,8	-0,7	1,88	28,76	1005,22	68	0
2	KEBBAB D1	Full	2022-10-02	8:56	67,4733817	-63,6810157	Trace Metals Rosette	Recovery		282	10,5	-0,2	1,88	28,73	1005,57	73	0
2	KEBBAB D1	Full	2022-10-02	8:42	67,4744067	-63,6832465	Trace Metals Rosette	Bottom		300	13,5	0	1,89	28,74	1005,39	65	0
2	KEBBAB D1	Full	2022-10-02	8:29	67,4755765	-63,6863063	Trace Metals Rosette	Deployment		285	8,8	-0,1	1,83	28,99	1005,54	69	0
2	KEBBAB D1	Full	2022-10-02	8:12	67,4683628	-63,6815258	CTD Rosette	Recovery		313	12,4	0,1	1,83	29,06	1005,55	67	0
2	KEBBAB D1	Full	2022-10-02	7:23	67,4738283	-63,6836233	CTD Rosette	Bottom		334	14,7	0,3	1,90	28,75	1005,24	68	0
2	KEBBAB D1	Full	2022-10-02	7:10	67,4743343	-63,68534	CTD Rosette	Deployment		352	15,6	0,3	1,89	28,78	1005,49	71	0
2	KEBBAB D1	Full	2022-10-02	6:46	67,471713	-63,6903467	Trace Metals Rosette	Recovery		306	12,6	0,1	1,92	28,67	1005,50	71	0
2	KEBBAB D1	Full	2022-10-02	6:36	67,4726568	-63,6920452	Trace Metals Rosette	Bottom		299	12,9	0,2	1,93	28,66	1005,39	68	0
2	KEBBAB D1	Full	2022-10-02	6:25	67,4734847	-63,6938965	Trace Metals Rosette	Deployment		318	20,9	0,3	1,93	28,66	1005,19	64	0
2	KEBBAB D1	Full	2022-10-01	22:42	67,4732633	-63,8223748	Baited camera	Recovery		301	16,9	0,9	2,03	28,53	1006,09	59	0
2	KEBABB D1	Full	2022-10-01	19:33	67,3953033	-63,850237	Box Core	Recovery		315	16	0,5	2,22	28,32	1005,98	67	0
2	KEBABB D1	Full	2022-10-01	19:22	67,3952705	-63,8527735	Box Core	Bottom					2,23	28,33			0
2	KEBABB D1	Full	2022-10-01	19:07	67,3961732	-63,8542922	Box Core	Deployment		296	13,9	0,3	2,23	28,31	1005,98	66	0
2	KEBABB D1	Full	2022-10-01	18:51	67,3939785	-63,8488263	CTD Rosette	Recovery		282	13,9	-0,1	2,21	28,31	1005,88	69	0
2	KEBABB D1	Full	2022-10-01	18:07	67,3959762	-63,8491838	CTD Rosette	Bottom		300	14,3	0,4	2,23	28,34	1005,71	66	0
2	KEBABB D1	Full	2022-10-01	17:57	67,3960392	-63,848706	CTD Rosette	Deployment		4	19,6	0,6	2,23	28,34	1005,63	62	0

2	KEBBAB D1	Full	2022-10-01	15:07	67,4737918	-63,8268505	Baited camera	Bottom		312	18,1	-0,4			1005,45	80	0
2	KEBBAB D1	Full	2022-10-01	14:58	67,4736748	-63,825318	Baited camera	Deployment		299	20,4	-1,1			1005,63	89	0
2	KEBABB C1	Full	2022-10-01	3:43	67,347492	-62,5299437	CTD Rosette	Recovery		332	23,6	-0,5			1002,36	79	0
2	KEBABB C1	Full	2022-10-01	3:16	67,348119	-62,5318952	CTD Rosette	Bottom		335	27	-1,1			1002,76	94	0
2	KEBABB C1	Full	2022-10-01	3:10	67,3483737	-62,5306653	CTD Rosette	Deployment		325	23	-1,2			1002,53	95	0
2	KEBABB C1	Full	2022-10-01	2:28	67,3457217	-62,525092	Hydrobios	Recovery		329	25,5	0			1002,49	83	0
2	KEBABB C1	Full	2022-10-01	2:23	67,3455163	-62,5262738	Hydrobios	Bottom		327	21,5	0,1			1002,54	82	0
2	KEBABB C1	Full	2022-10-01	2:19	67,3460642	-62,525997	Hydrobios	Deployment		329	17,3	0			1002,50	83	0
2	KEBABB C1	Full	2022-10-01	1:46	67,3372332	-62,5140243	Tucker Net	Recovery		333	18,1	-0,7			1002,41	83	0
2	KEBABB C1	Full	2022-10-01	1:34	67,34456	-62,512492	Tucker Net	Bottom		330	21,3	-0,3			1002,31	80	0
2	KEBABB C1	Full	2022-10-01	1:18	67,3558243	-62,5165843	Tucker Net	Deployment		335	17,7	0,8			1002,42	74	0
2	KEBABB C2	KEBABB	2022-09-30	23:38	67,541386	-61,9045843	CTD Rosette	Recovery		345	21,3	-0,1			1001,20	80	0
2	KEBABB C2	KEBABB	2022-09-30	22:49	67,5464337	-61,9078948	CTD Rosette	Bottom		2	23,4	0,1			1001,00	79	0
2	KEBABB C2	KEBABB	2022-09-30	22:41	67,5474373	-61,9075915	CTD Rosette	Deployment		347	25,3	0,1			1000,95	79	0
2	KEBABB C3	Full	2022-09-30	20:28	67,7469377	-61,2517267	Box Core	Recovery		351	19,2	0,1			999,88	86	0
2	KEBABB C3	Full	2022-09-30	19:50	67,7501285	-61,2615038	Box Core	Bottom		0	22,8	0,3			999,83	83	0
2	KEBABB C3	Full	2022-09-30	19:15	67,7527358	-61,2635287	Box Core	Deployment		5	24	0,1			999,75	88	0
2	KEBABB C3	Full	2022-09-30	17:45	67,7174258	-61,1502332	IKMT	Recovery		350	20,4	0,3			999,37	85	0
2	KEBABB C3	Full	2022-09-30	16:45	67,7325798	-61,2485102	IKMT	Bottom		351	18,5	0,3			998,91	81	0
2	KEBABB C3	Full	2022-09-30	16:17	67,7413983	-61,2800247	IKMT	Deployment		357	16,4	1,8			999,15	80	0
2	KEBABB C3	Full	2022-09-30	15:03	67,7368022	-61,261797	Tucker Net	Recovery		345	16,8	-0,1			999,30	90	0
2	KEBABB C3	Full	2022-09-30	14:53	67,7373895	-61,2749382	Tucker Net	Bottom		341	15,6	0			999,22	89	0
2	KEBABB C3	Full	2022-09-30	14:45	67,741118	-61,2786812	Tucker Net	Deployment		312	9,9	2,1			999,52	83	0
2	KEBABB C3	Full	2022-09-30	14:29	67,7475365	-61,2793393	CTD Rosette	Recovery		353	16	0,2			999,31	84	0
2	KEBABB C3	Full	2022-09-30	13:23	67,748246	-61,2730652	CTD Rosette	Bottom		8	19,2	-0,3			999,24	89	0
2	KEBABB C3	Full	2022-09-30	12:56	67,7478217	-61,2686312	CTD Rosette	Deployment		12	16,6	0			999,54	89	0
2	KEBABB C4	KEBABB	2022-09-30	10:42	67,95427	-60,6256595	Box Core	Recovery		1	12,2	-0,4			999,02	92	0
2	KEBABB C4	KEBABB	2022-09-30	10:04	67,9588187	-60,6272465	Box Core	Bottom		2	15,8	0			998,81	87	0
2	KEBABB C4	KEBABB	2022-09-30	9:28	67,9619078	-60,6302962	Box Core	Deployment		10	13,1	0			998,77	85	0
2	KEBABB C4	KEBABB	2022-09-30	8:55	67,9480103	-60,6019143	CTD Rosette	Recovery		32	9,5	0,2			998,94	82	0
2	KEBABB C4	KEBABB	2022-09-30	7:37	67,9568673	-60,6166033	CTD Rosette	Bottom		7	14,1	-0,3			998,82	82	0
2	KEBABB C4	KEBABB	2022-09-30	7:06	67,957928	-60,624794	CTD Rosette	Deployment		4	12,6	-0,5			998,87	84	0
2	KEBABB C5	Full	2022-09-30	4:52	68,1194907	-59,9479017	IKMT	Recovery		6	10,1	-0,6			998,78	84	0
2	KEBABB C5	Full	2022-09-30	4:05	68,1422732	-59,9973762	IKMT	Bottom		2	9,3	0,1			999,01	85	0
2	KEBABB C5	Full	2022-09-30	3:45	68,1386718	-60,0042243	IKMT	Deployment		357	10,1	-0,5			998,99	88	0
2	KEBABB C5	Full	2022-09-30	3:19	68,1465485	-59,9914543	Hydrobios	Recovery		353	9,9	-0,5			999,15	89	0
2	KEBABB C5	Full	2022-09-30	2:36	68,1468152	-59,9847933	Hydrobios	Bottom		9	11,8	-0,6			999,20	93	0
2	KEBABB C5	Full	2022-09-30	2:06	68,146595	-59,9775133	Hydrobios	Deployment		351	12,9	-0,7			999,13	92	0
2	KEBABB C5	Full	2022-09-30	1:37	68,1452998	-59,9728813	Tucker Net	Recovery		343	3,2	0			999,28	84	0
2	KEBABB C5	Full	2022-09-30	1:26	68,1427358	-59,9678468	Tucker Net	Bottom		349	15,2	-0,5			999,32	87	0

2	KEBABB C5	Full	2022-09-30	1:17	68,1423442	-59,9806975	Tucker Net	Deployment		355	6,5	-0,7			999,52	87	0
2	KEBABB C5	Full	2022-09-30	1:05	68,1459168	-59,9791803	Bongo Net	Recovery		9	12,6	-0,2			999,34	87	0
2	KEBABB C5	Full	2022-09-30	1:02	68,1458735	-59,9777892	Bongo Net	Bottom		360	11	-0,3			999,56	85	0
2	KEBABB C5	Full	2022-09-30	0:59	68,1457942	-59,9772863	Bongo Net	Deployment		9	10,9	-0,3			999,60	86	0
2	KEBABB C5	Full	2022-09-30	0:47	68,1411477	-59,9872883	CTD Rosette	Recovery		359	9,1	-0,3			999,57	86	0
2	KEBABB C5	Full	2022-09-29	23:35	68,1456242	-59,9735033	CTD Rosette	Bottom		359	10,5	-0,8			999,62	91	0
2	KEBABB C5	Full	2022-09-29	23:11	68,1458848	-59,9730353	CTD Rosette	Deployment		360	12,8	-0,9			999,71	89	0
2	KEBABB B1	Full	2022-09-29	16:32	67,077615	-61,4861957	Beam trawl	Recovery		356	13,1	0,6			1001,86	77	0
2	KEBABB B1	Full	2022-09-29	16:10	67,0634605	-61,4961322	Beam trawl	Bottom		330	7,4	0,4			1002,12	78	0
2	KEBABB B1	Full	2022-09-29	15:59	67,0595187	-61,5055508	Beam trawl	Deployment		313	3,6	0,2			1002,25	82	0
2	KEBABB B1	Full	2022-09-29	15:37	67,0733963	-61,5015733	Tucker Net	Recovery		325	7,8	0			1002,41	86	0
2	KEBABB B1	Full	2022-09-29	15:30	67,0692902	-61,501638	Tucker Net	Bottom		297	6,5	-0,4			1002,48	90	0
2	KEBABB B1	Full	2022-09-29	15:22	67,0662043	-61,5092432	Tucker Net	Deployment		314	4,6	-0,5			1002,55	90	0
2	KEBABB B1	Full	2022-09-29	15:03	67,0658905	-61,5155233	CTD Rosette	Recovery		300	5,1	-0,3			1004,93	88	1
2	KEBABB B1	Full	2022-09-29	14:42	67,0611852	-61,5094498	CTD Rosette	Bottom		342	8,6	-0,1			1003,47	87	1
2	KEBABB B1	Full	2022-09-29	14:38	67,0601792	-61,50843	CTD Rosette	Deployment		346	10,5	-0,2			1003,57	86	1
2	KEBABB B2	KEBABB	2022-09-29	11:50	67,1947187	-60,901257	Bongo Net	Recovery		320	9,9	0			1003,18	78	0
2	KEBABB B2	KEBABB	2022-09-29	11:47	67,1949673	-60,9005753	Bongo Net	Bottom		316	11,6	-0,1			1003,02	79	0
2	KEBABB B2	KEBABB	2022-09-29	11:43	67,1951442	-60,8989812	Bongo Net	Deployment		324	9,5	-0,3			1003,00	81	0
2	KEBABB B2	KEBABB	2022-09-29	11:31	67,1871528	-60,9040777	CTD Rosette	Recovery		338	12,4	-0,1			1003,20	81	0
2	KEBABB B2	KEBABB	2022-09-29	10:42	67,1939878	-60,8962197	CTD Rosette	Bottom		348	12,9	0,1			1003,55	79	0
2	KEBABB B2	KEBABB	2022-09-29	10:26	67,1961792	-60,896634	CTD Rosette	Deployment		337	14,1	0			1003,59	81	0
2	KEBABB B3	Full	2022-09-29	8:28	67,3222122	-60,2675067	Box Core	Recovery		344	18,3	0,2			1004,62	77	0
2	KEBABB B3	Full	2022-09-29	8:02	67,3264307	-60,272153	Box Core	Bottom		343	17,3	0,2			1004,76	83	0
2	KEBABB B3	Full	2022-09-29	7:33	67,3286585	-60,2739643	Box Core	Deployment		340	15,8	0,3			1005,41	80	0
2	KEBABB B3	Full	2022-09-29	6:59	67,3172675	-60,2386282	Hydrobios	Recovery		347	17,1	0,3			1005,48	79	0
2	KEBABB B3	Full	2022-09-29	6:26	67,3243642	-60,2524847	Hydrobios	Bottom		341	17,1	0,4			1005,56	82	0
2	KEBABB B3	Full	2022-09-29	6:01	67,327418	-60,2665043	Hydrobios	Deployment		346	16,6	0,2			1005,96	86	0
2	KEBABB B3	Full	2022-09-29	5:32	67,3225927	-60,2500988	Tucker Net	Recovery		331	13,3	0			1005,74	86	0
2	KEBABB B3	Full	2022-09-29	5:24	67,3258538	-60,259595	Tucker Net	Bottom		339	12,6	-0,3			1005,90	91	0
2	KEBABB B3	Full	2022-09-29	5:16	67,3297208	-60,2676668	Tucker Net	Deployment		350	13,3	0,6			1006,31	81	0
2	KEBABB B3	Full	2022-09-29	4:12	67,3339963	-60,2613988	CTD Rosette	Recovery		345	19,2	0,2			1006,12	83	0
2	KEBABB B3	Full	2022-09-29	3:04	67,3305378	-60,2767812	CTD Rosette	Bottom		334	15,4	-0,1			1006,44	91	0
2	KEBABB B3	Full	2022-09-29	2:44	67,3294782	-60,2771493	CTD Rosette	Deployment		342	16	-0,2			1006,31	91	0
2	KEBABB B4	KEBABB	2022-09-29	0:52	67,4646322	-59,6419228	CTD Rosette	Recovery		350	15,6	-0,2			1006,12	93	0
2	KEBABB B4	KEBABB	2022-09-28	23:31	67,4648217	-59,6341528	CTD Rosette	Bottom		344	13,5	0,3			1007,09	84	0
2	KEBABB B4	KEBABB	2022-09-28	23:05	67,4665233	-59,635311	CTD Rosette	Deployment		1	14,5	0,3			1007,14	85	0
2	KEBABB B5	Full	2022-09-28	20:37	67,5802628	-58,873789	IKMT	Recovery		3	18,7	1			1007,43	83	0
2	KEBABB B5	Full	2022-09-28	19:35	67,5779222	-58,9802325	IKMT	Bottom		2	16,8	0,9			1008,28	86	0
2	KEBABB B5	Full	2022-09-28	19:05	67,58843	-59,0128552	IKMT	Deployment		8	14,3	1,7			1008,97	86	0

2	KEBABB B5	Full	2022-09-28	18:34	67,5842113	-59,0108057	Hydrobios	Recovery		8	14,7	1,2			1008,64	90	0
2	KEBABB B5	Full	2022-09-28	17:58	67,5850297	-59,0168123	Hydrobios	Bottom		12	16	1,2			1008,60	89	0
2	KEBABB B5	Full	2022-09-28	17:30	67,5850065	-59,0192095	Hydrobios	Deployment		357	12,2	1,2			1009,16	91	0
2	KEBABB B5	Full	2022-09-28	16:49	67,5783342	-59,008042	Tucker Net	Recovery		358	13,3	1,1			1010,46	90	0
2	KEBABB B5	Full	2022-09-28	16:40	67,5786652	-59,0209637	Tucker Net	Bottom		357	13,9	1,1			1010,50	91	0
2	KEBABB B5	Full	2022-09-28	16:26	67,583051	-59,0350595	Tucker Net	Deployment		355	11,4	2,1			1010,90	90	0
2	KEBABB B5	Full	2022-09-28	15:45	67,5891753	-59,0573917	Bongo Net	Recovery		335	16	0,9			1010,88	94	0
2	KEBABB B5	Full	2022-09-28	15:42	67,5895003	-59,057156	Bongo Net	Bottom		349	13,1	1			1010,95	94	0
2	KEBABB B5	Full	2022-09-28	15:39	67,5895572	-59,0571638	Bongo Net	Deployment		356	15,2	1,1			1010,94	94	0
2	KEBABB B5	Full	2022-09-28	15:25	67,5939008	-59,0653487	CTD Rosette	Recovery		355	13,5	1,3			1010,85	94	0
2	KEBABB B5	Full	2022-09-28	14:25	67,589929	-59,0327932	CTD Rosette	Bottom		357	15	1,1			1010,92	91	0
2	KEBABB B5	Full	2022-09-28	14:04	67,5872858	-59,0237987	CTD Rosette	Deployment		360	12,4	1			1010,95	91	0
2	KEBABB B6	Benthic	2022-09-28	11:22	67,2891507	-58,4475898	Box Core	Recovery		355	13,5	0,4			1009,82	99	0
2	KEBABB B6	Benthic	2022-09-28	10:53	67,2877692	-58,447282	Box Core	Bottom		349	13,3	0,4			1009,66	99	0
2	KEBABB B6	Benthic	2022-09-28	10:21	67,286971	-58,4471972	Box Core	Deployment		358	12,4	0,6			1009,82	99	0
2	KEBABB B6	Benthic	2022-09-28	9:53	67,2786537	-58,4238693	Bongo Net	Recovery		9	11,8	0,6			1009,83	99	0
2	KEBABB B6	Benthic	2022-09-28	9:50	67,278883	-58,4242382	Bongo Net	Bottom		15	13,7	0,6			1009,67	99	0
2	KEBABB B6	Benthic	2022-09-28	9:46	67,279235	-58,4250102	Bongo Net	Deployment		3	13,9	0,6			1009,57	99	0
2	KEBABB B6	Benthic	2022-09-28	9:35	67,2804267	-58,426557	CTD Rosette	Recovery		3	11,2	0,5			1009,43	99	0
2	KEBABB B6	Benthic	2022-09-28	9:11	67,2830602	-58,4321132	CTD Rosette	Bottom		354	11	0,3			1009,34	99	0
2	KEBABB B6	Benthic	2022-09-28	8:52	67,285147	-58,4366773	CTD Rosette	Deployment		351	11,2	0,1			1009,17	99	0
2		Nutrient	2022-09-27	20:24	67,0674538	-54,4789845	MVP	Deployment		137	4,4	4,7			1004,93	99	0
2	198	Full	2022-09-27	18:18	67,0842303	-54,197539	Box Core	Recovery		116	3	4,9			1005,40	96	0
2	198	Full	2022-09-27	18:15	67,0842733	-54,1979173	Box Core	Bottom		113	3,2	4,8			1005,46	96	0
2	198	Full	2022-09-27	18:12	67,0843772	-54,1983548	Box Core	Deployment		139	2,9	5			1005,43	96	0
2	198	Full	2022-09-27	18:00	67,0844737	-54,1994645	Van Veen	Recovery		151	2,3	4,9			1005,29	96	0
2	198	Full	2022-09-27	17:56	67,084535	-54,2000187	Van Veen	Bottom		153	2,9	4,9			1005,28	96	0
2	198	Full	2022-09-27	17:53	67,0846018	-54,2004422	Van Veen	Deployment		168	3,4	5			1005,23	95	0
2	198	Full	2022-09-27	17:31	67,082433	-54,1982723	Beam trawl	Recovery		189	2,9	5,2			1004,70	93	0
2	198	Full	2022-09-27	17:10	67,0847698	-54,1906722	Beam trawl	Bottom		184	4,4	5,1			1004,61	93	0
2	198	Full	2022-09-27	17:03	67,0820067	-54,1949218	Beam trawl	Deployment		148	8,6	5,2			1004,33	96	0
2	198	Full	2022-09-27	15:31	67,0911717	-54,200099	Zodiac	Recovery		154	5,5	4,9			1004,51	96	0
2	198	Full	2022-09-27	15:17	67,0882268	-54,2013207	Tucker Net	Recovery		170	5,5	5			1004,11	95	0
2	198	Full	2022-09-27	15:04	67,0876825	-54,2054897	Tucker Net	Bottom		162	4	5,2			1004,28	94	0
2	198	Full	2022-09-27	14:59	67,085247	-54,2031118	Tucker Net	Deployment		160	3,6	5,2			1004,16	93	0
2	198	Full	2022-09-27	14:42	67,0930797	-54,1943827	Zodiac	Deployment		130	5,3	4,9			1003,91	96	0
2	198	Full	2022-09-27	14:24	67,0911637	-54,1979702	CTD Rosette	Recovery		170	7	5,4			1003,80	95	0
2	198	Full	2022-09-27	14:05	67,0856195	-54,2031773	CTD Rosette	Bottom		134	4,2	5,1			1003,50	95	0
2	198	Full	2022-09-27	14:03	67,0850243	-54,203705	CTD Rosette	Deployment									0
2	198	Full	2022-09-27	13:36	67,0911118	-54,1948773	Trace Metals Rosett	Recovery		157	5,7	5,2			1003,30	94	0

2	198	Full	2022-09-27	13:32	67,0900182	-54,1956702	Trace Metals Rosette	Bottom		158	7	5,3			1003,28	94	0
2	198	Full	2022-09-27	13:25	67,08731	-54,1977417	Trace Metals Rosette	Deployment		154	6,5	5,4			1003,23	94	0
2	197	Nutrient	2022-09-27	5:28	67,0446067	-55,0870143	Van Veen	Recovery		171	21,7	5,9			1000,82	94	0
2	197	Nutrient	2022-09-27	5:24	67,0444135	-55,0866995	Van Veen	Bottom		174	23,8	5,9			1000,73	94	0
2	197	Nutrient	2022-09-27	5:21	67,0442045	-55,0862398	Van Veen	Deployment		177	22,3	5,9			1000,74	94	0
2	197	Nutrient	2022-09-27	4:58	67,0441215	-55,1019103	CTD Rosette	Recovery		172	25,1	6			1000,61	94	0
2	197	Nutrient	2022-09-27	4:44	67,0443352	-55,0969645	CTD Rosette	Bottom		174	24,4	6			1000,42	95	0
2	197	Nutrient	2022-09-27	4:41	67,044221	-55,0955957	CTD Rosette	Deployment		173	25,1	5,9			1000,40	95	0
2	196	Basic	2022-09-27	1:37	66,9984305	-56,1187627	Beam Trawl	Recovery		142	17,7	4,7			998,02	99	0
2	196	Basic	2022-09-27	1:20	66,993916	-56,0914312	Beam Trawl	Bottom		138	16,6	4,8			998,15	99	0
2	196	Basic	2022-09-27	1:11	66,9895067	-56,0806087	Beam Trawl	Deployment		133	13,3	7,2			998,58	97	0
2	196	Basic	2022-09-27	0:50	66,9862128	-56,071472	Trace Metals Rosette	Recovery		151	19,8	4,9			998,08	99	0
2	196	Basic	2022-09-27	0:43	66,985169	-56,0724312	Trace Metals Rosette	Bottom		153	19,4	5			998,05	99	0
2	196	Basic	2022-09-27	0:35	66,9844192	-56,0702487	Trace Metals Rosette	Deployment		149	19	5			997,93	99	0
2	196	Basic	2022-09-27	0:13	66,9935522	-56,076444	Hydrobios	Recovery		148	19,6	5,2			997,77	99	0
2	196	Basic	2022-09-27	0:06	66,9925462	-56,0782903	Hydrobios	Bottom		153	20,2	5,3			997,90	99	0
2	196	Basic	2022-09-27	0:00	66,9915623	-56,0781935	Hydrobios	Deployment		150	20,6	5,3			997,94	99	0
2	196	Basic	2022-09-26	22:49	66,9855053	-56,0678783	Trace Metals Rosette	Recovery		153	14,5	5,3			997,55	99	0
2	196	Basic	2022-09-26	22:38	66,9847608	-56,0672608	Trace Metals Rosette	Bottom		154	16,9	5,4			997,43	99	0
2	196	Basic	2022-09-26	22:28	66,9840377	-56,0671785	Trace Metals Rosette	Deployment		151	18,5	5,4			997,53	99	0
2	196	Basic	2022-09-26	21:51	66,9994373	-56,0855995	Tucker Net	Recovery		150	14,1	5,3			997,34	99	0
2	196	Basic	2022-09-26	21:46	66,9991028	-56,078315	Tucker Net	Bottom		148	15,8	5,3			997,35	99	0
2	196	Basic	2022-09-26	21:31	66,9935275	-56,0664207	Tucker Net	Deployment		139	18,7	7,9			997,63	97	0
2	196	Basic	2022-09-26	20:51	66,9857985	-56,065386	Zodiac	Recovery		126	12,8	5			997,02	99	0
2	196	Basic	2022-09-26	20:46	66,9852	-56,0645105	CTD Rosette	Recovery		135	13,5	5,2			997,10	99	0
2	196	Basic	2022-09-26	20:21	66,983328	-56,0673782	CTD Rosette	Bottom		134	14,7	5,3			997,09	99	0
2	196	Basic	2022-09-26	20:18	66,9832297	-56,067219	CTD Rosette	Deployment		137	13,3	5,3			997,13	99	0
2		Nutrient	2022-09-26	15:38	66,8956427	-56,9421667	MVP	Deployment		135	18,8	4,7			999,35	99	0
2	195	Nutrient	2022-09-26	14:56	66,8921588	-56,9326692	Box Core	Recovery		121	16	4,7			998,98	99	0
2	195	Nutrient	2022-09-26	14:43	66,8909048	-56,9290617	Box Core	Bottom		114	16,4	4,7			999,11	99	0
2	195	Nutrient	2022-09-26	14:25	66,8913197	-56,9219293	Box Core	Deployment		106	17,3	4,6			998,73	99	0
2	195	Nutrient	2022-09-26	14:03	66,8915382	-56,9590867	CTD Rosette	Recovery		158	7,2	4,8			997,80	99	0
2	195	Nutrient	2022-09-26	13:14	66,8871127	-56,9345287	CTD Rosette	Bottom		91	17,7	4,3			997,68	99	0
2	195	Nutrient	2022-09-26	13:02	66,8871537	-56,9308232	CTD Rosette	Deployment		74	16,4	4,2			997,70	99	0
2		Full	2022-09-26	9:32	66,8623097	-57,9172693	MVP	Deployment		57	15,6	2,4			997,73	94	0
2	KEBABB A5	Full	2022-09-26	9:00	66,8682572	-57,9391675	Box Core	Recovery		53	13,7	2,6			997,91	94	0
2	KEBABB A5	Full	2022-09-26	8:40	66,8700842	-57,9420198	Box Core	Bottom		66	14,7	2,6			998,21	94	0
2	KEBABB A5	Full	2022-09-26	8:19	66,8710243	-57,9450607	Box Core	Deployment		51	13,5	2,4			998,20	95	0
2	KEBABB A5	Full	2022-09-26	7:45	66,8667503	-57,9010563	IKMT	Recovery		40	9,9	2,3			998,36	93	0
2	KEBABB A5	Full	2022-09-26	7:00	66,8650322	-57,925435	IKMT	Bottom		33	12,6	2,4			998,11	90	0

2	KEBABB A5	Full	2022-09-26	6:39	66,8723967	-57,9480898	IKMT	Deployment		29	10,5	2,7			998,18	90	0
2	KEBABB A5	Full	2022-09-26	6:11	66,8708505	-57,9421385	Hydrobios	Recovery		66	5	2,5			998,43	93	0
2	KEBABB A5	Full	2022-09-26	5:40	66,8729853	-57,9448525	Hydrobios	Bottom		16	11,6	2,5			998,70	93	0
2	KEBABB A5	Full	2022-09-26	5:18	66,8739872	-57,948981	Hydrobios	Deployment		22	12	2,4			998,76	94	0
2	KEBABB A5	Full	2022-09-26	4:30	66,8790745	-57,9360925	Tucker Net	Recovery		3	10,5	2,1			999,14	93	0
2	KEBABB A5	Full	2022-09-26	4:20	66,8777127	-57,9512715	Tucker Net	Bottom									0
2	KEBABB A5	Full	2022-09-26	4:05	66,8814813	-57,9698952	Tucker Net	Deployment		3	8,4	1,8			999,48	93	0
2	KEBABB A5	Full	2022-09-26	3:48	66,8852758	-57,9678043	CTD Rosette	Recovery		12	12,2	2,3			999,37	93	0
2	KEBABB A5	Full	2022-09-26	2:51	66,8779817	-57,9575802	CTD Rosette	Bottom		34	1,7	3,2			1000,38	89	0
2	KEBABB A5	Full	2022-09-26	2:35	66,8766342	-57,9571188	CTD Rosette	Deployment		321	11	1,9			1000,25	91	0
2		Full	2022-09-26	2:16	66,870837	-57,9605958	MVP	Recovery		328	8,9	2			1000,52	92	0
2		CTD	2022-09-25	23:38	66,7998285	-58,7421218	MVP	Deployment		350	12,6	1,4			1001,05	90	0
2	KEBABB A4	CTD	2022-09-25	22:56	66,79818	-58,7510997	Box Core	Recovery		20	9,5	1,6			1002,11	88	0
2	KEBABB A4	CTD	2022-09-25	22:33	66,79756	-58,7553918	Box Core	Bottom		29	6,7	1,5			1002,80	89	0
2	KEBABB A4	CTD	2022-09-25	22:09	66,796925	-58,7597542	Box Core	Deployment									0
2	KEBABB A4	CTD	2022-09-25	21:34	66,7884843	-58,7307772	Trace Metals Rosette	Recovery		47	9,3	1,4			1003,32	90	0
2	KEBABB A4	CTD	2022-09-25	21:24	66,7887063	-58,730471	Trace Metals Rosette	Bottom		45	8,2	1,4			1003,67	90	0
2	KEBABB A4	CTD	2022-09-25	21:14	66,7896908	-58,7303998	Trace Metals Rosette	Deployment		38	2,5	1,5			1003,67	91	0
2	KEBABB A4	CTD	2022-09-25	20:43	66,7915193	-58,728203	CTD Rosette	Recovery		7	1,9	1,5			1004,05	93	0
2	KEBABB A4	CTD	2022-09-25	19:44	66,7964273	-58,7348638	CTD Rosette	Bottom		89	4,8	2,3			1005,63	89	0
2	KEBABB A4	CTD	2022-09-25	19:26	66,7976792	-58,7380565	CTD Rosette	Deployment		58	1,7	2,1			1005,66	91	0
2	KEBABB A4	CTD	2022-09-25	19:01	66,794801	-58,7375317	Trace Metals Rosette	Recovery		118	1,7	2,2			1006,46	87	0
2	KEBABB A4	CTD	2022-09-25	18:53	66,7950328	-58,7404107	Trace Metals Rosette	Bottom		108	5,3	2,2			1006,55	88	0
2	KEBABB A4	CTD	2022-09-25	18:45	66,7952278	-58,7443173	Trace Metals Rosette	Deployment		121	5,5	1,8			1006,84	91	0
2		CTD	2022-09-25	18:12	66,7941615	-58,7393082	MVP	Recovery		131	8,2	1,2			1007,54	94	0
2		Full	2022-09-25	15:10	66,7088667	-59,6031787	MVP	Deployment		168	16,9	1,5			1008,94	93	0
2	KEBABB A3	Full	2022-09-25	14:22	66,7339415	-59,6058962	Box Core	Recovery		149	17,9	1,4			1009,22	94	0
2	KEBABB A3	Full	2022-09-25	13:58	66,7334642	-59,6038893	Box Core	Bottom		165	20,8	1,5			1009,15	93	0
2	KEBABB A3	Full	2022-09-25	13:34	66,7326953	-59,6052962	Box Core	Deployment		158	24	1,6			1009,13	93	0
2	KEBABB A3	Full	2022-09-25	12:14	66,7682065	-59,7229758	IKMT	Recovery		156	23,4	1,7			1009,68	93	0
2	KEBABB A3	Full	2022-09-25	11:05	66,7422468	-59,6287325	IKMT	Bottom		165	23,4	1,1			1010,42	93	0
2	KEBABB A3	Full	2022-09-25	10:50	66,7354322	-59,6167188	IKMT	Deployment		164	20,2	2,8			1011,51	89	0
2	KEBABB A3	Full	2022-09-25	10:14	66,7338585	-59,5967388	Hydrobios	Recovery		164	16,9	1,4			1011,66	92	0
2	KEBABB A3	Full	2022-09-25	9:47	66,7321567	-59,602133	Hydrobios	Bottom		162	21,5	1,2			1011,94	93	0
2	KEBABB A3	Full	2022-09-25	9:25	66,732637	-59,6100405	Hydrobios	Deployment		170	20,6	1,3			1012,51	92	0
2	KEBABB A3	Full	2022-09-25	9:20	66,7326578	-59,6115547	Hydrobios	Deployment		169	23,6	1,3			1012,33	92	0
2	KEBABB A3	Full	2022-09-25	9:14	66,7331953	-59,611662	Hydrobios	Recovery		174	28,6	1,4			1012,21	93	0
2	KEBABB A3	Full	2022-09-25	9:08	66,7332872	-59,6138627	Hydrobios	Deployment		164	22,8	1,3			1012,44	93	0
2	KEBABB A3	Full	2022-09-25	8:36	66,737758	-59,6360637	Tucker Net	Recovery		160	24,4	1			1011,76	93	0
2	KEBABB A3	Full	2022-09-25	8:23	66,736167	-59,6184013	Tucker Net	Bottom		161	19,8	1,1			1012,04	92	0

2	KEBABB A3	Full	2022-09-25	8:09	66,7321127	-59,6042983	Tucker Net	Deployment		168	20,8	1,8			1012,68	89	0
2	KEBABB A3	Full	2022-09-25	7:48	66,7219288	-59,5889913	CTD Rosette	Recovery		157	21,7	1,1			1012,85	92	0
2	KEBABB A3	Full	2022-09-25	6:45	66,728012	-59,606166	CTD Rosette	Bottom		175	21,7	1,1			1013,17	91	0
2	KEBABB A3	Full	2022-09-25	6:26	66,7308333	-59,6080493	CTD Rosette	Deployment		165	23,4	1,1			1013,51	90	0
2		CTD	2022-09-25	3:09	66,664483	-60,480056	MVP	Deployment		176	27,6	1,2			1013,56	91	0
2	KEBABB A2	CTD	2022-09-25	2:39	66,6691093	-60,4799913	Bongo Net	Recovery		178	26,3	1,1			1013,36	89	0
2	KEBABB A2	CTD	2022-09-25	2:37	66,6687943	-60,4778905	Bongo Net	Bottom		177	26,8	1,1			1013,87	89	0
2	KEBABB A2	CTD	2022-09-25	2:34	66,6684318	-60,4756397	Bongo Net	Deployment		176	25,9	1,1			1013,80	89	0
2	KEBABB A2	CTD	2022-09-25	2:18	66,671607	-60,4843195	CTD Rosette	Recovery		183	22,5	1			1014,08	89	0
2	KEBABB A2	CTD	2022-09-25	1:28	66,6702798	-60,474042	CTD Rosette	Bottom									0
2	KEBABB A2	CTD	2022-09-25	1:17	66,669338	-60,4755428	CTD Rosette	Deployment		180	24,2	1,4			1014,61	84	0
2	KEBABB A1	Full	2022-09-24	22:57	66,6156418	-61,1891925	Beam trawl	Recovery		163	7,6	1,4			1014,56	87	
2	KEBABB A1	Full	2022-09-24	22:41	66,6150073	-61,1829622	Beam trawl	Bottom		179	17,5	1,2			1014,00	85	
2	KEBABB A1	Full	2022-09-24	22:32	66,608744	-61,1849192	Beam trawl	Deployment		198	8,4	4,4			1014,64	74	
2	KEBABB A1	Full	2022-09-24	22:09	66,5953885	-61,1996862	Baited camera	Recovery		179	14,7	0,9			1014,20	89	
2	KEBABB A1	Full	2022-09-24	21:23	66,6081247	-61,1924305	Hydrobios	Recovery		177	15	0,9			1013,90	87	
2	KEBABB A1	Full	2022-09-24	21:17	66,6068803	-61,1928225	Hydrobios	Bottom		185	13,1	0,9			1013,70	87	
2	KEBABB A1	Full	2022-09-24	21:14	66,6060487	-61,1933338	Hydrobios	Deployment		193	13,5	0,9			1013,66	86	
2	KEBABB A1	Full	2022-09-24	20:40	66,6118438	-61,1937108	Tucker Net	Recovery		197	16,9	1			1013,56	86	
2	KEBABB A1	Full	2022-09-24	20:26	66,6137955	-61,1769783	Tucker Net	Bottom		193	13,9	1			1013,60	87	
2	KEBABB A1	Full	2022-09-24	20:16	66,6092565	-61,1747413	Tucker Net	Deployment		174	9,3	3,2			1013,46	79	
2	KEBABB A1	Full	2022-09-24	19:56	66,6060418	-61,180719	CTD Rosette	Recovery		178	14,3	1,3			1013,32	92	
2	KEBABB A1	Full	2022-09-24	19:35	66,6062933	-61,1876643	CTD Rosette	Bottom		189	16,2	1,2			1013,03	91	
2	KEBABB A1	Full	2022-09-24	19:23	66,6073282	-61,1885375	CTD Rosette	Deployment		186	16,2	1,3			1012,96	91	
2	KEBABB A1	Full	2022-09-24	18:48	66,6010742	-61,2005927	Trace metals Rosette	Recovery		178	20,6	1,1			1012,34	91	
2	KEBABB A1	Full	2022-09-24	18:40	66,6021365	-61,2002418	Trace metals Rosette	Bottom		177	16,8	1,3			1012,43	90	
2	KEBABB A1	Full	2022-09-24	18:25	66,6044372	-61,198713	Trace metals Rosette	Deployment		178	18,3	1,2			1012,20	89	
2	KEBABB A1	Full	2022-09-24	17:34	66,5939235	-61,199645	Baited camera	Bottom		188	17,7	1,7			1011,03	86	
2	KEBABB A1	Full	2022-09-24	17:29	66,5941812	-61,1996057	Baited camera	Deployment		196	14,5	3,6			1011,22	84	