AMUNDSEN SCIENCE

2021 | Expedition Report

CCGS *Amundsen*

LEG 1
NRCan

LEG 2
ROV Seabed Habitats,
ArcticNet

LEG 3
KEBABB, ArcticNet,
Sentinel North

LEG 4
PeCaBeau, RADCARBBS,
ArcticNet

LEG 5
DarkEdge

Amundsen Science
Université Laval
Pavillon Alexandre-Vachon, room 3432
1045, avenue de la Médecine
Québec, QC, G1V 0A6
CANADA
www.amundsen.ulaval.ca

Amélie Desmarais
Amundsen Expedition Reports Editor
amelie.desmarais@as.ulaval.ca

Anissa Merzouk
Marine Research Coordinator
anissa.merzouk@as.ulaval.ca

Alexandre Forest
Amundsen Science Executive Director
alexandre.forest@as.ulaval.ca

Table of Content

List of Figures

Part I – Overview and synopsis of operation

List of Tables

2021 Expedition Report

The 2021 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 2021 CCGS *Amundsen* Expedition. The 2021 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 five 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 2021. 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 sections in Part II describing each project are organized with atmospheric, surface ocean and sea ice components first (sections 0 to 6), followed by water column properties, which include the mooring and buoy program, CTD-Rosette operations and physicochemical properties (sections 7 to 15), as well as a suite of biological parameters and benthos sampling (sections 16 to 31). Subsequent sections cover sediments sampling and seabed mapping (sections 32 to 35).

The five 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 onboard during each leg. A description of each ROV dive is also attached.

The core oceanographic data generated by the CTD-Rosette operations, as well as meteorological information (AAVOS) 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 2021 *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 the public and private sectors. In 18 years of operation 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, her contribution to the International Polar Year and to the Network of Centres of Excellence ArcticNet, and her support of major environmental assessments have 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 4 July, the Canadian research icebreaker CCGS *Amundsen* left Quebec City for its 18th annual mission to the Arctic Ocean. The multidisciplinary expedition ran until 3 November and allowed more than 140 scientists from national and international research teams to study the marine and coastal environments of the Canadian and Greenlandic Arctic. Programs onboard included the NRCan, ROV SeaBed habitat, ArcticNet annual marine-based research program, the Knowledge and Ecosystem-Based Approach in Baffin Bay (KEBABB) program, the European PeCaBeau program, the novel RADCARBBS program and the international DarkEdge program. From aquatic microorganisms to seabirds to melting glaciers and seabed mapping, all aspects of the northern environment were studied during this 122-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 carries 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. From this perspective, gathering scientific knowledge about the area is of particular importance as to inform decision makers, federal departments and the private sector about the risks associated with the exploration and exploitation of oil and gas 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. It is an important pathway for exchange of heat, salt and ice between these two oceans. Baffin Bay's connection to the Arctic Ocean consists of three relatively narrow passages through the Canadian Arctic Archipelago (CAA). One of these passages, Nares Strait, is located between Ellesmere Island and Greenland and includes from south to north: Smith Sound, Kane Basin, Kennedy Channel, Hall Basin and Robeson Channel.

Each winter, there is a prolonged period during which a land-fast ice arch spans the strait at the entrance to Robeson Channel and south of Kennedy Channel the southward flux of ice. However, in the past decade, variability in the formation of the ice arch has been observed with weaker conditions resulting in an increase in ice flux from the Arctic Ocean into Baffin Bay. The formation of an ice arch in Nares Strait, the input of warm and salty Atlantic water from the West Greenland current moving northward along the coast of Greenland, and upwelling of warmer waters, all contribute to the creation of a large polynya, a year-round expanse of open waters, in Smith Sound and northern Baffin Bay. The North Water (NOW) Polynya is the largest (~80,000km^2) and most productive polynya in the Canadian Arctic and in addition to the tremendous marine bird resources in this area; it is of significance to many species of marine mammals. The NOW polynya has been the subject of intense ecosystem studies, including the Canadian-led study of the NOW Polynya in 1998.

The Manson Icefield is in southeast Ellesmere Island, Canada, and directly connect with Northern Baffin Bay. This icefield has the highest concentration of surging glaciers in the Canadian Arctic Islands, characterized by variable glacier flow and surging periods (Copland et al, 2003). The Mittie Glacier is the largest surging glacier and drains north from the icefield into Smith Bay.

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, chemistry nutrients, contaminants, and the biodiversity present along precise transects.

0.2.3 *Canadian Arctic Archipelago*

The Canadian Arctic Archipelago (CAA) is a vast array of islands and channels that lies between Banks Island in the west and Baffin and Ellesmere Islands in the east. While transiting through the Northwest Passage, the science teams aboard the Amundsen extended their time series of atmosphere, ice and ocean data. This work aims at better understanding how the climate, ice conditions as well as ocean currents and biogeochemistry are changing under the effects of climate change and industrialization. With ice extent and volume shrinking in the Arctic, the Northwest Passage may become partly ice-free and open to navigation during summer in the near future. Bathymetry data and sub-bottom information were collected while transiting through the Northwest Passage to map the seafloor and identify potential geohazards and obstacles to the safe navigation of this seaway.

0.2.4 *Beaufort Sea*

The Canadian Beaufort Sea/Mackenzie Shelf region of the Arctic Ocean has witnessed major changes in recent years, with decreasing sea ice cover and major shifts in sea-ice dynamics. The Beaufort Sea is characterized by a broad shelf onto which the Mackenzie River, one of the largest rivers in North America, carries large amounts of freshwater. The mixing of freshwater from the Mackenzie River and Arctic marine waters of the Beaufort Sea establishes an estuarine system over the shelf, with associated inputs of land-derived nutrients and freshwater biota. Along the Mackenzie Shelf stretches the Cape Bathurst polynya, an expanse of open water that exists year-round and is highly productive. This ecosystem is also exceptional since it provides habitat for some of the highest densities of birds and marine mammals in the Arctic.

Since 2002, extensive multidisciplinary research programs have been conducted in the Beaufort Sea area. Major oceanographic research activities were carried out as part of two major international overwintering research programs conducted on board the CCGS *Amundsen* in 2003-2004 (CASES program) and in 2007-2008 (CFL Study). Environmental and oceanographic research activities were also conducted in the offshore region of the Mackenzie Shelf, shelf slope and Beaufort Sea since 2009, in partnership with the Oil & Gas industry and within the framework of the Beaufort Regional Environmental Assessment (BREA, www.beaufortrea.ca) program.

0.3 2021 Expedition Plan

0.3.1 *General schedule*

Based on the scientific objectives and regions of interest, the summer expedition was divided into five separate legs. Leg 1 took the Amundsen in the Labrador Sea for the Marine Spatial Planning program of NRCan. Leg 2 took the ship further along the coast of Labrador and in Baffin Bay for the ROV Coral seep project. DFO's KEBABB project took place in Baffin Bay and Lancaster Sound during Leg 3, in addition to Sentinel North's Quaqtaq Survey in Nunavik. Leg 4 hosted the international PeCaBeau program and the RADCABBS projects in the Beaufort Sea. The ship then headed back to Quebec City while conducting the Dark Edge integrated study in Baffin Bay. Finally, members of the ArcticNet Marine program were also sampling from the CCGS *Amundsen* during Leg 2 to 5.

0.3.2 *Leg 1 – NRCan's Marine Spatial Planning Program – 4 to 15 July – Labrador Sea*

The first Leg of the Expedition was dedicated to seabed habitats study for the Marine Spatial Planning Program of the Natural Resources Canada (NRCan). The scientific operations conducted during this leg include seafloor-mapping surveys, sediment-coring activities and bottom camera deployments on the Northeast Newfoundland shelf and slope.

0.3.3 *Leg 2 – ROV Coral Seep Habitats – 15 July to 12 August – Labrador Sea, Baffin Bay*

Leg 2 of the 2021 Expedition used 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. The ArcticNet marine program also conducted varied scientific operations with a focus on sediment coring activities, bottom camera deployments and fishes. In addition, moorings recoveries and deployments took place at 5 locations.

0.3.4 *Leg 3 – KEBABB & ArcticNet– 12 August to 9 September – Baffin Bay & CAA*

Leg 3 of the 2021 Expedition took place in Baffin Bay and Lancaster Sound. The Knowledge and Ecosystem Based Approach in Baffin Bay (KEBABB) program sampled various components of the ecosystem along five transects in the Southern Baffin Bay area. In between these stations, dedicated bottom mapping, river sampling and Glacier operations for the ArcticNet program took place, in addition to ArcticNet historical transects in the Hudson Strait, in the Davis Strait and in Northern Baffin Bay. Scientific operations also took place in Quaqtaq (QC) for the Sentinel North program.

0.3.5 *Leg 4 – PeCaBeau, RADCABSS & ArcticNet – 9 September to 7 October – CAA, Beaufort Sea*

Leg 4 programs studied the Permafrost Carbon in the Beaufort Sea (PeCaBeau) through biogeochemical and carbon cycling studies of seawater and sediments at more than 20 stations. In addition, the Radiocarbon Distributions and Carbon Cycling between Baffin Bay and the Beaufort Sea (RADCARBBS) program and ArcticNet marine program were onboard. They studied fishes, plankton, contaminants, carbon cycle and biogeochemistry in the Northwest Passage and along key historical transects.

0.3.6 *Leg 5 – DarkEdge – 7 October to 3 November – Baffin Bay*

During the final Leg of the 2021 Expedition, an integrated study called DarkEdge) took place at the ice edge to study the key processes taking place during the fall-winter transition in northern Baffin Bay with the help of novel technologies. This study builds on the results of the Green Edge project, hosted on the *Amundsen* in 2016. Amongst other instruments, the scientists deployed an Autonomous Underwater Vehicle (AUV), a small ROV and an ice-canoe. This integrated study clocludes with the return of the CCGS *Amundsen* to Quebec City for the end of the annual expedition on November 3rd.

1 Leg 1 – 4 to 15 July – Labrador Sea

Chief Scientist: Vladimir Kostylev[1] (vladimir.kostylev@canada.ca)

[1] Natural Resources Canada, Bedford Institute of Oceanography, Darmouth, NS

1.1 Introduction and Objectives

Led by Natural Resources Canada (NRCan), the Seabed habitats and marine geohazards in Northeast Newfoundland slope program is a recent Marine Geoscience for Marine Spatial Planning (MGMSP) program, which aims at providing innovative regional geoscience products to support the Department of Fisheries and Oceans (DFO) Marine Spatial Planning and evidence-based decision-making. The program was also supported in 2020 in the mist of the COVID-19 pandemic when then icebreaker stayed in the subarctic.

In August 2019, a joint Geological Survey of Canada (Atlantic) and Canadian Hydrographic Service team carried out multibeam bathymetry mapping and sub-bottom profiling on board the Canadian Coast Guard ship Louis S. St. Laurent (LSSL) in the northern part of Orphan basin, as well as along the shelf break and slope from Orphan Spur to Notre Dame Trough. The multibeam survey gave new insight into surficial geology, geohazards and benthic habitats of the northeast Newfoundland slope, northern part of Orphan Basin and Orphan spur.

Better interpretation of geomorphological features observed in multibeam bathymetry and validation of preliminary interpretations of morphology and backscatter data required collection of ground-truth information on grain size distribution, stratigraphy, dating of slope failures, and on the nature of seabed habitats. Specifically, we planned to augment the existing geophysical data coverage of the area by carrying new multibeam bathymetry and sub-bottom profiler surveys, and to carry out piston and gravity coring, sampling of surficial sediments, and seabed imaging. The scientific objectives of the Leg 1 included:

- Geological mapping
- Collecting sediments on the on the Northeast Newfoundland shelf and slope
- Habitat mapping
- Identification of geological hazards
- Dating of geological hazards
- Gaining better understanding of geological controls on ecological processes.

1.2 Synopsis of operations

The Amundsen Science 2021 Leg 1 cruise took place in the northeast Newfoundland slope and northern Orphan Basin region between Latitudes 50.1 – 52.6 N and Longitudes 51.1 – 48.8 W (see Figure 1-1). The cruise took place during July 4th – 15th 2021, departing from Quebec City, stopping in St. John's and returning to St. John's, Newfoundland on board the CCGS *Amundsen*. The cruise activities consisted of sampling the seabed by collecting piston cores, gravity cores, box cores, grabs and bottom camera imagery during daylight hours (approximately 6 am – 6 pm) and surveying the seabed using sub-bottom profiler and multibeam echosounder during night hours with sound velocity measurements taken along the track. Additionally, a wildlife observer was present to report sightings of birds and mammals encountered during the cruise.

The Amundsen 2021 Leg 1 expedition has been impacted by delays in the repairs of a crane (delaying the departure from Quebec City from 30 June to 4 July) and by stormy conditions in the Labrador Sea. Nonetheless, scientists, with the help of the crew, were able conduct the following operations:

- 2 piston cores
- 1 box core
- 2 CTD-Rosettes

- 3 drop cameras, yielding high-resolution photographs of sea bed
- 3495 km^2 of seabed mapped with Multibeam Echosounder in average water depths of 996 m
- 1459 NM of 3.5 kHz sub-bottom profiler survey lines

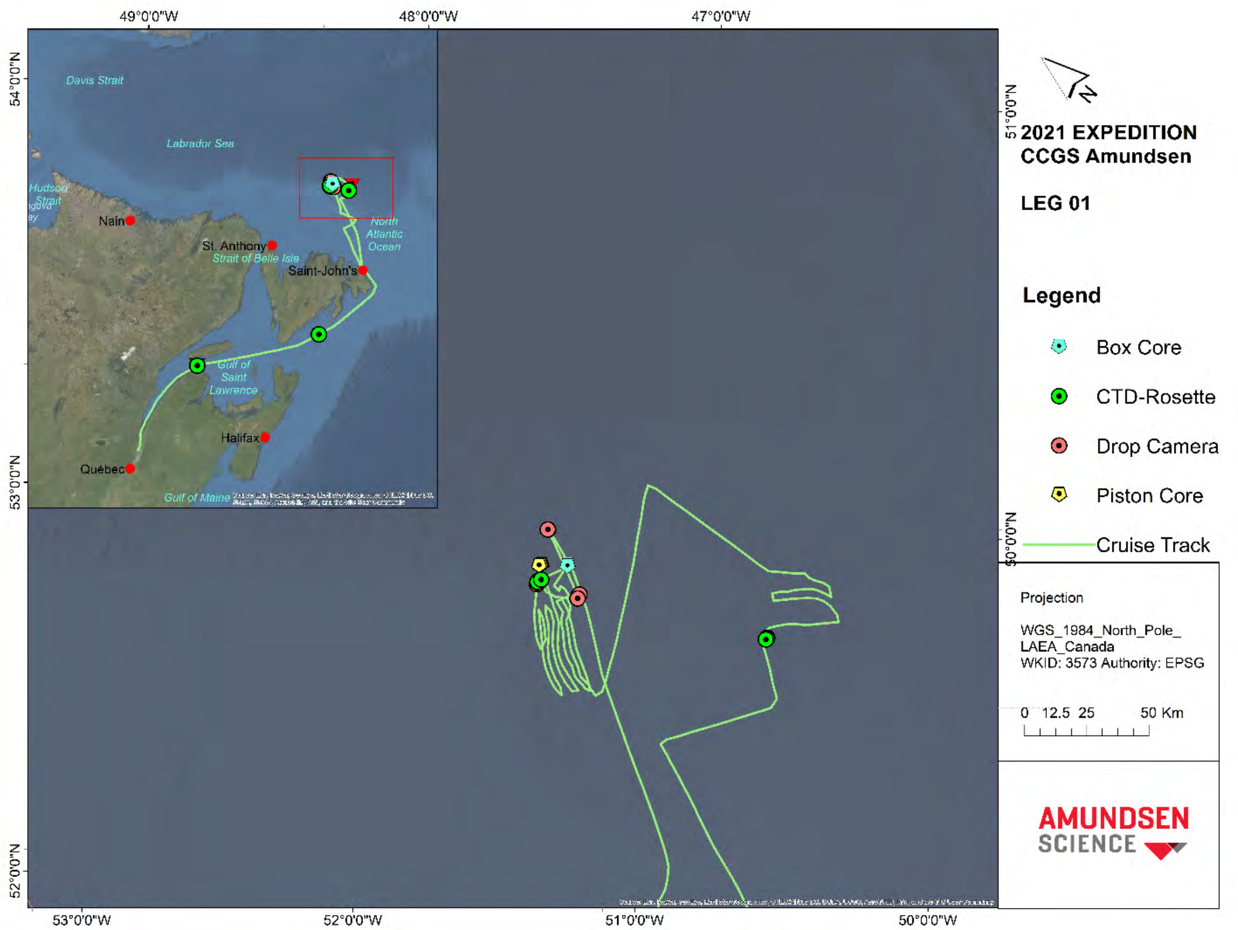

Figure 1-1: Ship track and location of stations sampled by the CCGS *Amundsen* in support of NRCan's marine spatial planning program during Leg 1 of the 2021 Expedition

1.2.1 *Daily synopsis*

4-6 July 2021: The anchor windlass was successfully repaired and tested, resulting in a departure from Quebec City on Sunday July 4th at 4PM. Two CTD-Rosette test casts were conducted during the transit to St. John's.

7 July 2021: The ship arrived in St. John's around midday and embarked 8 scientists. The departure was postponed to next day 8 July 1:00PM based on weather forecast (incoming storm). Scientists attended the General Science Meeting and Life on Board Presentation.

8 July 2021: After the health and safety presentation, scientists and crew tested the Piston Core assembly and deployment with the new cranes and foredeck configuration while docked. The deployment was conducted in three phases and took most of the day. Departure from St. John's at 6:00PM after securing equipment in the laboratories.

9 July 2021: Most of the day consisted of transit to the southernmost Station MSP21-15, on a diverted course to avoid swell hitting broadside. We arrived on station 5:00PM and conducted a CTD-Rosette cast to bottom 1700 m with sampling for eDNA at 5 depths. The deployment of the Bottom Camera was canceled due to a communication problem with the fiberoptic cable. Troubleshooting started late in the afternoon, and communication problem could not be fixed. Daylight quickly fading and sea state worsening resulted in no attempt to deploy the other Bottom Camera.

10-15 July: Due to heavy sea state, only a limited number of scientific activities could be conducted. On July 11-12, waves abated and we conducted mapping, deployed box cores, piston cores, Drop Camera and CTD-Rosettes. The slow and wavy transit back to St. John’s started on July 12, and we were able to demobilize on July 14.

2 Leg 2 – 15 July to 12 August – Labrador Sea & Baffin Bay

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

[1] *Fisheries and Marine Institute of Memorial University of Newfoundland, St. John's, NL*

2.1 Introduction and Objectives

The extreme sensitivity of the Arctic to anthropogenic induced climate change has resulted in warming at a rate twice as fast as the global average. This warming and increased ice melt has already altered Arctic/sub-Arctic marine ecosystems, with impacts on fisheries and other fauna of cultural and economic value to northern communities. Fisheries and Oceans Canada has prioritized conservation of these taxa as key goals within Canada's Marine Conservation Targets (MCT) that aim to conserve 10% of our waters by 2020. These MCTs include three new Marine Refuges in the Northern Labrador Sea and Baffin Bay (Hatton Basin, Davis Strait and Disko Fan Conservation Areas), as well as two potential Areas of Interest in northern Labrador; a coastal system within the "Imappivut" territorial waters of the Nunatsiavut Government, and a deep ocean zone from the shelf out to Canada's Exclusive Economic Zone (EEZ). However, fundamental gaps remain in understanding faunal communities and associated processes across environmental gradients. In light of these knowledge gaps, we conducted an integrated, multi-investigator expedition that focused on Arctic ecosystems from surface waters down to the seafloor and from primary producers to seabirds and marine mammals. This study addressed current ecosystems and processes, and looked back in time to understand periods of change to enable predictions for future Arctic ecosystems and geology (e.g. landslides).

The Canadian Arctic gateway stretching from Makkovik Bank to Pond Inlet spans a wide range of oceanographic conditions, and process rates facing fundamental re-organization as the Arctic continues to warm. At the base of the food web, changes in stratification, light, and nutrient availability will alter the phenology and community composition of primary productivity. These changes will affect the timing and flux of exported organic material that supports mesopelagic and benthic organisms. Mesopelagic organisms represent important prey for higher trophic levels and a key component of the biological carbon pump through diel vertical migrations. The 10 billion metric tons of estimated global biomass of mesopelagic fishes within sound scattering layers (SSL) could represent the most abundant fish stock in the world. Yet, Arctic and sub- Arctic SSL species composition remains poorly documented, due to limited sampling. Benthic organisms include deep-sea corals and sponges, which create complex habitat for other organisms, but are vulnerable to anthropogenic threats including bottom contact fishing, oil and gas exploration and production, and ocean acidification. Fragile benthic organisms contribute to ecosystem functioning by altering sedimentation patterns and carbon cycling and reburial. Limited access to deep-sea environments has constrained knowledge of distributions, species associations, and life history strategies among these benthic organisms, particularly in high latitudes. In some of these habitats, primary production is catalyzed by chemosynthetic microbial communities that degrade hydrocarbons that seep up from the subsurface. In addition to providing an alternative base for benthic food webs, these hydrocarbon-degrading microbes warrant further study as potential model organisms for oil spill remediation in the Arctic.

The new **Comanche 38 ROV** aboard CCGS *Amundsen* forms an integral part of the ArcticNet, NSERC STAC, and DFO funded programs. Associated research used instrumental data and water sampling from the CTD-rosette, invertebrate and ichthyoplankton sampling using the IKMT and Hydrobios nets, video sampling with a drop camera and baited camera, piston and gravity coring, and benthic sampling using the box corer to sample the same environments through the water column, while seafloor mapping with multibeam sonar and sub-bottom profiler characterizes the seafloor underlying these benthic environments. Our integrated geological, biological, and oceanographic sampling addresses these understudied environments in a holistic fashion. Related activities, including results from the ROV program, water sampling for dissolved nutrients, stable isotope analysis of dissolved nutrients, and carbonate chemistry, are covered in separate reports submitted by the students.

The scientific objectives as presented in the NSERC STAC proposal for this cruise are listed below (1-9). Additional scientific objectives related to DFO Science activities in Labrador, the ArcticNet seafloor geology project (Normandeau), Geological Survey of Canada activities, and the ArcticNet Labrador coastal marine science & conservation project (Coté, Edinger) are included below.

1) Extend knowledge on the abundance, distribution, and diversity of cold-water corals and associated biodiversity in relation to depth and substrate in previously unexplored areas.
2) Assess environmental drivers of life-history strategies (distribution patterns, size, sex, fecundity, reproductive mode), trophic ecology and pigmentation diversity in benthic invertebrates and associated epibionts across depth and latitudinal gradients.
3) Investigate age-frequency distributions and corresponding carbonate production rates of cold-water coral populations in the context of ocean acidification in a rapidly changing environment.
4) Determine annual growth rates of bamboo corals (*Acanella arbuscula* and Keratoisis cf. *flexibilis*) using an *in-situ* coral staining chamber.
5) Develop novel biomarkers of ice-associated (sympagic) vs pelagic primary productivity and use these biomarkers to reconstruct paleoceanographic variability in export productivity recorded in sediments and coral skeletons.
6) Evaluate infaunal biodiversity and its influence on nutrient efflux and respiration in northern upper slope 3D biogenic habitats.
7) Quantify benthic carbon mineralization in relation to microbial communities and benthicpelagic coupling.
8) Characterize the microbiology of permanently cold marine seabed hydrocarbon seep ecosystems and isolate psychrophilic hydrocarbon-degrading bacteria.
9) Assess benthic biodiversity and ecological patterns in conservation-priority regions.
10) Characterize variability in the mesopelagic sound scattering layer (SSL) over an annual cycle and ground-truth the signal with mesopelagic nets, hull-mounted acoustics, and ROV videography.
11) Characterize bottom types and fauna in the Makkovik Trough area identified by Inuit knowledge and fishermen's reports, and initially explored without the benefit of an ROV during the Amundsen 2020 cruise (DFO; ArcticNet coastal Labrador)
12) Characterize sediment movement associated with iceberg-induced slope failures and other slope instabilities in Southwind Fjord and Scott Inlet (GSC, ArcticNet Seafloor geology).
13) Recover a CTD/Rosette lost during operations in Scott Inlet in 2019 (Amundsen Science).

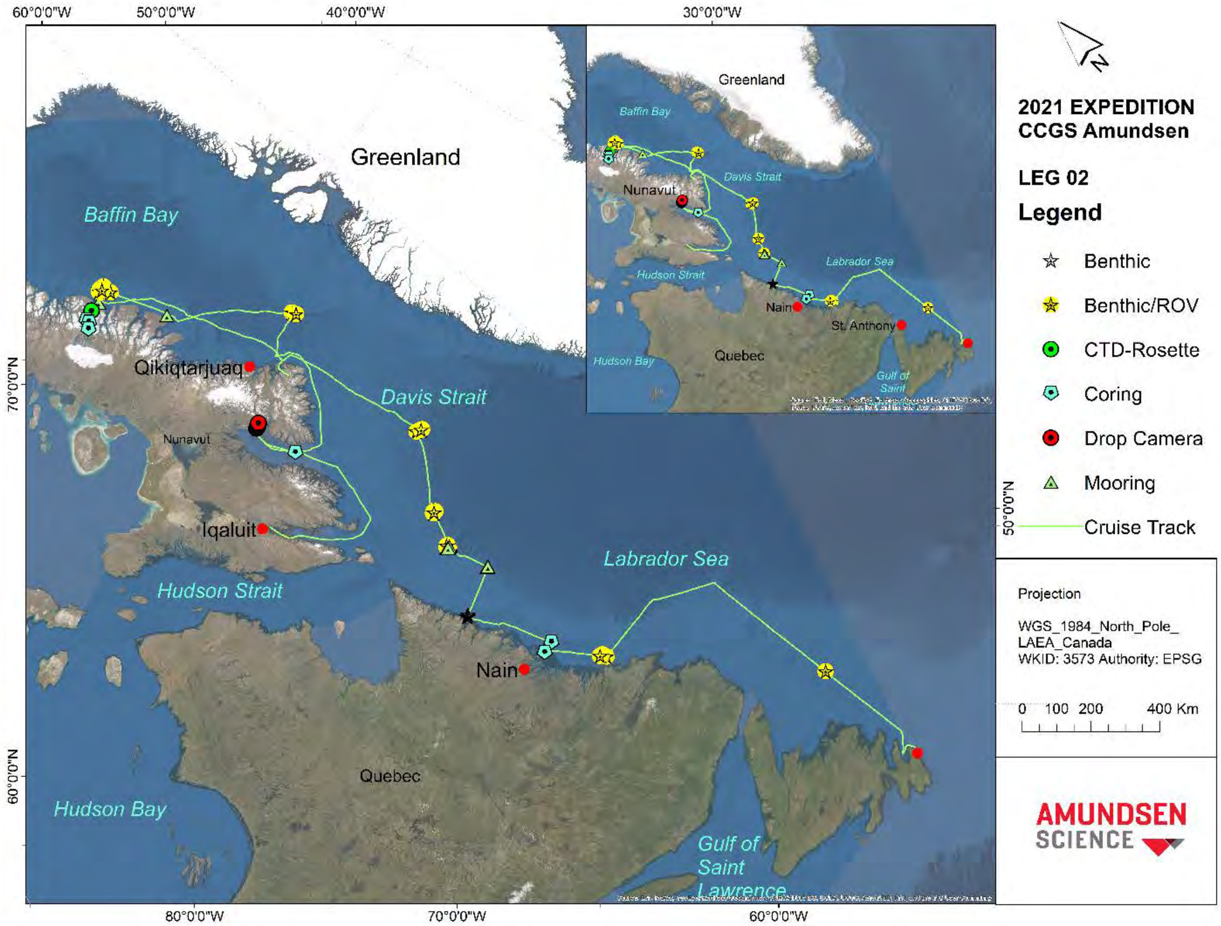

Figure 2-1: Ship track and location of stations sampled by the CCGS *Amundsen* during Leg 2 of the 2021 Expedition

2.2 Synopsis of operations

Thirty-five scientists participated in the leg 2 of the 2021 CCGS *Amundsen* scientific cruise between 16 July and 12 August 2021. While dives with Amundsen Science's new Commanche ROV were central to this scientific study and a high-priority of leg 2, 17 different operations were conducted on a total of 189 occasions and at 68 stations spawning from southern Labrador Sea to the fjords of Baffin Island (Figure 2-1). Compared to the initial mission plan, the completion rate of each operation varied between 100% and 267%, for an overall completion rate of 149% (Table 2-1). The scientific activities and objectives were part of a Ship Time Allocations Committee (STAC; habitats of the northern Labrador Sea and Baffin Bay: biodiversity, microbiology, paleoceanography, and conservation) project and three ArcticNet studies (ArcticKELP, ArcticFish, and Seafloor Mapping). Program elements, their rationale, methods and preliminary results are highlighted in Part II of this Expedition Report.

Table 2-1: Operations conducted during Leg 2 of the 2021 Amundsen Expedition

Operation	Conducted	Planned	Percent (%)
Baited Camera	12	7	171
Beam Trawl	4	2	200
Box Core	24	17	141
CTD-Rosette	35	25	140
Ice Sampling	2	2	100
Drop Camera	27	25	108
Gravity core	4	3	133
Hydrobios	15	6	250
IKMT	9	6	150
Mooring deployment	7	7	100
Mooring recovery	2	2	100
Phytoplankton net	6	6	100
Piston Core	16	6	267
ROV	17	8	213
Tucker	8	6	133
Van Veen Grab	1	0	
Bottom Mapping	3432 nm		
TOTAL	189	128	148

3 Leg 3 – 12 August to 9 September – Baffin Bay & CAA

Chief Scientist: Jean-Éric Tremblay[1] (jean-eric.tremblay@bio.ulaval.ca)
[1] Department of Biology, Université Laval, Quebec City, QC

3.1 Introduction and Objectives

Leg 3 started on 12 August in Iqaluit and ended on 9 September in Resolute Bay. This leg supported DFO's ongoing Knowledge and Ecosystem-Based Approach in Baffin Bay (KEBABB) program and and initiated the KEBABS program in Lancaster Sound. Leg 3 also supported the following ArcticNet's Marine programs: Arctic Seafloor, Contaminants, GO-Ice, NTRAIN, Biogeochemistry, ArcticFish; and collected environmental information ashore from Quaqtaq, Nunavik, in support of the Sentinel North project on belugas and bivalves nutrients properties and link of the marine environment.

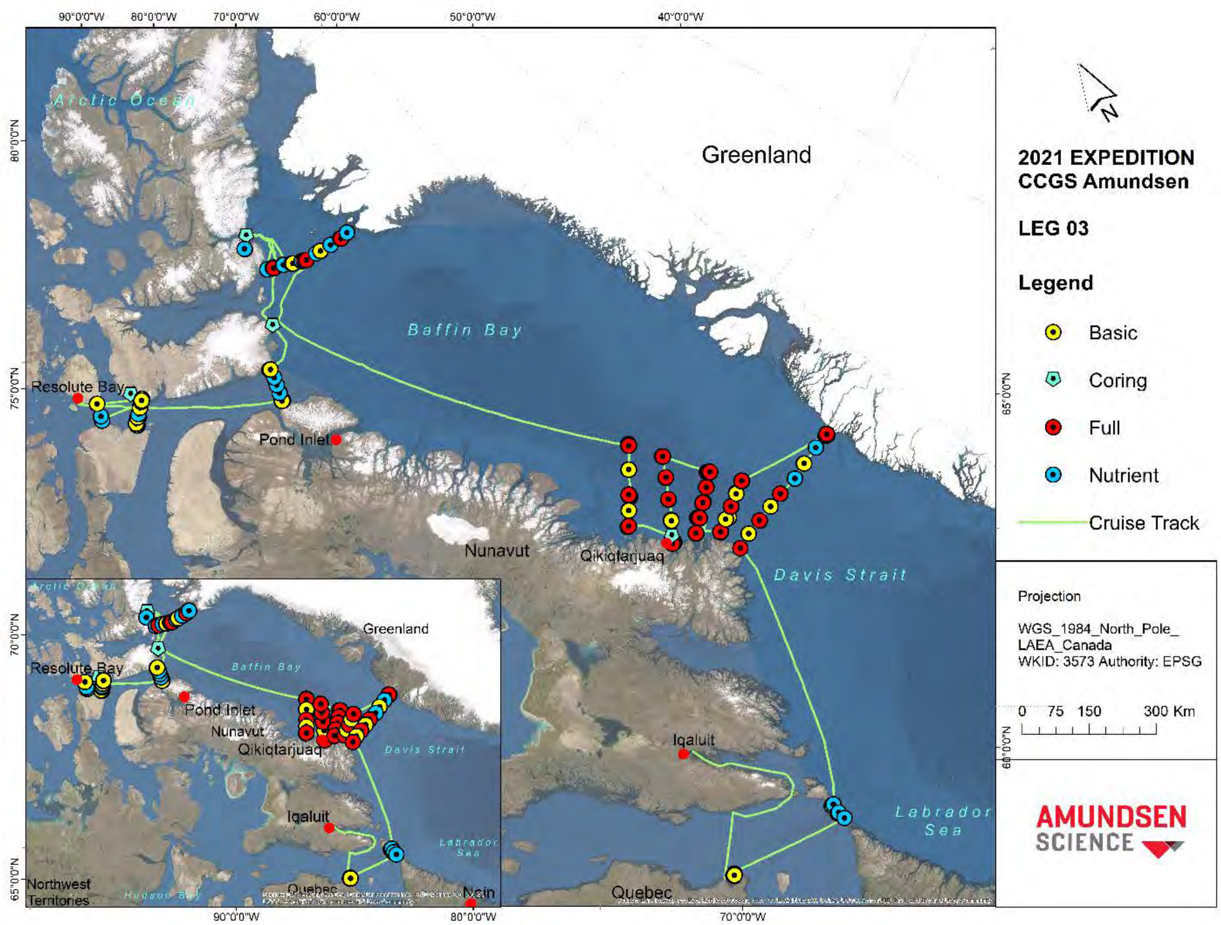

Figure 3-1: Ship track and location of stations sampled by the CCGS *Amundsen* during Leg 3 of the 2021 Expedition

3.2 Synopsis of Operations

The CCGS *Amundsen* accommodated 37 scientists during Leg 3 of the 2021 Expedition. The ship started its journey in Iqaluit on 12 August, and ended on August 9 in Resolute Bay (see Figure 3-1).

3.2.1 *Daily Synopsis*

12 August: The crew change was very long in part due to covid measures. As things dragged on and on with the flights, a heavy fog settled in and we had to use the zodiac to bring the last of the cargo on board the ship. The officers were exhausted after this very long day (some had not slept the previous night due to their own travel plans and covid testing early in the morning), so it was deemed unsafe to navigate the narrows at night with no visibility (a 9 hour delay).

13 August: Most of the day was spent transiting, relatively slowly at first given the fog. We gave the first series of security meetings to cover the first operations to be done (MVP, Rosette, Tucker, Agassiz, box core) and all the crew and scientists attended their familiarization tours.

14 August: The MVP line across Hudson Strait begun early at night and since the instrument performed very well we decided to leave it in the water for each of the turns planned. We made turns with a very wide arc so as to not put pressure on the cable. This has to be a record for the longest uneventful deployment of the instrument. We sampled the Quaqtaq stations in the afternoon and through the evening. The Agassiz nets were rich and provided a lot of material for Ariane Barrette's project. We had planned to use to zodiac to gather bivalves at the low tide waterline, but a mechanical problem happened once in the water and the sortie had to be canceled. It was later realized that a foreign object in the fuel reservoir had clogged the intake line.

15 August: After finishing work in Quaqtaq we transited to the entrance of Hudson Strait and began the transect in early afternoon. A first test was made for the deployment of the trace-metal-clean (TM) bottles in the moonpool at station 356. This was a very tedious at first and obviously had not been planned ahead of time. Initially we had the impression that we'd have to lower the cable guide each time a bottle was arriving at the bottom of the moonpool (in order to avoid damaging the cable or the bottles or the HiPAP on the edge), but we eventually conceived a strategy to do away with it. The idea is to have 12 m of distance between the attachment point of each bottle. In this fashion, the ship can manoeuver slightly when the time comes to lower a bottle or take it back on board, so that the cable sits vertically in the middle of the moonpool with the deployment beam pushed forward. When a bottle is at crew level during deployment or retrieval (with the beam retracted), the bottle (or bottom weight + HiPAP depending on the step) underneath remains below the lower edge of the moonpool and cannot be damaged when the cable inevitably leans against it. Once ready for the next bottle, the ship manoeuvers again etc. If this happens in the future, it would be useful to set-up a powerful light that could be lowered to the edge of the moonpool.

17 August: After the long transit (all of 16 August and par of the 17th) we began sampling line A after transiting from Hudson Strait with the Counting Plankton Recorder (CPR) in tow.

18 August: We continued on line A and finished the western Kebbab stations.

19 August: The Agassiz was lost early in the morning at station 196. The cable came back with a clean break. Based on the multi-beam data, a sudden and short-lived rapid rise of the bottom coincided with the event, which was felt as a jolt on the winch cable. Helicopter operations for iceberg beacons were not possible early in the day due to heavy fog. Things cleared in late afternoon, but then only one fair-sized iceberg was in sight and Luke decided that it was not worth the effort. Sampling operations were completed with the NTRAIN stations at the eastern end of line A and the transit toward line B started early in the night with Jonathan's CPR in tow.

20 August: During transit from 198 to B5, another window occurred early in the morning for iceberg ops. As the team was getting ready to fly the fog came in again and the flight was cancelled. Station B5 was sampled and B3 was started.

21 August: We finished B3, and then completed B2 and B1. Helicopter operations occurred just before arriving at Stn B2 to take profit of a weather window to deploy beacons on icebergs (Copland's team).

22 August: Transit to Merchant's trough. Following the mapping, one site suitable for a Piston core was identified, but nothing came out as a possible good second spot for a gravity core. Meanwhile, one helicopter sortie was completed to deploy 3 beacons on icebergs.

23 August: We began sampling line C with C1, C2 and C3.

24 August: Stations C4 and C5 were completed early in the night and in the morning. The ship then transited to the offshore end of the D line, starting with D5 five in late afternoon and

25 August: Stations D3 and D2 were completed, followed by the mapping survey and associated gravity and box cores. We decided to do the mapping operations first since the lines were around D2 and not near the coast as hinted by the mission plan. This strategy was preferred since it would allow the ship to get close to the coast for the glacier ops. We learned in the mean time that the Desgroseillers had been damaged by contamined fuel and was stuck near Grise Fjord. It is possible that we need to assist them.

26 August: The mapping survey proceeded during the night. Jean-Carlos and Pascal Guillot took off at ca. after 06h30 to go sample in the Owl's river. That went well and they came back on board at 8h30, just in time for Jean-Carlos to get ready for the box core and gravity core that followed at 9h00 (the target site was identified late in the mapping survey while the helicopter was still out). After the gravity core we then moved toward station Bro-3.1 at 8 knots in order to fill a gap in the mapping for the area. Meanwhile this allowed to prepare the Piston core. After the Piston was completed we moved towards station D2 while Luke's team departed for the Penny ice cap.

28 August: We finished station E3, E4 and E5. In the mean time we got a request from the Regional Operation Center (COR) to divert the ship and move toward Grise fjord to provide help to the DesGroseillers. Transit to Grise fjord on August 29.

30 August: The ship arrived at the coordinates identified for the launch of the helicopter toward the DesGroseillers. The idea was to find the maximum distance with which the pilot was comfortable and in doing so minimize the detour taken by the Amundsen. We decided not to use the time to go perform ocean operations at Belcher since the detour from our position represented ca. 8 hours of additional transit time prior to reaching Stn 116. Since the strong winds expected for Wednesday afternoon would be most intense in the eastern half of the line, we wanted to finish that part of the transect ASAP. On the way back from the North, stopping in Belcher for ocean ops would represent a negligible bend in our itinerary.

31 August: After transiting overnight, we started Stn 116 early in the morning (05h00) and then proceeded to sample Stns 115, 114, 113 and 112 and 111. One iceberg beacon was deployed by helicopter.

1 September: During the night, we performed stations 110, 109 and began station 108 early in the morning. After completing stations 107, 106, 105, 104, 103 and 102, we interrupted the line and began our transit toward Smith Bay/Mittie glacier in order to arrive by 6 am and perform a series of operations that need to occur during day time (mapping with the barge, piston cores, helicopter flights).

2 September: After doing one rosette, 1 CTD and a box core early in the morning, the mapping with the barge begun outside of Smith Bay. The barge encountered technical problems with the sounding and while this was getting fixed we received a SAR call tasking us to leave for Pond Inlet. We took the barge back and left. Several hours later as we were transiting south through the North Water line, we received a call cancelling the SAR. We used this opportunity to finish the line with stations 101 and 100 and headed North to repeat the Mittie survey. In late afternoon the captain received a call from the COR informing us that we would be diverted to Resolute Bay on Sept 6 to participate in a search-and-rescue exercise with the USGSC Healy.

3 September: We successfully completed the program in Smith Bay, with mapping (using the zodiac as a scout because the waves were too high initially). The helicopter was sent toward Talbot and Trinity with Luke and Adam, but once on site, the conditions were unsuitable and they redirected their energy to deploying a met station and a camera at a nearby site and deployed beacons on several icebergs. Once the first mapping line was completed and the ship was as further in in the bay as it would go, we recuperated the Zodiac and then performed water sampling (1 rosette, 1 TM cast). The helicopter then came back and we deployed the barge for mapping at the foot of the glacier. This went semi-well as several technical glitches initially happened. At some point while we were resuming the mapping, the barge came close to the ship to take spare parts to fix stuff (a router switch and ethernet cables). They were eventually able to map some at the foot of the glacier. Meanwhile the Amundsen identified a suitable coring site inside the bay, but then proceeded to start with the Piston core at the previously targeted station offshore due to time constraints with the duty shifts of the crew. While the team was cutting and storing the core, the ship continued mapping until they were ready to do a box core and gravity core at the inner site in the Bay. All in all, this operation took 17 hours.

4 September: After completion of the gravity core the ship slowly exited the area and began its transit south. Once clear, the initial transit was quite fast (4 DP) but had to be slowed owing to freezing spray. The speed was very variable until we reached the protection of Coburg Island and were able to do 12 knots. Prior to arriving at the new coring station in Devon Island (East 5 in Cowles Bay, replaces SS-7.1 at the request of Jean-Carlos), the helicopter was sent to put a met station on the Southeast Glacier. We started a short mapping survey and selected a coring site. As the Gravity core was about to be deployed, the helicopter came back to the ship to recuperate a missing part for their tripod. It was then decided to send Amélie Desmarais with them so they could sample the Riddie and Cuningham rivers. Meanwhile, the gravity core was completed and the helicopter rejoined the Amundsen as it was transiting south toward Lancaster Sound.

5 September: The Lancaster Sound transect begun near midnight at Stn 300 and we progressed towards the South during the night and morning. The plan was to keep operations at a bare minimum (rosettes and TM bottles) since we would barely be able to finish the line before the ship's cutoff time for heading west to Resolute. So unfortunately we had to forego any plans to do nets, box cores and such, focusing on the one instrument that provides data to the greater number of teams. Winds, darkness and currents proved to be too strong for the moonpool operation at Stn 322 and 323 but we were able to do it at Stn 325, the most important one to capture the outflow from the central Beaufort Sea. A video was also made of the moonpool TM procedure so that it can be handed off to the next crew and avoid all the initial testing that we had to go through. We then begun the transit west toward Resolute, while Jean-Carlos was able to fly to three rivers in Bylot Island and Sirmilik Park in the afternoon.

6 September: We arrived in Resolute just before breakfast and anchored in the passage just outside the bay, while the Healy approached its designated location for the SAREX exercise. I used to opportunity to greet the science crew on board the Healy. The helicopter took off for the airport in order to ferry 12 VIPs to the Healy. The Amundsen's role was to coordinate the exercise, which involved deploying dummies (empty mustang suits) at a known location at sea, and use the helicopter to spot them and guide the Healy's and Amundsen's zodiacs to it. As the exercise was proceeding, the Healy deployed their zodiac but was forced to bring it back immediately due to communication problems. The Amundsen zodiac stayed on site but was unable to get a visual on the 'victims'. Once the exercise was completed, the helicopter ferried the VIPs back to the Airport and we could resume to science activities.

We started the 305 line late in the evening, moving toward the south shore. Unfortunately, some moonpools had to be canceled due to the presence of ice and the fact that all 'quick' solutions would certainly result in contamination of the sampling bottles.

7 September: We finished line 305. Since station 305A was in dense ice, we sampled 2-miles off. We then moved to the Rigby Bay to do some mapping and potential gravity core for Jean-Carlos. The sediment was not suitable and we moved to begin the S line. We started with S10 to give filtration time to the teams, then moved toward CTD S11 and headed to Stn S9 while mapping to locate a suitable box core/Agassiz site. After doing S9 and the box core (Agassiz canceled) we moved to S8.

8 September: We proceeded with stations S7, S6, S5, S3. We had hoped to go as far south as Stn S1, but we lacked the time to go through all the old ice packed against the south shore. There was also no point trying to sample at two locations since S1 and S2 were only 1 nautical mile apart on the schedule. So we settled for a intermediate point, located slightly to the northeast of S1 in 100 m of water. The ship then headed to stations S4 for the last rosette, and then on to S5 for the beam trawl that was skipped during the night (in order to get proper timing for the overall sampling effort).

3.3 Conclusion

Despite the cuts that we had to do here and there, the overall program of this leg was a success, thanks to the professional and indefatigable help of the crew and Amundsen Science, who again went above the call of duty. This expedition shows that the dispatching of the CCGS *Amundsen* by the COR to assist in regular Coast Guard operations should be kept to a minimum in order to achieve the scientific objectives of the mission.

In the end, the following operations took place during Leg 3 of the 2021 Amundsen Expedition:

- 16 Agassiz trawls
- 2 baited camera deployments
- 10 beam trawls
- 23 box cores
- More than 80 CTD-rosettes
- 4 gravity cores
- 10 hydrobios
- 11 IKMT
- 23 monster nets
- 51 collections of water for trace metal analysis
- 99 nm of MVP transects
- 2 piston cores
- 1200 NM of Continuous Plankton Recorder samples were obtained within seven transects
- 16 plankton nets
- 21 tucker nets
- 8 Van Veen grabs
- 11135 km^2 of seabed mapped with Multibeam Echosounder
- 3692 NM of 3.5 kHz sub-bottom profiler survey lines

4 Leg 4 – 9 September to 7 October – Beaufort Sea & CAA

Chief Scientist: Martine Lizotte[1, 2] (martine.lizotte@arcticnet.ulaval.ca)
[1] *Takuvik, Université Laval, Quebec City, QC*
[2] *Now affiliated with ArcticNet, Université Laval, Quebec City, QC*

4.1 Introduction and Objectives

The continental shelves of the Arctic Ocean are rapidly responding to global climate change. Rising air temperatures and declining summer sea-ice extent have direct consequences as strong coastal erosion and permafrost (frozen soil) thawing lead to the release of large quantities of sediment, organic carbon and nutrients into nearshore waters. During Leg 4, scientists from the international Permafrost Carbon in the Beaufort Shelf program (PeCaBeau) were studying fluxes, composition and fate of organic matter in Southern Beaufort Sea. Their goals were to identify the provenance of organic matter (from permafrost coastal erosion, Mackenzie River discharge or submarine permafrost degradation), and to investigate how these sources have changed in the last millennia.

The RADCARBBS program was on the Amundsen to study radiocarbon cycling within the Northwest Passage and the southwestern Beaufort Sea. More specifically, their work aims to tell: 1) how and where most marine carbon is produced in the Northwest Passage (i.e. produced by marine phytoplankton or by riverine input from land), 2) how long it will persist, and 3) how microbes can use this marine carbon, perhaps transforming it into stable forms that can be stored in the deep sea. Once again, scientists from the ArcticNet marine program are onboard to study fish, plankton, contaminants, carbon cycle and biogeochemistry along specific historical transects in the area.

4.2 Synopsis of Operations

The CCGS *Amundsen* accommodated 35 scientists during Leg 4 of the 2021 Expedition. The ship started its journey in Resolute Bay on 9 September. For the first few days, sampling operations for ArcticNet and transit took place in the Northwest Passage, trough Prince Regent Inlet, Franklin Strait and Victoria Strait, all the way to the Amundsen Gulf and Beaufort Sea (see Figure 4-1). Scientists then conducted numerous operations in the Beaufort Sea, for both the PeCaBeau and the ArcticNet programs at more than 20 stations. On 30 September, the vessel moved further North to conduct operations in the M'Clure Strait and came back to Kings Bay through the Prince of Whales Strait to deploy acoustic moorings for the community of Ulukhaktok. The last days were dedicated to transit to Cambridge Bay for a crew change taking place on October 7.

In the end, the following operations were conducted during Leg 4 of the 2021 Amundsen Expedition:

- 20 beam trawls
- 20 box cores
- 103 CTD-rosettes
- 7 gravity cores
- 1 ice collection operation
- 3 IKMT
- 20 monster nets
- 38 collections of water for trace metal analysis
- 1 mooring deployment
- 30 multicorer deployments
- 12 piston cores
- 20 tucker nets

- 7193 km^2 of seabed mapped with Multibeam Echosounder
- 4035 NM of 3.5 kHz sub-bottom profiler survey lines

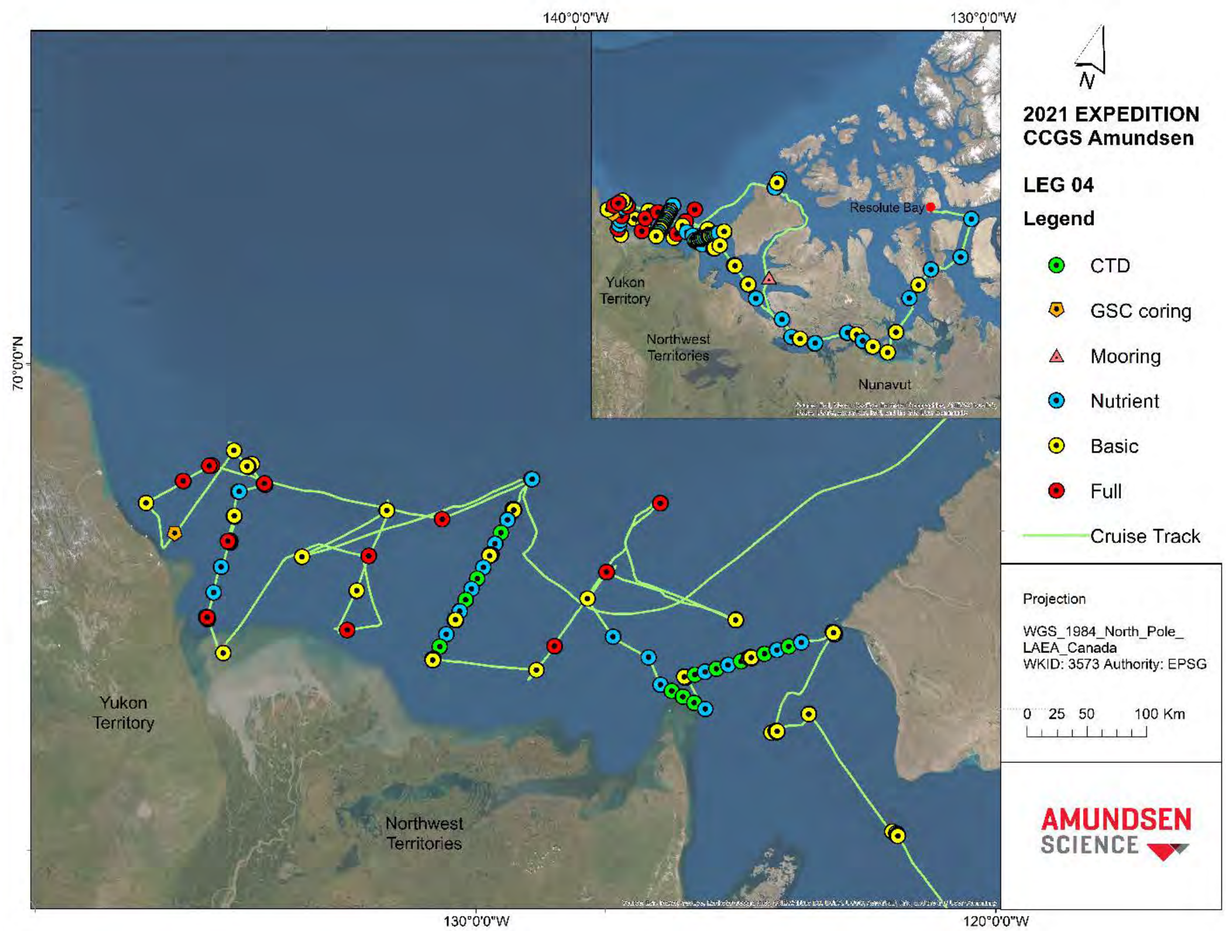

Figure 4-1: Ship track and location of stations sampled by the CCGS *Amundsen* during Leg 4 of the 2021 Expedition

4.2.1 *Daily Synopsis*

9-10 Sept 2021: The crew change and chartered flight Quebec – Iqaluit – Resolute took place on Sept 9. We departed from Resolute Bay on 10 Sept at 6am. We sailed east towards Prince Regent Inlet to avoid heavy ice conditions and sample Nutrient Stn C002. The Familiarization tours and Tool box meeting for the Rosette are completed.

11 Sept 2021: We had safety training for scientists and crew: Tool box for Nets – TM rosette – Box core and Fire Drill. Operations completed are a CTD-Rosette at station Nutrient Stn C003 and a CTD-Rosette, Beam Trawl and Monster net at Nutrient Stn C004

12 Sept 2021: Early (01h00) arrival on our first Basic Stn (301E). All went well. Nutrient Stn 311 was cancelled, the PeCaBeau multicorer was assembled and the MSCL table prepared in the paleo lab.

13 Sept 2021: Early (04h30) arrival on our second Basic Stn (C010). There was an issue with one of the propellers during Tucker and the ship had to stop in mid-operation. We conducted the first deployment of the zodiac for the trace metal sampling team and Amundsen Science (calibration of the 360° cameras). The helicopter flew for river sampling in QMG bird sanctuary (Simpson and Perry River).

14 Sept 2021: After the refueling in Cambridge Bay and testing for contamination by the radioactive source, we resumed the scientific operations at Basic Station 314.

15 Sept 2021: The morning fog lifted in the early pm and we were able to deploy the helicopter (13h15) for the sampling of the last river (Tree River). A flight test was conducted for the drone at station 316. Unfortunately, the drone showed signals of internal compass errors. Part of the tucker net (godet) was broken during a deployment, the issue is being fixed with help from the CG. We conducted operations at stations Nutrient C012, Basic 316 and Nutrient CG13.

16-17 Sept 2021: Scientific operations conducted as planned. An issue was detected concerning the starboard temperature-controlled laboratory (difference between measured and programmed temperatures).

18 Sept 2021: The day was very busy with the start of a North to South transect in Amundsen Gulf and Cape Bathurst. Everything ran smoothly (stations 407 to 412 completed). The potential “issue” with the starboard temperature-controlled laboratory was only due to the door not properly closed.

19 Sept 2021: The day was again very busy with the end of a North to South transect in Amundsen Gulf and Cape Bathurst. Everything ran according to plan (stations 413-420 completed). With some advance on our global schedule and with the presence of favorable winds and an upwelling feature in Cape Bathurst we decided to go for an opportunistic sampling of the southern end of the ArcticNet/RADCARBBS transect. We added six CTD and nutrient stations (JET series) along an east-west line before pursuing our route towards the PeCaBeau line.

20 Sept 2021: We finished the last of the JET stations early in the morning then moved on to PCB stations. The first piston core of the leg was successfully completed at PCB-04. The teams were very satisfied with the entire operation as well as with the length of the core extracted. In the evening, we had a problem with the surface pump. Unfortunately, the tubing got caught in the ship’s propeller and an adapter piece connecting the tubing to the pump was broken. Thanks to the AS team and members of the CG crew (engine room), the adapter was replaced/fixed. Recommendation from this experience: deployment of the surface pump should be made from mid-ship and the tubing extended in the water column should not be deeper than 2m.

21 Sept 2021: We transited to PCB-03 during the early hours of the day, changing our course to avoid a field of ice between PCB-02 and PCB-03. Sampling at PCB-03 was lengthened in time by an issue with the rosette. Communication was lost during the second cast and the rosette was brought back on board empty. We opted for some surface pump sampling (for surface water) and used the moonpool to deploy individual niskins to collect the missing samples needed at the DCM (55m). Everybody pulled together to help each other out. This strategy worked really well and we were able to complete the sampling there for water. Meanwhile, the AS team worked tirelessly to fix the issue (termination). By dinnertime, the AS team had fixed the issue. Thanks to the excellent work by AS will be able to pursue our course with no delay in the coming operations. The coring operations were again very successful at PCB-03 and a ca. 6m core was collected at the PC. The multicorer continues to prove very easy to use with a great success rate.

22 Sept 2021: PCB Full Station PCB-06 was reached at 01h00am. A second MUC (multicorer) had to be deployed at PCG-06, after a first attempt failed. Second deployment successful. Piston core was deployed but only little sediment was retrieved. On the way to PCB-07, the mapping group observed a sedimentary feature 6 nautical miles before the station and the decision was taken to move the station above that feature which turned out to be a submerged pingo-like dome. Because the feature was so interesting, we added an opportunistic giant gravity core. The day was followed by the sampling of basic station 434 (with a gravity core there) and CTD station 433.

23 Sept 2021: This was a busy day along a South to North transect (stations 424, 426 to 432, 435 and PCB-08 completed). There seems to be an issue with the TSG (AS team are looking into it). Station 424 that was presented as a “FULL” in the original kmz and excel files (with a PC) actually ended up to be a nutrient station (no nets, no sediment, just one rosette).

24 Sept 2021: Transiting north to nutrient station 546. Three rosette casts were planned here to accommodate all the teams (PCB + ANet + RADCARBBS). Amundsen Science took the opportunity of this very deep station (1600m) to run maintenance (freshwater cleaning) of the rosette cable. The operation was coordinated with Chief Engineer in order to make sure freshwater supply was sufficient. At some point during the first cast, communication with the rosette was lost but rebooting the system fixed the issue. During the second cast, another issue occurred (which could not be fixed by rebooting the system). AS team will need to work on the termination again. We took the decision to postpone the second and third cast and transit towards PCB-09 immediately. The plan is to come back to station 546 at the end of the western sampling scheme. Because of the weather predictions (expecting 30 knot winds close to the PCB-10 to PCB-13 line) we decided to steam as far west as possible where winds are predicted to be at calmer. We will work in the western sector for the next days along the PCB-20 to PCB-23 line. The day ended with the PCB-09 station, where only coring work is conducted. The rosette has been fixed and seems like it is quite sensitive to high pressure during deep casts.

25 Sept 2021: The PCB team expressed the interest in transiting at 7 knots between stations for the Mackenzie Trough area and western sector of the Beaufort Sea sampling grid. The new transit times pushed a new agenda (largely because of PC timing). The ship will steam directly from PCB-21 to PCB-22. We will sample PCB-20 tomorrow on our way back to the North of the 480-70 line. The transits at 7 knots actually serve a double purpose: mapping the area but also allowing a bit of ventilation of the schedule (turnover time for operations and sleep). We had an issue with the piston arm cable at station PCB-22. The cable was frayed. AS team is looking into a replacement cable.

26-27 Sept 2021: Proceeding to PCB-16 early am, the PCB team decided to switch the PC planned there with a giant gravity core + gravity core. The outcome was not bad but not what they expected (only 3.5m core). Around 9h00, we started to encounter electrical problems with the forward starboard crane preventing the deployment of the multicorer (MUC). The CG electrician was called to the scene, and there seems to be an issue with the breaker. The issue was fixed in time and the MUC was deployed. The operations proceeded smoothly after that until the recovery of the zodiac at station 476/PCB-18 when the embarkation hit the davit causing a hydraulic leak. This should be fixed in ½ day (likely in time for the next planned zodiac).

28 Sept 2021: Sampling at stations proceeded as planned, even faster than anticipated, largely due to shallow depths. The PCB team was very busy with the station work and the added work of making a video for the educational event planned with Mangilaluk School in Tuktoyaktuk (event planned for 29-09-2021 in the pm). The zodiac is still under repair. We hope it can be deployed tomorrow for station PCB-17A (then again, meteorological models predict increasing winds and waves for tomorrow).

29 Sept 2021: The sampling is being pursued in a timely manner. We cancelled the zodiac planned for the station PCB-17A (zodiac still under repair and the seas were too high to deploy barge). A Giant gravity core was added to the schedule at PCB-11 after the piston core came up almost empty (although visible signs of penetration on the core barrel). Our event with the Mangilaluk School planned for the afternoon had to be rescheduled to Friday (01-10-2021) due to difficulties in transferring the 30-minute movie we made.

30 Sept 2021: The Mangilaluk movie was uploaded and sent successfully last night. The event will be held tomorrow. Today has been another productive day in terms of operations (stations PCB 10,12,13 completed). There were some issues with Multicoring at stn PCB-13 and 3 attempts were made before obtaining a successful recovery (part of the weights had to be removed). Station PCB-15 has been canceled since there is consensus about the interest for sampling at M’Clure instead. After PCB-14 tomorrow, we will sail towards 546 to finish the last two rosettes there (that were postponed due to a problem with the rosette).

1 Oct 2021: After finishing the operations at PCB-14, we transited North to 546 to conduct the final operations there. ANet and RADCARBBS teams only needed 1 more rosette here. Everything ran smoothly. We started our transit towards M'Clure and navigated to avoid going through a tongue of ice (and avoid slowing our progression). We sailed south, then east, then north along the edge of the ice pack in the hope of finding a lead near the CB1-BR3-17 station.

2 Oct 2021: Early morning, the Commanding Officer, ice specialist and Chief scientist took the decision to cancel the attempt to reach mooring station CB1-BR3-17. The conditions had deteriorated from the previous 2-3 days (at that moment leads had developed making the transit towards the station easier). With a change in the winds and the re-packing of the ice, it was no longer a viable option. We kept transiting towards M'Clure Strait. The plan is to go straight to station 516 (second station from South) and transform this nutrient into a basic (with nets, coring, etc.). We should arrive at this station at 22h00.

3-4 Oct 2021: After trying to find suitable leads through the thick multiyear ice in the darkness, we finally decided to stop our transit towards 514 (it was about 01h00). We aimed for a new position in line with the S-N transect, a new station that we later named 515 (between 516 and 514, at about 6 nautical miles south of 514). The station name was changed to 515 (a posteriori) in the event log by AS. The breaking of ice and the strong vibration that accompanied it revealed several issues throughout the ship (electrical grounding issue, fire alarms in the radvan related to absence of heat in the container, etc.). While not necessarily dramatic, the accumulation of these issues slowed our progress. When the sampling at station 515 was completed, we transited through the ice again towards station 518. At that point, the ice had already started to move south, and the station 518, which had been ice-free, was now filling up with floes and newly formed ice. Every operation was complicated by the presence of this ice. The moonpool was filled with ice and snow, it took about an hour to clear it to start operations, then a repositioning of the ship (because of ice floes) had to be done, which further delayed the operation. Finally, there was an issue with the gate valve of the moonpool, which had to be fixed before starting our transit again. Overall, we lost several hours along the M'Clure transect. The ice conditions along our transit East towards Prince of Whales also slowed us down, especially during the night.

5 Oct 2021: The ice conditions along our transit East towards Prince of Whales slowed us down, especially during the night. Because we did not receive the latest ice images of our sector (approach to Prince of Whales and Prince of Whales), the helicopter was sent in reconnaissance. Because of the induced delay in our schedule, the captain increased our speed capacity with 6 engines in Prince of Whales (16.5 knots). We expect to be at PKC_Ulubluff-21 for the mooring deployment (+CTD) around 4h15am tomorrow.

6 Oct 2021: Our transit to PKC_Ulubluff-21 near Holman went smoothly and we were able to conduct a CTD-rosette deployment as well as the deployment of the tripod mooring starting at 4h15am. The mooring deployment itself went well although there were uncertainty about the proper functioning of the ADCP current meter. We are continuing the transit towards Cambridge Bay for the crew change of Oct 7th, 2021.

5 Leg 5 – 7 October to 3 November – Baffin Bay & CAA

Chief Scientist: Marcel Babin[1] (marcel.babin@takuvik.ulaval.ca)
[1] Takuvik, Université Laval, Quebec City, QC

5.1 Introduction and Objectives

The scientific objectives of DarkEdge were to study the fall-to-winter transition of the Arctic Ocean and its ecosystem as the ice is forming and light availability is reduced significantly and continue decreasing. To address this important process, we aimed to **1)** identify the key processes that control mixing by measuring complete upper ocean heat and energy budgets using autonomous platforms (ocean surface wave and flux buoys, a Flame-lite buoy, a catamaran, remotely piloted aircrafts and helicopter flights) **2)** survey the underwater light climate, inorganic nutrient concentrations, phytoplankton stocks using a Kongsberg HUGIN AUV and a small ROV, **3)** quantify the low-light photoacclimation state of phytoplankton and their growth through photosynthesis, **4)** identify phytoplankton species and their genetic adaptation to these conditions and **5)** to cartography and qualify zooplankton and fish stocks using various net trawls and hauls and shipboard acoustic instruments.

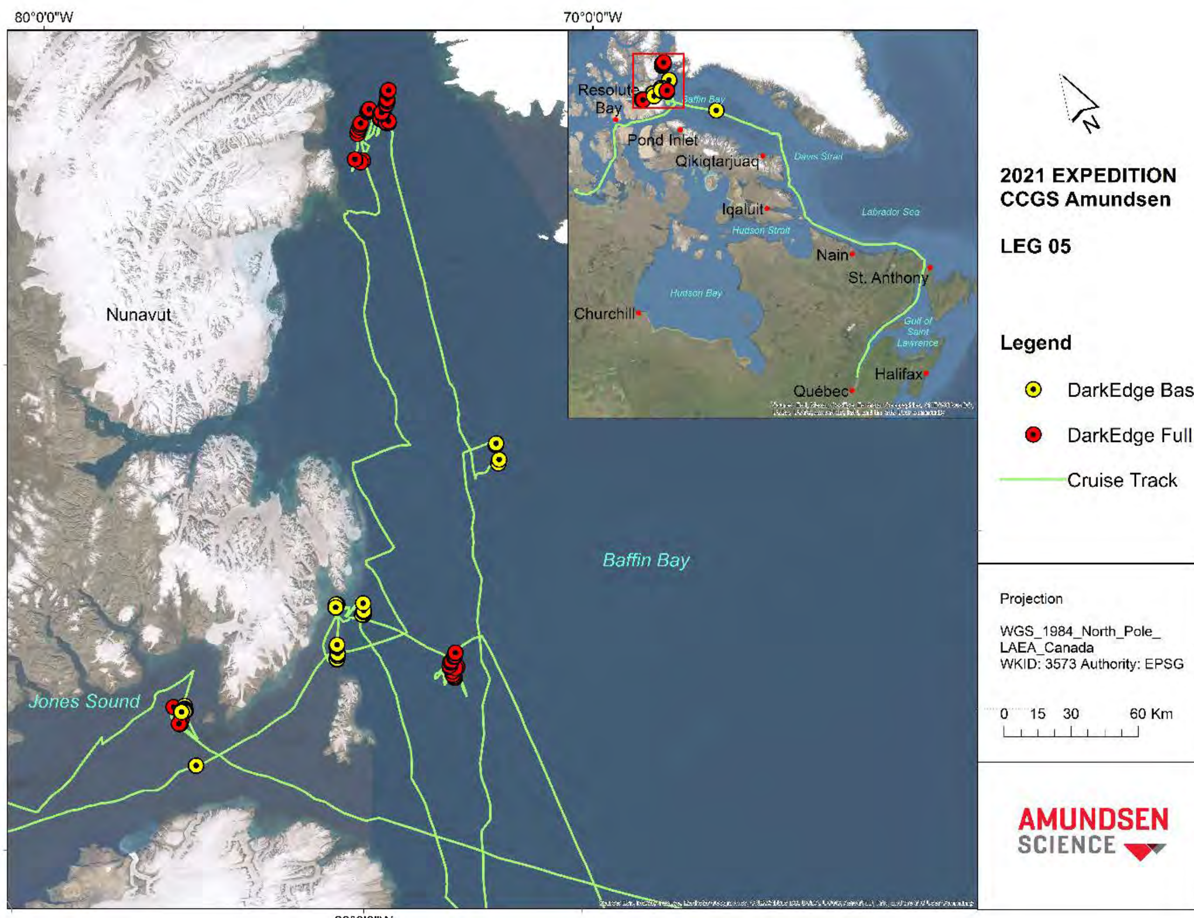

Figure 5-1: Ship track and location of stations sampled by the CCGS *Amundsen* during Leg 5 of the 2021 Expedition

5.1.1 *Sampling strategy*

The sampling strategy that was adopted was to cover, over a 3-day period, a sector with ice. On day 1, the measurements focused on open water near the ice, on day 2, the transition zone between open water and ice and finally on day 3 the ice and under ice conditions (see Fig. 1). Due to a 2-week delay in ice formation in Baffin Bay, the study area was much norther than anticipated, covering the northern sector of Baffin Bay, Smith Sound and Jones Sound.

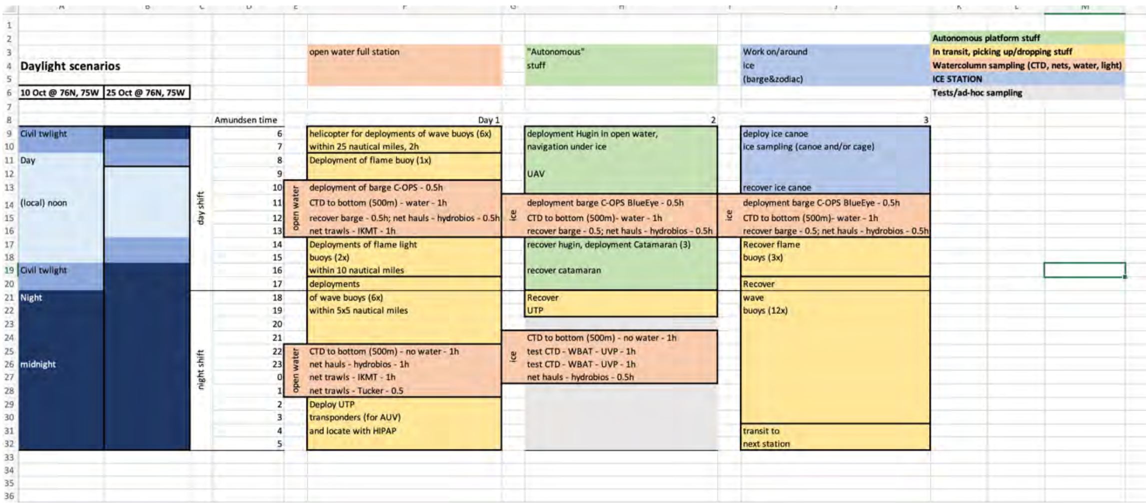

Figure 5-2: Sampling strategy for each study site, delineated on a 3-day period, which was adjusted according to environmental conditions (wind and sea state).

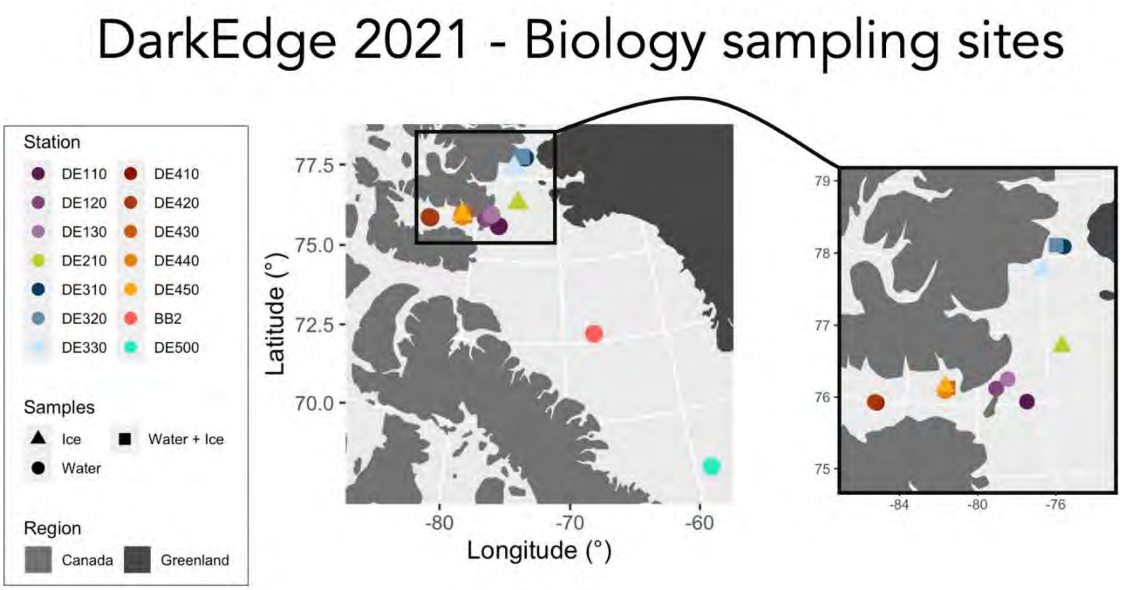

Figure 5-3: Sampling stations during the Dark Edge campaign (From Gaëlle Mével).

5.1.2 *Scientific context and accomplishment*

Due to the time of the year of the campaign and the presence of the ice cover, the light available to the under ice and water column phytoplankton community is about one order of magnitude lower during Dark Edge than during Green Edge (Table 1). Underice horizontal light field measurements were accomplished both from the Kongsberg HUGIN-1000 (Marvin) and the BlueEye robotic ROV (Kevin). These underice in situ optical measurements were complemented with in situ open water optical measurements as well as laboratory observations on water components and ice samples.

Table 5-1: Light availability of the studied system, compared to the GreenEdge campaign in June 2016 (From Lisa Matthes).

Light availability

Comparison Greenedge and DarkEdge

Campaign	Green Edge (Ice camp, 2016)	Dark Edge (2021)
Month	June	October
Sea ice type	Landfast sea ice	New sea ice
Ice thickness	110 - 130 cm	2 - 30 cm
Sea ice surface	Bare ice and ponded ice	Bare ice
Surface PAR at noon	680 - 1300 µE m-2 s-1	16 - 140 µE m-2 s-1
PAR at ice bottom	100 - 280 µE m-2 s-1	<1 - 10 µE m-2 s-1

Physical properties of the ocean in open-water and ice-covered conditions were performed using an array of platforms (buoys, catamaran, ice canoe, drone and helicopter flight).

Although a low chlorophyll concentration was measured in the water column (Fig. 3), an amplification of the phytoplankton density in the forming sea ice was registered with a large diversity of the phytoplankton species identified. Ecophysiological and genetic observations were performed on phytoplankton collected from water and ice samples. A 36-hours diel cycle was also completed to assess the variability of the phytoplankton properties.

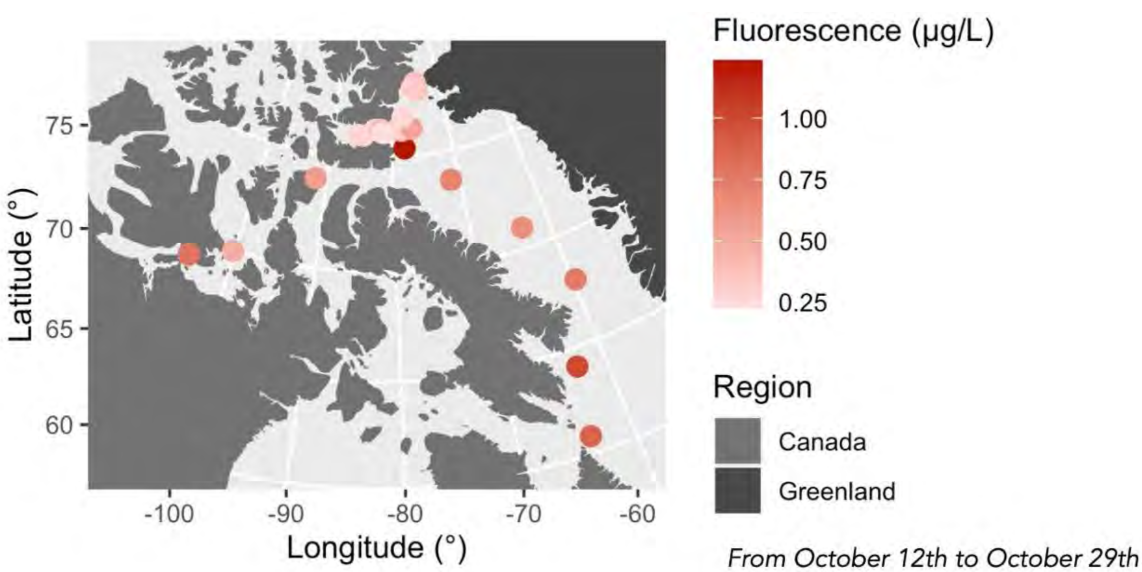

Figure 5-4: Chlorophyll-a concentration based on flow-through in situ fluorescence, showing low chlorophyll concentration in the studied areas (from Gaëlle Mével)

Zooplankton was also studied both during the day and night time from various net operations (hydrobios, Tucker, IKMT) and sensing approaches (WBAT, UVP, EK80). Significant differences were observed between the developmental stages of the Calanus populations and the species diversity observed during this campaign compared to the observation from the Norwegian waters. Light sensitivity analyses were performed at night by turning off the light from the ship and assessing the impact on the zooplankton behaviors. Two different sounding approaches (WBAT and UVP) using respectively sound and light to measure zooplankton density were compared.

5.1.3 *Challenges*

The first main challenge for this campaign was to find the site locations that had good ice cover. Considering that the ice formed 2-week later that the climatology for the Baffin Bay region, the sampling sites were located in the very North of the Baffin Bay, up to Smith and Jones Sounds, resulting in longer transit time.

The second main challenge was the high wind conditions frequently over 15 nots, limiting autonomous platform operations, such as the deployment of the AUV and the catamaran. In many occasions, scheduled operations had to be cancelled due to the environmental conditions, and the sampling strategy day number moved around, resulting in the difficulty to predict the timeline of the operations.

The third main challenge was the short daylength and the number of operations that required day light for sampling, whether due to risks associated with the operations (AUV, ice canoe, catamaran) or due to biological requirements for the measurements (nets and rosette sampling as close as possible to local noon).

Finally, COVID restrictions, charter delays and charter passenger and cargo limits provided significant logistic challenges before and during the field campaign, resulting in a nearly 3-day delay in the start of the leg.

5.2 Synopsis of Operations

The CCGS *Amundsen* accommodated 37 scientists during Leg 5 of the 2021 Expedition. The ship started its journey in Cambridge Bay on 7 October. A logistical problem forced the ship to stay anchored next to Cambridge Bay for a day before the initial transit and sampling could start. The first sampling took place in Smith Sound.

In the end, the following operations were conducted during Leg 5 of the 2021 Amundsen Expedition:

- 2 AUV operations
- 2 small ROV deployments
- 2 canoe operations
- 2 autonomous catamaran operations
- 2 C-Node deployment
- 1 deployment of a flame-lite buoy
- 10 C-OPS operations
- 6 Bongo nets
- 38 CTD-rosettes
- 11 hydrobios
- 8 IKMT
- 1 Monster net
- 2 plankton nets
- 4 phytoplankton nets

- 2 Tucker nets
- 7303 km^2 of seabed mapped with Multibeam Echosounder
- 4035 NM of 3.5 kHz sub-bottom profiler survey lines

5.2.1 *Daily Synopsis*

5 October: First science meeting held at Université Laval, Quebec City.

6 October: COVID testing of all scientific personnel.

7 October: flight overweight due to bad weather in Cambridge Bay and increased volume of fuel. Had to leave 550kg of scientific equipment in Quebec City. Flight departure around 11am. Stop in Iqaluit, and flight arrival in Cambridge Bay at 16:00. Helicopter flights for CG crew and cargo. Transfer of scientific personnel through 4 barge's trips. Transfer completed at 22:45.

8 October: wait in Cambridge Bay for CG personnel traveling by commercial flights and scientific cargo. Installation of labs and equipment

9 October: 9:00 transfer of scientific cargo by helicopter. 1 scientific personnel present symptoms of COVID, had 3 negative tests. Medical officer requests her evacuation for preventive reason, along with her cabin partner. Through discussion with Nunavut public health and CG office, it was agreed that the two scientific personnel would be tested in Cambridge Bay, and if negative returned on the ship, in isolation in the sick bay. 1st science meeting onboard the ship. It was decided that the first lecture would take place on 11 October by IBENS team and on 12 October by UiT team. Departure of the ship at 19:30.

10 October: steaming to station 1, north of Baffin Bay. 1st meeting of the Steering Committee (Marcel Babin, Dany Dumont, Maxime Geoffroy, Flavienne Bruyant, Achim Randelhoff, Vincent Taillandier, Lisa Matthes, Chris Bowler, Marie-Hélène Forget), were also present Gabrièle Deslongchamps, Dylan Roux et Gaëlle Mével. preparation of the different equipment.

11 October: steaming to station 1, north of Baffin Bay. Ongoing preparation of the laboratory and instruments.

Figure 5-5: (left) Overview of station 100: High wind (25-35 nots, North, North-West, West, South) with high sea state in open water (2-4m). thick (1-2m) old ice, drifting in stripes according to wind and currents. AUV and catamaran operations canceled due to environmental conditions. (right) Station 200: light wind (5 nots), no wave, long swell. Pancake ice. Deployment of AUV and collection of pancake ice. No other operations.

12 October: Arrived on Open Water Station 110 at 10:00. For physical team, deployment of wave buoys and flame light. Around noon: CTD rosette (Nutrient and biology), IKMT trawl net and C-OPS (measured from the front of the ship). Night-time, 3 nets (IKMT, Tucker and Hydrobios) and 1 CTD-Rosette. Transport of the flame buoy from aft to front of the ship.

13 October: ice Station 120. Evaluation of the environmental conditions at 6:00, high winds, snow with limited visibility and 3m-wave prevents the deployment of AUV, postponed operation until 15 October. Ship sails towards the coast to find proper ice conditions. Arrived on station at 12:00. Old ice strip near the coast of Ellesmere Island. Daytime, CTD-nutrient and CTD biology, hydrobios canceled due to late start of the day operation. Phytoplankton net deployed. Barge deployed to do light measurements (C-OPS and ROV with MPE sensor). Transport of the catamaran to front of the ship, using the barge. Difficult operations with the barge due to the high wind conditions. Night-time, hydrobios and CTD-Rosette. Overnight test of the impact of light of the ship on the zooplankton diel vertical migration (3 cycles of the lights of the ship being turned on and off). Note: saw 2 polar bears on the ice.

14 October: ice station 130, deployment of 1 wave buoy and ice canoe operation. Ice canoe operators collected ice samples from 2 different floes. CTD rosette and hydrobios and C-OPS from the ship performed at mid-day. Catamaran and barge operations canceled. Transit to recover the 2 flame buoys deployed at station 110 and then transit to station 2, near Smith Sound where newly formed sea-ice is expected.

15 October: pancake ice station 210, AUV operations (CTD physics, UTP and AUV deployment). Iceberg in the trajectory of the mission plan, had to re-route the AUV. Short incursion under the seaice. Pancake ice collected from the zodiac still attached to the ship for biological analyses. Full biology dataset.

16 October: open water near new ice station, in Smith Sound, station 310. Light northerly wind, 15nots. Deployment of 1 wave buoy, 1 flame light buoy. Daytime biology station (hydrobios, CTD-nutrient, tucker, CTD-Biology, C-OPS from the ship). Deployment of the catamaran in pm. Night-time open water station (hydrobios, tucker, IKMT and CTD-rosette).

Figure 5-6: Overview of Station 300: Smith Sound, Northernmost station, high winds from the North turning from the South, resulting in swell propagating deep in the ice pack. Different types of new ice present slush, thin floes, thicker floes, with floes of old ice. AUV operations cancelled due to high swell. A day dedicated to physics operations focusing on buoys and ice measurements.

17 October: station 320, snow station. Wind from the North (15-30 nots). Daytime biology station (phytoplankton net, CTD-nutrient, C-OPS from the ship, CTD-Biology). ROV operations from the zodiac attached to the Amundsen. Canoe operations, including sea ice collection. Night-time measurements of the light under the ship (with light on and off) using the C-OPS deployed from the A-frame. WBAT vs UVP5 tests (3 CTD casts on and off). CTD casts over night to highlight the variability of the front from the Atlantic waters into the Arctic waters.

18 October: station 330, high wind and swell from the South. AUV operations cancelled. Ice station focusing on physical dynamism, including wave buoys deployments, ice buoy deployments, aquadop measurements and ice measurements and collection (from the cage). Recovery of all the buoys (ice, wave and flame) prior to transit to Jones Sound.

19 October: high wind and sea state, relatively warm temperature (-1oC) transit to station in Jones Sound, station 400 to do a CTD-physics. Deployment of 3 WB on transit to station 410.

20 October: station 410 in open water in Jones Sound, light wind conditions, temperature getting colder (-4oC). Start the 36h diel cycle with CTD-rosette every 3 hours (6:00, 9:00, 12:00, 15:00, 18:00, 21:00, 24:00). In addition, 2 phytoplankton nets, 1 hydrobios during the day and 1 at night, 3x C-OPS, 1 IKMT at night as well as the deployment of a flame-lite buoy. Coast Guard inform the chief scientist that the Amundsen may be required to go to Iqaluit to support the water crisis.

21 October: station 420, in open water, relatively cold temperature (-6oC). Continue the 36h diel cycle with CTD rosette every 3h (6:00, 9:00, 12:00, 15:00, 18:00). In addition, 2 phytoplankton nets, deployment of the catamaran, 2x C-OPS, ROV from the zodiac attached to the ship, 1 Tucker net during the day. Evening for recovery of flame-lite and wave buoys and transit to ice station. Coast Guard inform the chief scientist that the Amundsen is no longer required to go to Iqaluit and can stay in science mode.

22 October: station 430, in newly formed ice, wind relatively high (25 nots, from the North) in a bay North-East of Jones Sound. Searching for the proper AUV deployment site, with a relatively flat bathymetry and open water conditions. CTD-physics and c-node deployment. AUV deployment, AUV turned 180o during its 45-sec waiting period and after moving around the ship had a collision with the ship slightly damaging the nose. Emergency recovery with the zodiac. CTD-rosette during the day and night. C-OPS, ROV and collection of ice from the zodiac. C-OPS from A-frame to assess artificial light pollution from ship and test comparing WBAT and UVP6 at night.

Figure 5-7: Overview of Station 400: Jones Sound. 36h diel cycle in the centre of the basin with no ice cover and then operations in the bay near Grease Fjord, with AUV, ice canoe and catamaran operations. Mainly thin nilas with some multi-annual ice. Light wind during the 36h diel cycle, then high wind from the North. No sea state.

23 October: station 440, in newly formed ice, wind relatively high (25 nots from the North), cold temperature (-10 to -15oC). Scheduled operation is the deployment of AUV, multiple problems (propeller, positioning of the AUV, moving sea ice) result in significant delays. Deployment at 14:00, and recovery at 17:00. Meanwhile, helicopter flight to characterize the ice conditions and to study wave dynamism. C-OPS from the front of the ship. Flame-lite recovery. Night cast of the hydrobios. Test comparing WBAT and UVP6 at night in a different site to minimize the bias of the bathymetry while the ship is drifting. Night CTD-rosette.

24 October: station 450, ice is covering nearly the entire sector, light wind, cold temperature (-10 to -15oC). Deployment of catamaran in a newly created pool in ship tracks. Ice canoe deployment to do a wave dynamic experiment (breaking the ice floe from the ship moving nearby). ROV and ice collection from the zodiac deployed in the catamaran pool. Recovery of all embarkation by noon. Group photo at noon. Transit to BB2.

25 October: BB2 station, low wind and sea state. Rosette to 1500m and deployment of 4 BGC-Argo floats and 3 arvor floats (for DFO).

26 October: transit in Baffin Bay

27 October: DE500, low wind and sea state, no ice-cover. Recovery of glider from Norway team through nose deployment and A-frame, CTD-rosette and 2 hydrobios. The IKMT was also rinsed.

28 October – 2 November: transit from Baffin Bay to Quebec City. Deployment of AUV in St. Lawrence estuary was schedule on 2 November but operations were cancelled due to high winds.

5.3 Photos

Unless specified otherwise, photo credit: Marie-Hélène Forget.

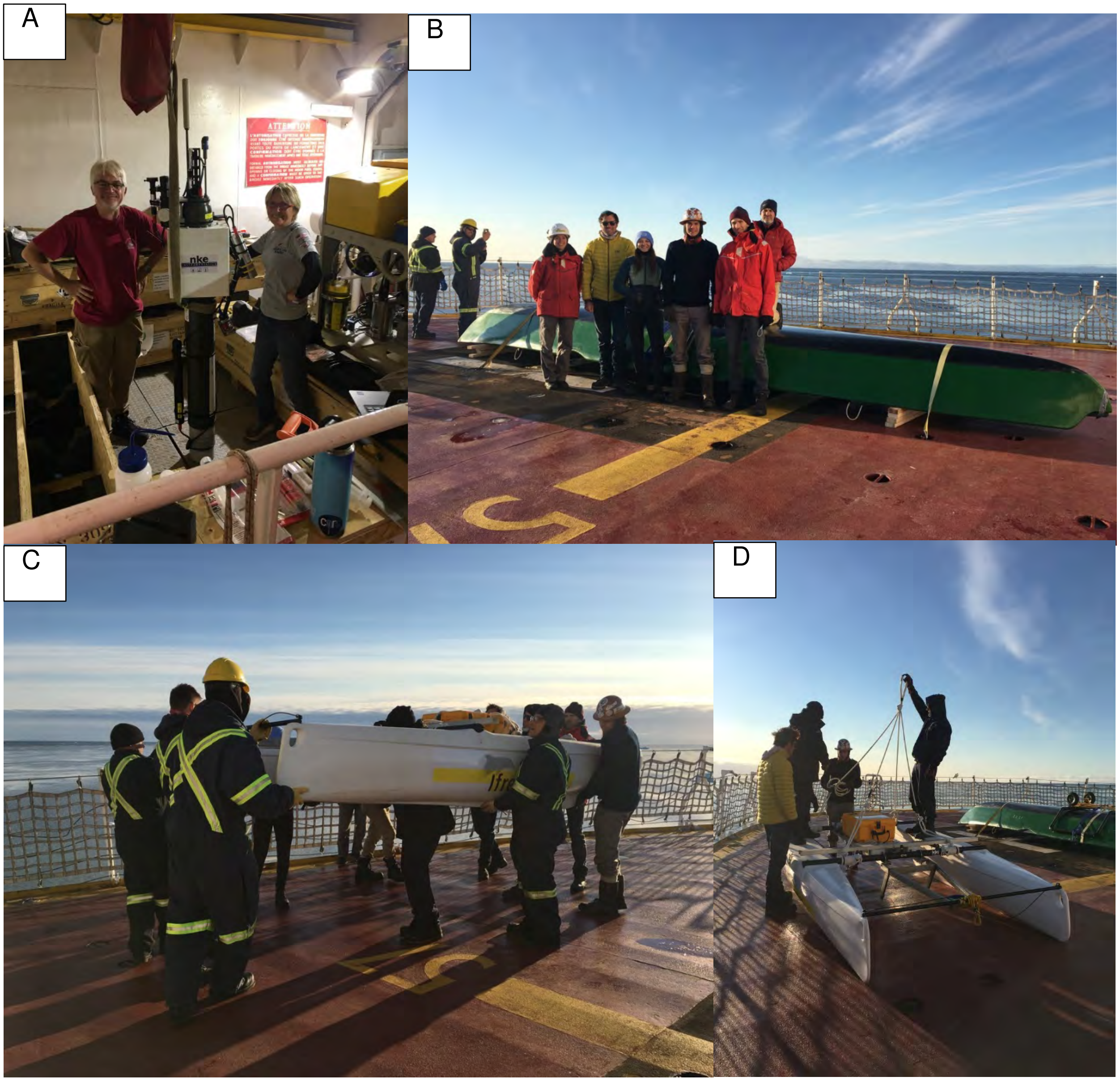

Figure 5-8: A) Claudie Marec and Edouard Leymarie, preparation of BGC-Argo floats, B) Physics team: Peter Sutherland, Dany Dumon, Hugo Sellet, Eloise Pelletier, Emma Bent, Paul Nicot, C) Catamaran moved from container to helideck, D) Preparation of the Catamaran

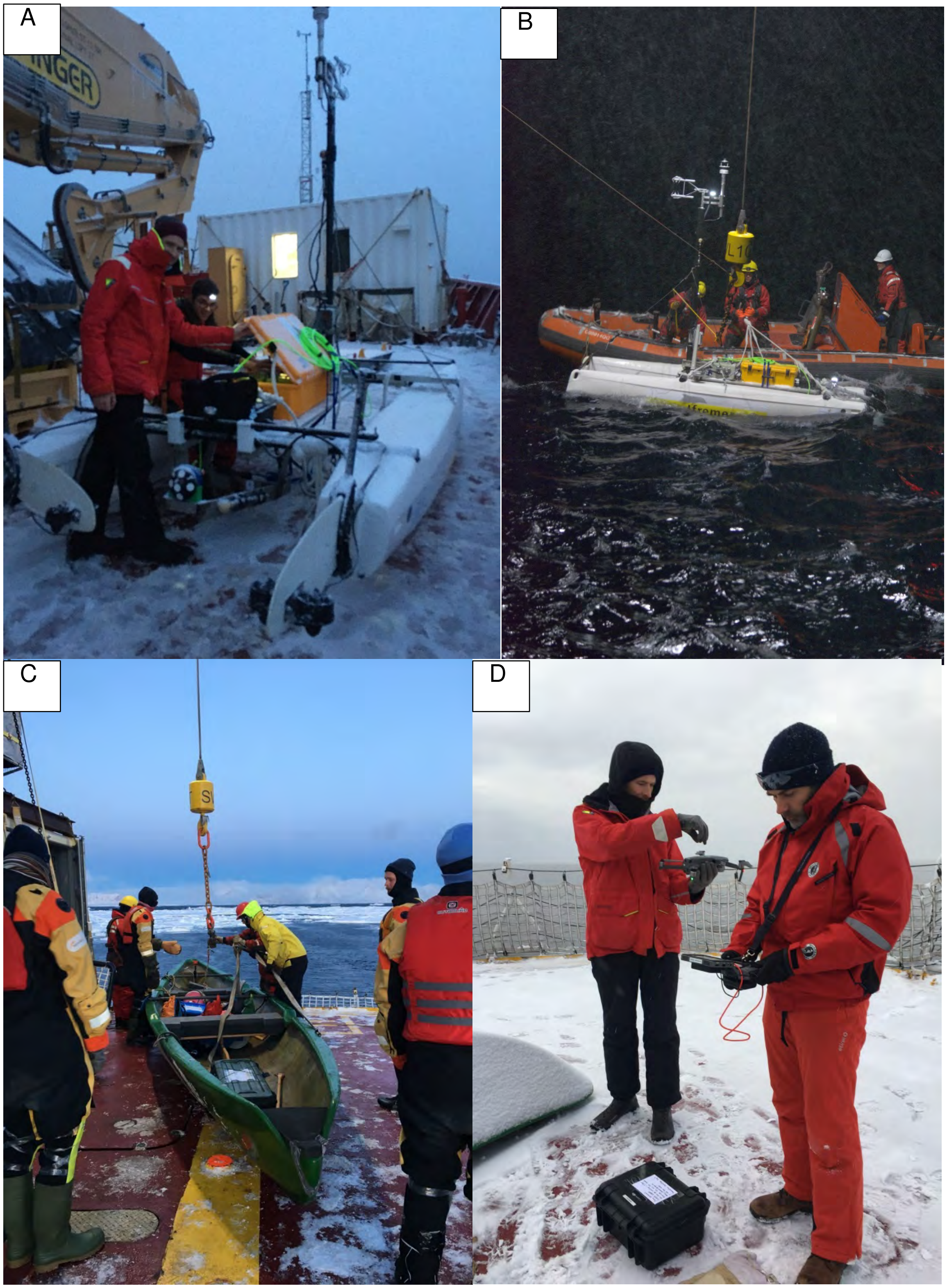

Figure 5-9: A) Preparation of the catamaran, B) Recovery of the catamaran (photo credit: Carl Fiset), C) Deployment of the ice canoe, D) Drone deployment, Dany Dumont and Peter Sutherland

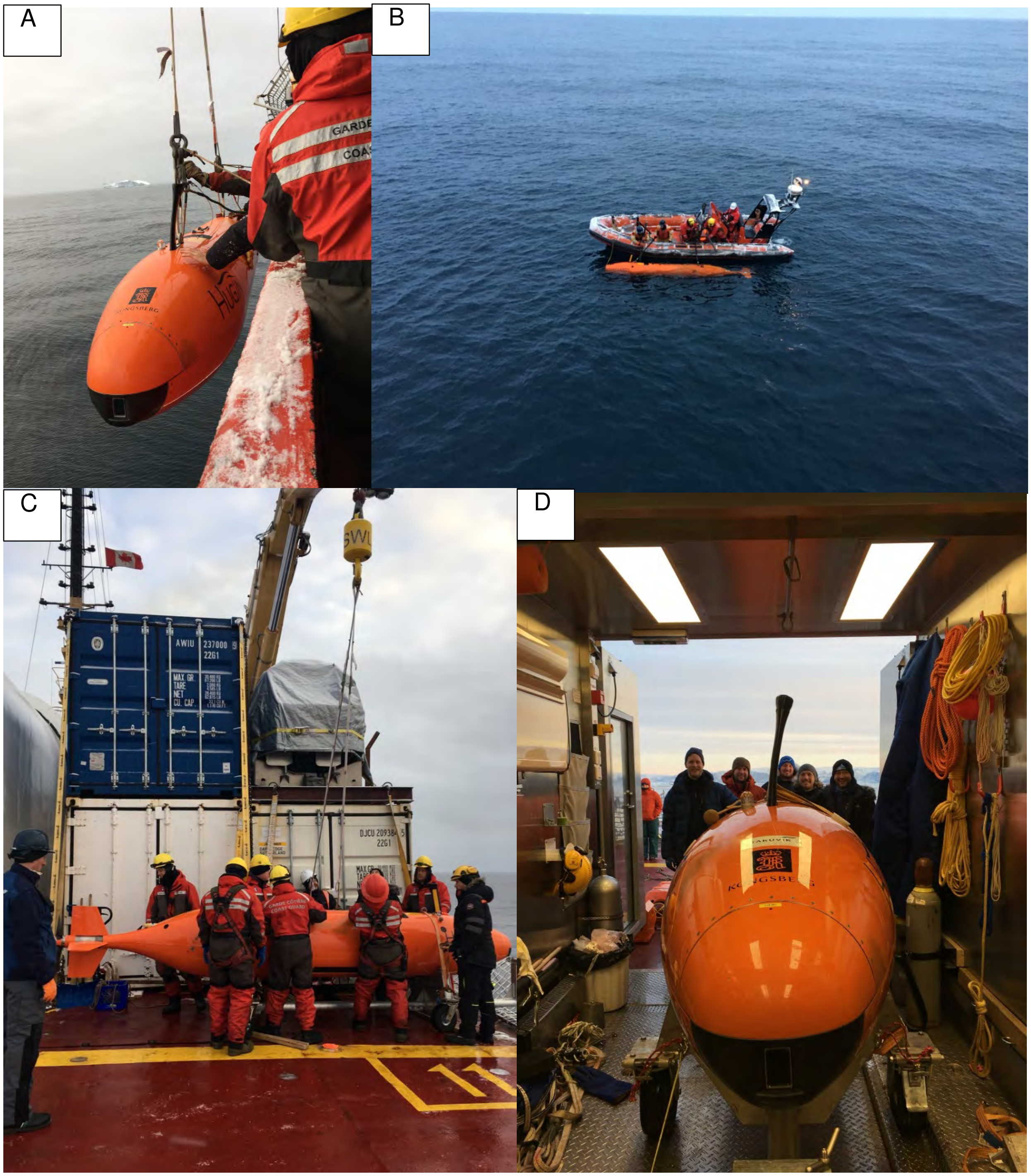

Figure 5-10: A) Deployment of the AUV (Marvin) including the removing the seacatch pins, B) recovery of the AUV, C) Deployment of the AUV, D) AUV (Marvin) team: Achim Randelhoff (Takuvik), Chris Morrissey (Amundsen Science), Christian Katlein (Alfred Wagener Institute), Jorgen Stray (Kongsberg), Guislain Bécu (Takuvik)

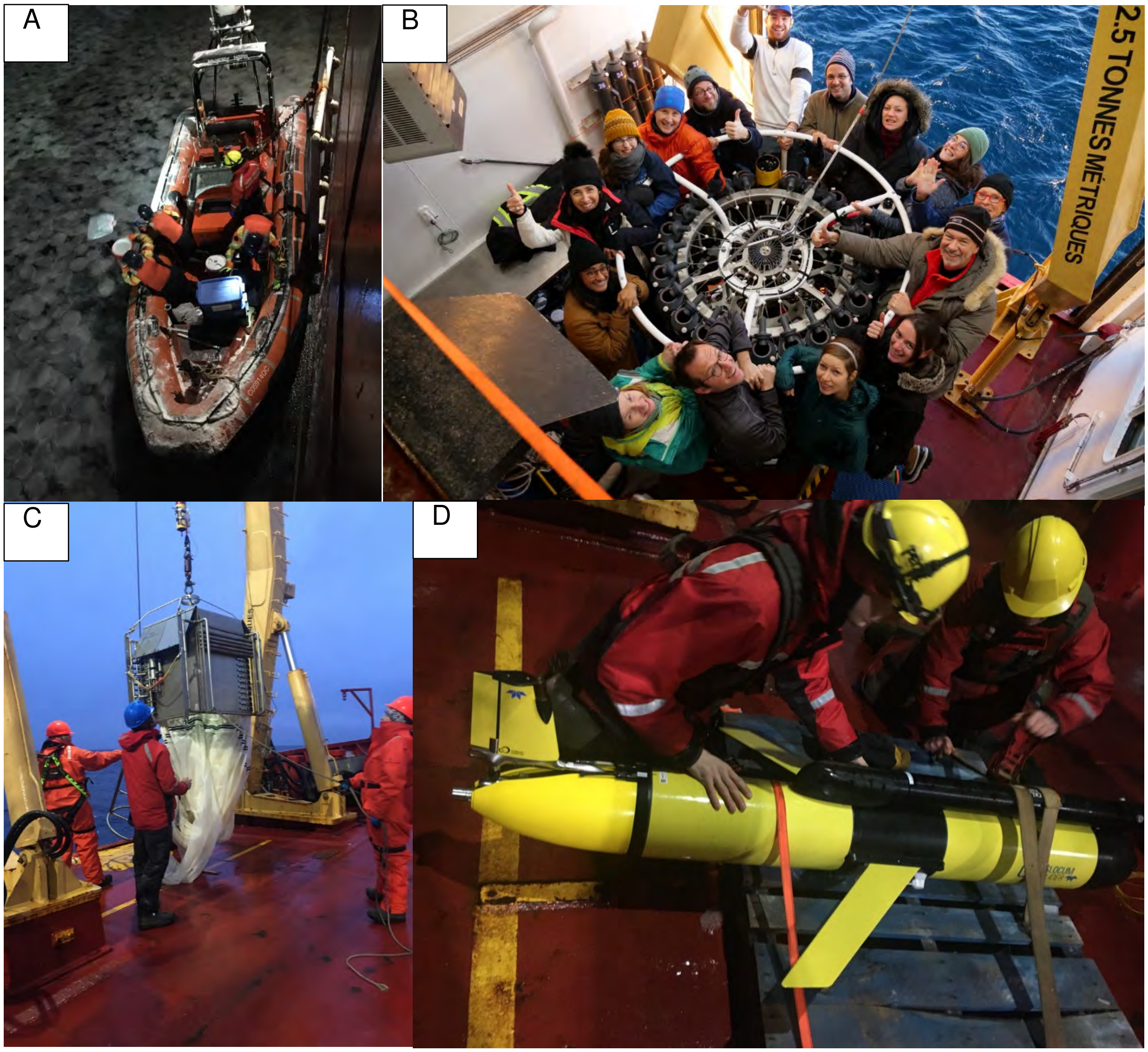

Figure 5-11: A) Collecting pancake ice from the zodiac still attached to the Amundsen, B) CTD rosette and water sampling team: Dylan Roux, Vincent Taillandier, Nathalie Joli, Laure Vilgrain, Claudie Marec, Chris Bowler, Carole Duchêne, Gabrièle Deslongchamps, Mathieu Ardyna, Lisa Matthes, Sneha Sivaram, Angela Falciatore, Gaëlle Mével, Flavienne Bruyant, Benjamin Bailleul, missing from the photo: Richard Dorrell, Jérémie Biron, Marie-Hélène Forget (photo credit: Laure Vilgrain), C) Deployment of Hydrobios by zooplankton team (on this photo, Malin Daase, Maxime Geoffroy and Estelle Coguec, missing from the photo, Pierre Priou and Maja Hattlebakk), D) Glider recovery, deployed from Norway team lead by Ilker Fer

Figure 5-12: A) Sea ice team: Lisa Matthes, Marcel Babin, and Christian Katlein (AWI) B) Biology team from IBENS: Nathalie Joli, Richard Dorrell, Carole Duchêne, Benjamin Bailleul, Angela Falciatore, Chris Bowler, C) ROV (Kevin) team: Lisa Matthes, Bastian Raulier and Christian Katlein. Deployment of the ROV from the zodiac as a platform attached to the Amundsen, D) Optics team: Lisa Matthes (Takuvik), Christian Katlein (Alfred Wagener Institute), Edouard Leymarie (Laboratoire d'océanographie de Villefranche) and Bastian Raulier (Takuvik). Also supporting the optics team, Guislain Bécu (not on this photo) (photo credit: Gaëlle Mével), E) Group photo in Jones Sound (photo credit: Dany Dumont)

Part II – Project reports

1 Eastern Canada Seabirds at Sea (ECSAS) pelagic seabird surveys

Project leaders: Carina Gjerdrum[1] (carina.gjerdrum@ec.gc.ca)

Cruise participants – Leg 1: Rick Ludkin[1]

Cruise participants – Leg 2: Rick Ludkin[1]

Cruise participants – Leg 3: Julia Baak[1,2]

[1] Canadian Wildlife Service, Environment and Climate Change Canada, Dartmouth, NS
[2] Department of Natural Resource Sciences, McGill University, Sainte-Anne-de-Bellevue, QC

1.1 Introduction

Seabird distribution is influenced by biological, chemical and physical oceanography, thus changes in seabird distribution can be an indicator of changes in the marine environment. For example, in the Arctic, many seabird species rely on ice-dependent fish (e.g. Arctic cod *Boreogadus saida*) during the breeding season. As climate change continues to reduce sea ice concentrations, fish populations and distributions may shift, resulting in similar shifts in seabird populations and distributions. As these impacts continue to increase in frequency and intensity, understanding seabird distribution will be increasingly important.

The Eastern Canada Seabirds at Sea Program (ECSAS) is a long-standing endeavour to identify seabird species, determine their numbers, and locate them as to time and place in the Eastern Canadian oceans – from the Atlantic provinces to the high Arctic. Seabird counters (affectionately known by their professional classification "birdyologists") are attached to research vessels as space is available. Data from at-sea surveys provide important information on pelagic seabird distribution throughout the year, including patterns of dispersal from breeding areas, migration routes and wintering areas. Over time, these data show trends in species abundance, diversity and distribution. This information can then be used to inform decisions regarding the protection of important marine areas, environmental assessment of proposed development projects, and appropriate response strategies to catastrophic events (e.g. oil spills; Fraser and Russell 2016). Additionally, these data can be used in conjunction with seabird tracking studies (e.g. Baak et al. *in press*). For example, Baak et al. (2021) examined the non-breeding movements of black guillemots (*Cepphus grylle*) in Atlantic Canada, and used distribution data from ECSAS surveys to assess potential error in tracking devices.

While seabirds are the main focus of ECSAS surveys, observers also collect opportunistic information on marine mammals and anthropogenic pollution. For example, Mallory et al. (2021) used data collected on the Amundsen and other ships of opportunity in the Canadian Arctic and West Greenland to examine the distribution of marine litter in this region. Marine litter, 74% of which was plastic, was observed as far as 78°N and to ~83°W in the Northwest Passage, showing that even large pieces of plastic pollution can reach these remote regions (Mallory et al. 2021).

1.2 Methodology

1.2.1 *Leg 1, 2*

The wildlife observers are stationed on the bridge, which offers a wide view of the surrounding ocean. There are 3 methods of performing counts:

a) Moving Watches: this “distance sampling” technique is the main method used to record bird numbers. Birds are counted from a moving vessel in 5-minute “watches” that repeat consecutively. Birds seen are identified; it is noted whether they are flying or sitting on the water; they are “placed” in terms of their relationship to the vessel (we concentrate on a square 300 m x 300 m on one side of the vessel). The distance categories are:0-50 m; 50-100 m; 100-200 m; 200-300 m; >300 m. Birds seen on the other side of the vessel can be recorded but do not figure in the analysis which ultimately is aimed at determining the number of birds total/species per square kilometer in a particular area.
b) Stationary Watches: when the vessel is stopped on station, the counter does an hourly assessment of the birds seen on one side of the vessel using the above distance categories but applied radially.
c) Incidental Observations: if the observer has a noteworthy sighting when not doing the above 2 counts, they are kept track of using this format which places the bird in time and place.

1.2.2 *Leg 3*

Seabird surveys were conducted using the Eastern Canada Seabirds at Sea (ECSAS) standardized protocol (Gjerdrum et al. 2012). When the Amundsen was in transit, 5-minute transects were conducted by scanning a 90° arc on the starboard side of the ship. At the beginning of each transect, weather, sea state, ice conditions and ship speed/direction were recorded. During the transect, all birds on the water were recorded continuously, and birds in the air were recorded using a snapshot approach to eliminate the over-estimation of flying birds (Gjerdrum et al. 2012). For all birds, the species, number, location (water/fly/land), and distance from ship (distance sampling methods are incorporated to address the variation in bird detectability) were recorded. Additional details such as behavior, flight direction, age and plumage were recorded when possible. Sampling occurred during the end of the breeding season and/or beginning of migration (August 12 to September 9, 2021), depending on the species.

The Canadian Wildlife Service places seabird observers on multiple ships of opportunity throughout the year. After the expedition, data are consolidated, summarized and analyzed from a central database maintained by the Canadian Wildlife Service Atlantic Region office in Dartmouth, Nova Scotia. The data are open and shared with other departments and jurisdictions.

1.3 Preliminary Results

1.3.1 *Leg 2*

By the end of this Leg, well >2000 Moving Counts will have been done; >100 Stationary Counts; and numerous Incidental Sightings. All the data is sent to Carina Gjerdrum, Seabird Biologist with the CWS/ECCC in Dartmouth NS for subsequent analysis.

A cursory look at the findings so far shows the following:

a) There was a diminishing variety of species the further north/northwest we went.
b) The relatively open floe ice areas were very rich in terms of numbers and species variety likely due to the plankton associated with the ice.
c) Northern Fulmars were plentiful and seen all along the route in large numbers, especially when the vessel moved offshore – they were rarely seen (or seen infrequently) when close to the land (e.g., in Conception Bay). When the vessel stopped to conduct research there would invariably be a build-up of fulmars around the vessel (likely thinking we were involved in a fishing exercise and food would be forthcoming). Sometimes they numbered over 200. There are a number of breeding colonies along the coast of Baffin Island which would account for their numbers there. Birds which we encountered further offshore could have come from Greenland as well.
d) Thick-billed Murres, although perhaps more numerous in the Arctic than fulmars were the 2nd highest species encountered. Their numbers were higher in proximity to known breeding cliffs (e.g., around the Minarets – just a short way from the entrance to Southwind

Fjord) but decreased the further we moved offshore. This was likely due to how they feed their young – carrying whole fish in their bills back to the nest, which becomes hard work the farther it has to go. [Fulmars on the other hand partially digest their catch into a viscous oil which makes transportation mush easier and allows them to forage much further from the nest.]

e) We crossed a latitudinal divide around the north end of Newfoundland below which Common Murres were the bird and beyond which we switched to Thick-billed Murres.
f) Razorbills, surprisingly, were not seen.
g) Atlantic Puffin numbers diminished as we preceded north but were still seen off the north coast of Labrador.
h) Dovekies, another small Alcid, began to show up off SE Baffin Island (a few) but their numbers increased markedly as we proceeded further north. They were quite numerous in the area of floe ice that we had to circumvent after leaving Southwind Fjord. This was likely due to the rich plankton sources that the ice provides. Except for a tiny breeding colony on Baffin Island, all the Dovekies nest in Greenland but many of them winter off Labrador and Newfoundland. These may have been early migrants as we were further from Greenland at this point than we were from Baffin Island.
i) A number of Black Guillemots were counted but usually within 20 NM of shore – anything beyond that I noted as unusual.
j) Leach's Storm-petrels were abundant along the Newfoundland part of the trip but dropped off dramatically once we past the Strait of Belle Isle. Interestingly a few were sighted in the area of the Torngats.
k) Three species of shearwater were encountered: Great, Sooty, and Manx. Most were seen in the lower section of the Leg.
l) Jaegers were seen regularly, especially well offshore, before we went through Davis Strait at which point their numbers fell. The most common species encountered was the Long-tailed Jaeger although the larger Pomarine Jaeger was a close second. Only one Parasitic Jaeger was sighted and it was comparatively close to land (which is typical for the species).
m) Large concentrations of King Eiders associated with the fjords of Baffin Island were observed, but no Common Eiders.
n) Not many gulls were seen offshore except for occasional groups of Black-legged Kittiwakes and occasional Glaucous Gulls (in the higher latitudes). Three relatively uncommon Thayer's Gulls were seen off SE Baffin Island.
o) Red Phalaropes and Red-necked Phalaropes were seen with the former in larger numbers (flocks up to 28 birds). These planktivorous little "shorebirds" are extremely pelagic coming to land only to nest. They would be heading at this time for the waters off Namibia. [Interestingly, all the Red Phalaropes were still in breeding plumage so they were all adults – either just having finished nesting or were failed nesters. There is a large influx of phalaropes into the open end of the Bay of Fundy in August and almost all these birds have either moulted from adult plumage into their duller "basic" plumage or are juveniles. The question is: where do the adults with breeding plumage moult before reaching the Bay of Fundy? Or does this cohort bypass the Bay and head straight for Africa?]
p) Some species were sighted well north of their usual range: e.g., Leach's Storm-petrel and Northern Gannet at >63 degrees N; Great Shearwater, Sooty Shearwater and Arctic Tern in the region of Saglek Bank; Atlantic Puffins just after crossing the Arctic Circle.
q) Perhaps the most significant finding was the discovery of two potential new bird species: they are now known (being recognized by the AOU – American Ornithological Union) as the Admunsen Seagull and the Admunsen Penguin. The former has a passing likeness to the Northern Fulmar and the latter to the Thick-billed Murre but close scrutiny will easily reveal the differences.

Researchers who are interested in following up on this information/data can contact Project Leader Carina Gjerdrum (carina.gjerdrum@ec.ca).

Seabirds survive by successfully finding and utilizing patches of food – plankton, fish. Future collaborative research efforts would be useful in determining how birds find these patches. Do patches give off cues (e.g., scents) that free-ranging birds can pick up when they are coursing the ocean? Can concentration of plankton be correlated with the presence of seabirds and, if so, what species (of each)?

A subsidiary role of the birdyologist is to keep track of marine mammals. Although not specifically trained to identify them, most observers have a fair amount of experience and can often identify marine mammals with accuracy. Those that cannot be positively identified are noted as “unknown”; e.g., “unknown seal”, etc.

I expected to see more whales than I did. I had good sightings of Fin Whale, Humpback Whale, and Bowhead Whale (in Scott Inlet). Also I saw Beluga Whales and a pod of ~20 Narwhal in Scott Inlet. I saw only a few Long-finned Pilot Whales which was a surprise as I had encountered large numbers in 2013 off the same coast of Baffin Island. There were a only a few seal sightings with positive identification made of Hooded Seal, Ring Seal, and Harp Seal.

A number of Polar Bears were sighted. Often it was a sow with an older cub (probably into its second year). Several of these bear sightings took place >30 NM offshore.

1.3.2 *Leg 3*

A summary of the seabird species observed during Leg 3 is provided in Table 1-1. Density estimated are not provided as the numbers counted during surveys are an underestimate and are used, in conjunction with data on the identity and behaviour of the species, weather conditions, sea state, and observer, to calculate density.

Table 1-1: List of seabird species observed on Leg 3 of the 2021 CCGS *Amundsen* Expedition (August 12 to September 9, 2021).

Common name (English)	Common name (French)	Scientific name
Dovekie/Little Auk	Mergule nain	Alle alle
Northern fulmar	Fulmar boréal	Fulmarus glacialis
Thick-billed murre/ Brünnich's guillemot	Guillemot de Brünnich	Uria lomvia
Black-legged kittiwake	Mouette tridactyle	Rissa tridactyla
Glaucous gull	Goéland bourgmestre	Larus hyperboreus
Black guillemot	Guillemot à miroir	Cepphus grylle
Great black-backed gull	Goéland marin	Larus marinus
Red-necked phalarope	Phalarope à bec étroit	Phalaropus lobatus
Pomarine jaeger	Labbe pomarin	Stercorarius pomarinus
Iceland gull	Goéland arctique	Larus glaucoides
Herring gull	Goéland argenté	Larus argentatus
Common redpoll	Sizerin flammé	Carduelis flammea
Common raven	Grand Corbeau	Corvus corax
Arctic tern	Sterne arctique	Stercorarius jaegers
Long-tailed jaeger	Labbe à longue queue	Sterna paradisaea
Northern gannet	Fou de Bassan	Stercorarius longicadus
Sabine's gull	Mouette de Sabine	Xema sabini

1.4 References

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2 Atmospheric methane monitoring

Investigators: Judith Vogt, Dave Risk, Owen Sherwood

Cruise participants – Leg 2: Judith Vogt

[1] *Department of Earth Sciences, St. Francis Xavier University, Antigonish, Nova Scotia*

2.1 Introduction

Methane is a potent atmospheric greenhouse gas due to its high potential to warm the earth, around 30 times more efficient than carbon dioxide over a 100-year timeframe. To produce realistic future climate predictions, a good understanding of global methane sinks and sources, but also of ambient background levels is important. However, measurements of atmospheric methane in northern regions are scarce, particularly over the ocean.

Two measurement systems were deployed onboard to continuously assess atmospheric and ocean surface methane over roughly 5000 km during leg 2. Objectives were to 1) establish a baseline study of atmospheric background methane concentrations and 2) track down potential anomalies of atmospheric levels measured on the ship with the help of water-based measurements. While global oceans generally do not act as carbon sources to the atmosphere, small local anomalies may occur due to seafloor seep activity for example at known seep locations like Scott Inlet [1].

2.2 Methodology

We mounted a gas analyzer (Ultraportable Greenhouse Gas Analyzer, LGR) for atmospheric measurements of methane and carbon dioxide in the Portable Electronics Lab on deck, connected with an inverted air inlet on the Met tower at the bow of the vessel (see Figure 2-1) via roughly 100 ft long Synflex tubing. In addition, a temperature probe (Campbell Scientific), a 2D anemometer (RM Young) for measurements of wind speed and direction and a GPS (Garmin) were installed on the tower. Data was continuously collected at 1 Hz on a datalogger (CR1000, Campbell Scientific) located inside the lab. A laptop was used to monitor real-time data. Instruments on the tower were powered through the power outlets on the datalogger, while a 12 V to 24 V converter was used for the anemometer. 100 ft long cables fed through a hole on the bottom of the Portable Electronics Lab connected the instruments with the datalogger. The gas analyzer was equipped with an internal pump, moving the air from the inlet to the analyzer at a flow rate of roughly 500 ml/min. The analyzer was connected serially with the datalogger. To monitor potential drifting of the gas analyzer, daily benchmarking was conducted using gas from a cylinder of compressed air.

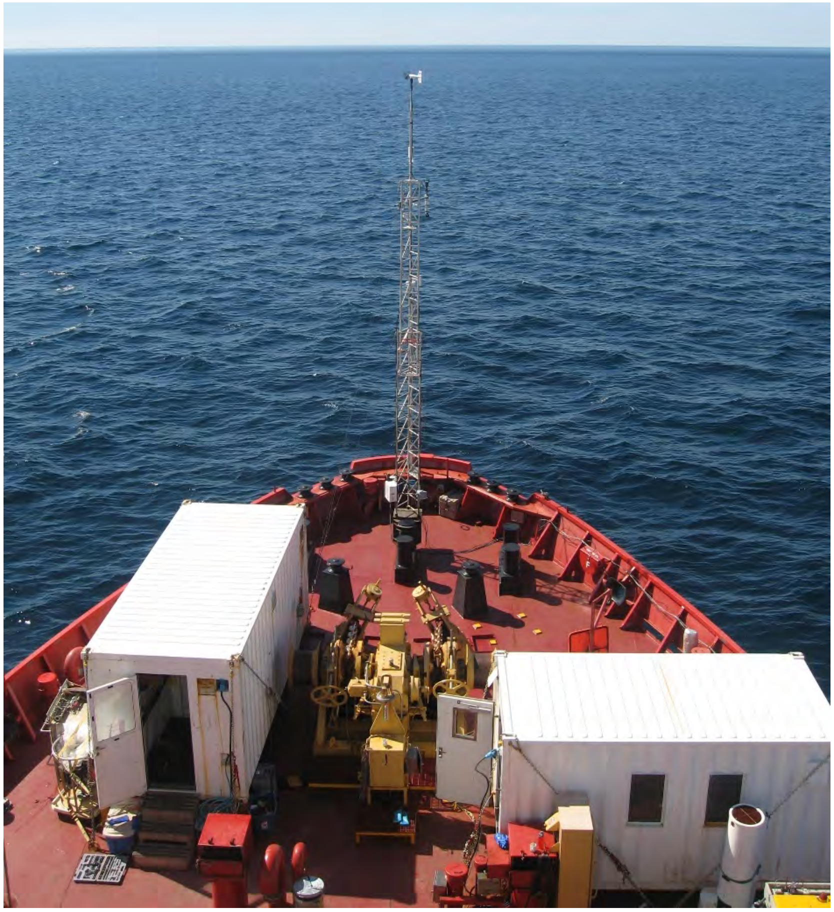

Figure 2-1: Met tower at the bow of the ship equipped with air inlet, temperature probe, anemometer, and GPS. The gas analyzer, datalogger and power source are located in the Portable Electronics Lab (container on the right).

Measurements of methane dissolved in ocean surface water were conducted continuously with an underwater methane sensor (METS, Franatech). The sensor was placed in a custom-built flow-through chamber fed with ocean surface water from the underway system in the Forward Filtration Lab. Water from this system was pumped from <5 m depth onto the ship, collected in a pressure tank and forwarded to different outlets. Therefore, a full cycle of ocean water being refreshed inside this system may take up to a couple of minutes. Data from the sensor was collected at 1 Hz on another datalogger (CR1000, Campbell Scientific). To monitor potential drifting of the underwater sensor, we frequently collected surface water from the same underway system as well as from Niskin bottles of the CTD-Rosette into 160 ml glass jars. These water samples were immediately poisoned with mercuric chloride and stored in a cold room until analysis.

Table 2-1: Stations, timestamp and locations of manual ocean surface water samples taken from the CTD-Rosette

Station	Date & time	Latitude	Longitude
Station 652 Makkovik	2021/07/18 23:51:33 2021/07/20 00:03:08	55.6438432 55.5377403	-55.5183120 -58.9609208
Kelp	2021/07/23 05:58:30	58.6665978	-62.6013818
HiBio A	2021/07/24 08:15:30	60.4428577	-61.2738587
HiBio C	2021/07/26 02:41:53	60.4657215	-61.1877363
Hatton Sill	2021/07/26 21:10:19	61.4310887	-60.6861782
Davis Strait	2021/07/28 18:09:18	63.3593530	-58.2703165
SF 3.1	2021/07/31 19:02:36	66.7602462	-62.3321295
Disko Fan	2021/08/02 01:48:53	67.8775548	-59.3644630
Scott Inlet	2021/08/04 10:21:52	71.3799633	-70.0759310
	2021/08/04 22:04:53 2021/08/04 23:11:07 2021/08/04 23:31:16	71.3790067 71.3725972 71.3866107	-70.0753275 -70.0488850 -70.0552897
	2021/08/05 00:01:43	71.4096240	-69.9763870
	2021/08/05 02:08:19	71.3895138	-70.3016597
	2021/08/06 02:57:31	71.3785897	-70.0786893
Gib-3.1	2021/08/07 13:47:54	70.6491142	-72.4828337

2.3 Data collection and encountered issues

Together with two days of mobilization and fixing leaks in the inlet tubing of the atmospheric system for a couple of days, continuous data collection started on July 20, 2021. Afterwards, the atmospheric system worked fine, and we collected data for roughly 24 days, allowing for time to pack up at the end of the cruise.

Regarding the underway system, the pump was clogged several times due to sea ice occurrence. In addition, the system had to be shut down a couple of times for up to 24 hours to allow for maintenance of leaks. These interruptions of flowing water led to data loss, and additional hours of warm-up of the underwater sensor once the pump was fixed and water was flowing again. To overcome this issue, we collected additional CTD-Rosette surface water samples at different seep locations in Scott Inlet, an area of high interest in terms of methane measurements.

2.4 Preliminary results

Throughout the cruise, observed atmospheric methane concentrations did not exceed 1.99 ppm, with a globally averaged marine surface annual mean concentration of 1.88 ppm in 2020 [2]. More detailed data post-processing is required following the cruise to draw conclusions on local differences. With the mentioned issues in mind, careful post-processing of water-based methane measurements is required before further conclusions can be drawn. In general, methane dissolved in surface ocean water is expected to be low in the studied areas, and the preliminary maximum observed concentrations were roughly 4 nmol/L in the Scott Inlet area. A slight increase of up to 3 nmol/L was also observed close to Cape Dyer as found previously [3, 4]. These small increases in ocean surface dissolved methane concentrations in hotspot areas reflect the low impact on atmospheric methane concentrations by water-borne processes like seafloor methane seeps [5] observed in the studied areas.

References

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3 Glacier Velocity and Iceberg Drift Tracking

Project leaders: Luke Copland[1] (luke.copland@uottawa.ca), Wesley Van Wychen[2] (wesley.van.wychen@uwaterloo.ca)

Cruise participants – Leg 3: Luke Copland[1], Adam Garbo[1]

[1] *University of Ottawa, Department of Geography, Environment and Geomatics, Ottawa, ON*
[2] *University of Waterloo, Department of Geography & Environmental Management, Waterloo, ON*

3.1 Introduction

Tidewater glaciers drain glaciers, ice caps and ice sheets, and terminate in the ocean where they discharge mass through the calving of icebergs and ice islands (large tabular icebergs). There are currently >300 tidewater glaciers in the Canadian Arctic, with a combined total solid ice discharge of >3.0 Gt a^{-1} (Van Wychen et al., 2021), most of which are rapidly retreating (Cook et al., 2019). The Greenland Ice Sheet discharges up to ~100 Gt a^{-1} of ice to the ocean (King et al., 2020), with the glaciers of west Greenland providing the dominant source of large icebergs in Baffin Bay.

Monitoring of ice discharge to the ocean is important for understanding glacier dynamics and how they are changing under a warming climate, to compute freshwater fluxes to the ocean, and to quantify iceberg hazards for shipping. The Canadian Ice Service (CIS) produces ice charts to identify the presence of icebergs in Canadian waters but has little knowledge about the sources and sinks of these ice masses. To improve their forecasting ability, and therefore minimize hazards for shipping operations in ice-infested waters, it is important to understand where these icebergs and ice islands originate from, where they drift to, how they deteriorate, and the time scale of these processes.

This project had two primary objectives:

1. To deploy satellite tracking beacons on icebergs to track their drift, as well as undertake air photo surveys to quantify their physical characteristics
2. To deploy multi-frequency Global Navigation Satellite System (GNSS) receiving stations on tidewater glaciers to measure their high-resolution ice motion.

3.2 Methodology

3.2.1 *Iceberg Drift Tracking Beacons*

A total of 10 "Cryologger" (https://cryologger.org; Garbo et al., 2021; Figure 3-1) and 2 "RockSTAR" (https://www.groundcontrol.com/product/rockstar-professional) iceberg drift tracking beacons were deployed between August 21st and September 3rd, 2021, on icebergs in Baffin Bay (Figure 3-2, Figure 3-3; Table 3-1). The suitability of potential targets was determined through an assessment of their size, morphology, location, and likelihood to drift further south; landings were preferentially made on tabular icebergs with a hear-horizontal, stable surface. The beacons were equipped with a suite of sensors allowing for the measurement of GPS location, temperature, pressure, pitch, roll, heading, and battery voltage. Positions are typically transmitted hourly through an Iridium satellite connection and are made freely available on https://cryologger.org and https://yb.tl/icebergs2021.

Figure 3-1: View if the interior of the Cryologger beacons deployed during the 2021 *Amundsen* Expedition Leg 3.

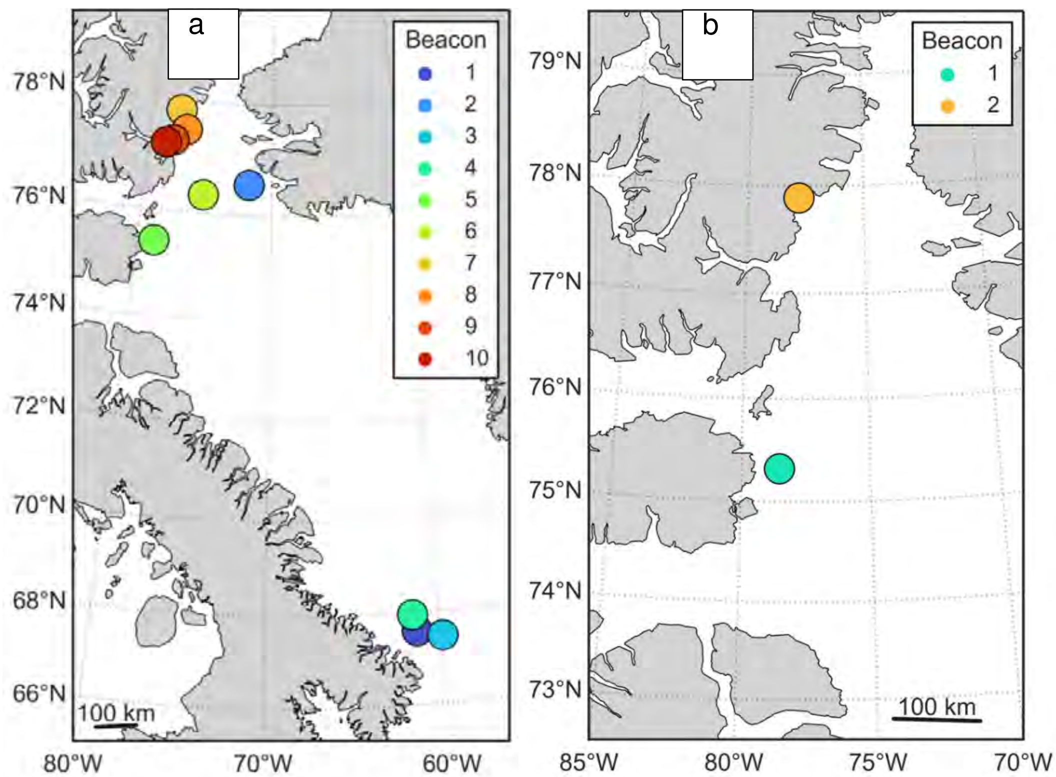

Figure 3-2: Map of the location of: (a) 10 Cryologger, and (b) 2 RockSTAR iceberg drift tracking beacon deployments completed during Leg 3 of the 2021 Amundsen Expedition.

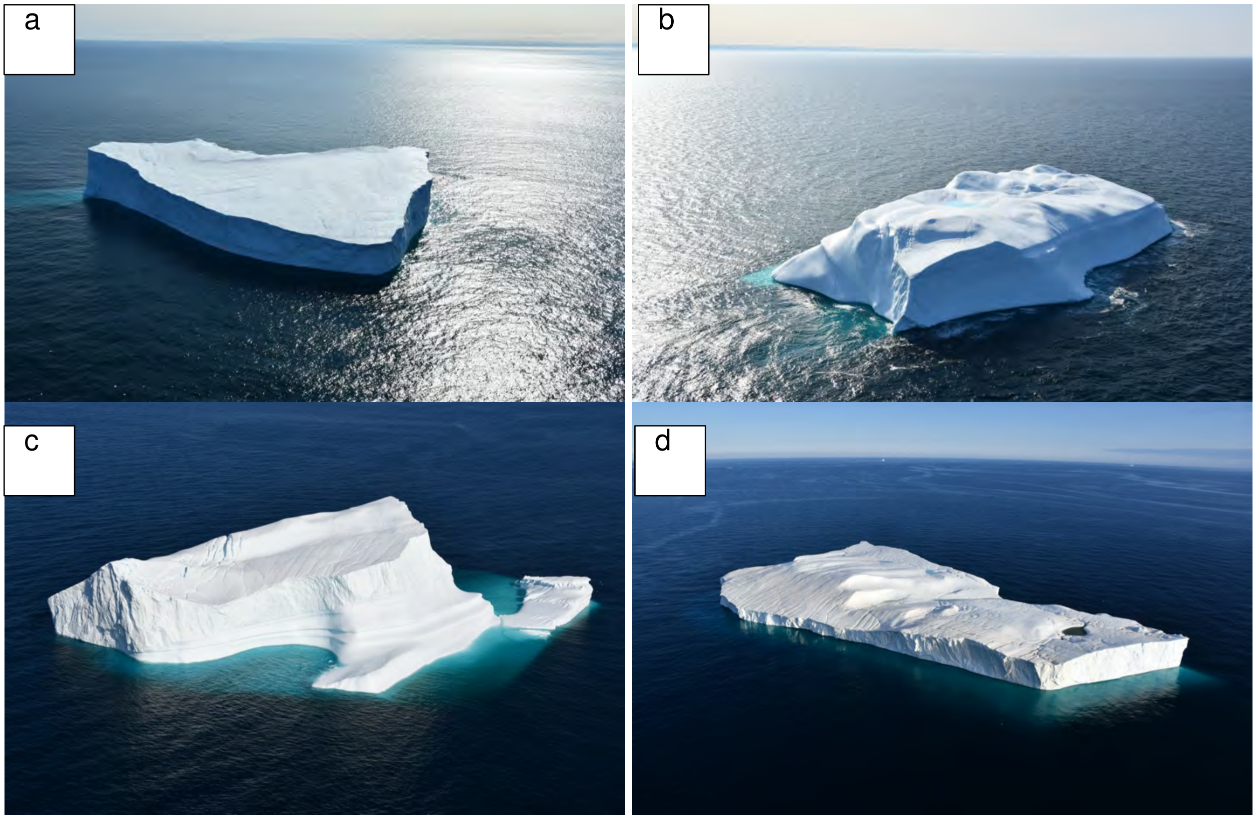

Figure 3-3: Examples of icebergs instrumented tracking beacons near the coasts of Baffin Island (a, b, c) and Coburg Island (d), Nunavut, between August 21st and September 3rd, 2021 during the 2021 Amundsen Expedition Leg 3.

An initial helicopter flight on August 21, 2021, saw the successful deployment of 3 Cryologgers on icebergs off the coast of Baffin Island. However, it was later determined that beacon #2 had been flipped upside down during deployment, likely from the helicopter's downdraft, and was encountering difficulties transmitting. It was deemed that the beacon enclosure was too light and required additional weight before additional deployments were made. A solution was devised to use recycled pieces of wood from the CCGS *Amundsen* to construct a 24" x 24" wooden "X" that could be affixed to the beacons (Figure 3-4). This increased the stability of the beacon on the iceberg's surface as well as its resistance to strong wind gusts. On August 23rd, the CCGS *Amundsen* transited near to the iceberg instrumented with beacon #2 and it was possible to conduct a short flight to deploy a new beacon with the attached wooden "X" and recover beacon #2. Since the replacement, no issues with the orientation of the beacon have been observed, and all other Cryologger beacons were deployed with similar wooden "X" frames attached to them. The RockStar beacons were deployed inside a case with a heavy (12V, 22 Ah) battery, so did not experience any similar issues with helicopter downdraft

Figure 3-4: Replacement Cryologger beacon #4 with attached wooden frame, deployed August 23, 2021.

Table 3-1: Summary of Cryologger iceberg tracking beacon deployments during Leg 3 of the 2021 Amundsen Expedition.

#	IMEI	Datetime (UTC)	Latitude	Longitude	Location
1	300434065734810	2021-08-21 17:09	67.60043	-61.37063	Baffin Island
2	300434065732760	2021-08-31 23:21	76.564928	-71.793988	Greenland
3	300434065868240	2021-08-21 18:04	67.46962	-59.9502	Baffin Island
4	300434065860260	2021-08-23 14:32	67.95295	-61.57047	Baffin Island
5	300434065869240	2021-08-30 21:50	75.432687	-78.743463	Coburg Island
6	300434065860320	2021-09-01 18:10	76.347067	-75.320222	N. Baffin Bay
7	300434065864290	2021-09-03 15:55	77.835556	-77.6175	Talbot Inlet
8	300434065861350	2021-09-03 16:18	77.494917	-77.032083	Smith Bay
9	300434063291950	2021-09-03 16:34	77.289111	-78.015917	Smith Bay
10	300434063497310	2021-09-03 16:45	77.238833	-78.636028	Smith Bay

Table 3-2: Summary of RockSTAR iceberg tracking beacon deployments during Leg 3 of the 2021 Amundsen Expedition.

#	IMEI	Datetime (UTC)	Latitude	Longitude	Location
1	300434065734810	2021-08-30 21:59	75.32028	-78.528565	Devon Island
2	300434065732760	2021-09-03 15:45	77.888889	-77.809167	Talbot Inlet

3.2.2 *Glacier Velocity Measurement Systems*

Five Cryologger glacier velocity measurement systems (GVMS) were planned for deployment during the 2021 Amundsen Expedition to monitor the daily changes in speed of several Canadian Arctic glaciers. The systems are powered by a low-cost multi-frequency global navigation satellite system (GNSS) receiver (u-blox ZED-F9P), GNSS antenna and open-source Arduino-based data logger (SparkFun Electronics). Power is provided by a 38 Ah gel cell battery (Deka Batteries) and 18 W solar panel (Voltaic Systems) and solar charge controller (Genasun GV-5). The systems are programmed turn on once daily and record data for 3 hours and are expected to achieve a GNSS position with an accuracy of <5 cm.

Two deployments were performed on Belcher Glacier on August 30, 2021 (Figure 3-5a). The lower GVMS (Figure 3-6a) was installed on a medial moraine (75.600803°N, 81.432948°W) and includes a temperature and relative humidity sensor housed in a radiation shield, as well as a hunting-style time-lapse camera programmed to record photos hourly. The camera faces an ablation stake drilled 1.97 m into the glacier (1.08 m exposed above the surface), marked with 5 cm increments to enable monitoring of surface melt rates. The upper GVMS (Figure 3-6b) was installed approximately 8 km further up the glacier (75.531148°N, 81.467183°W) on ice and did not include any additional equipment. A third deployment on Southeast Glacier 2 on Devon Ice Cap was performed on September 4, 2021 (Figure 3-5b). Due to external time constraints on the CCGS *Amundsen*, it was not possible to deploy the remaining two systems on Croker Bay Glacier, Devon Island, as had been originally planned.

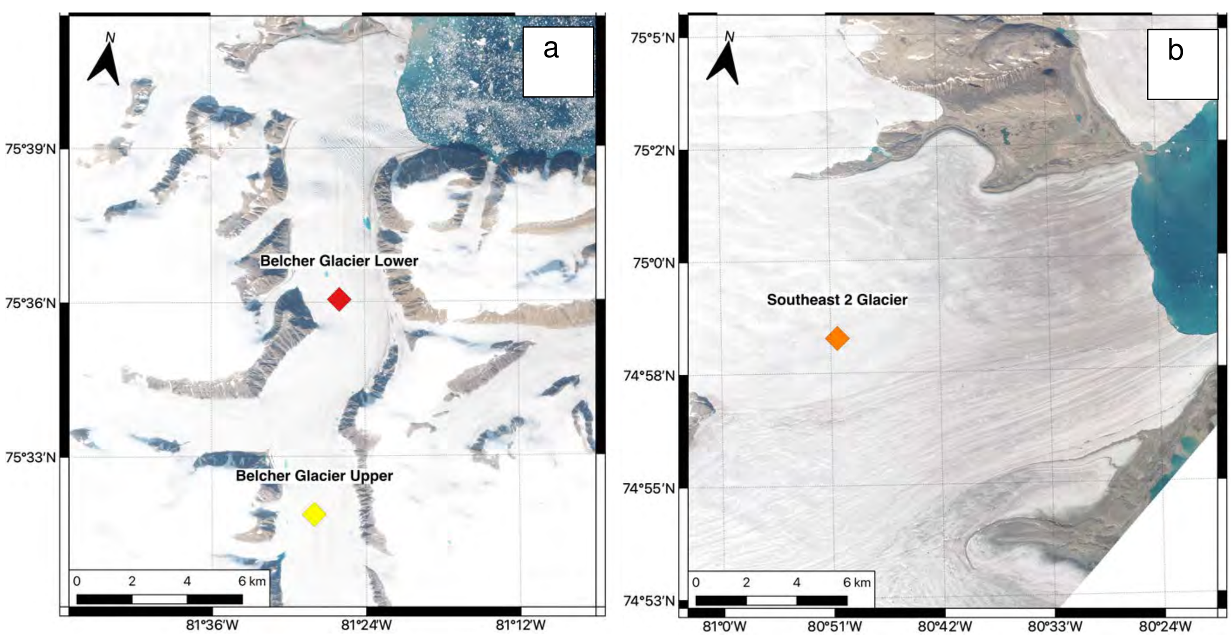

Figure 3-5: Map of Devon Island glacier velocity measurement system (GVMS) deployments: (a) Belcher Glacier, August 30, 2021; (b) Southeast 2 Glacier, September 4, 2021.

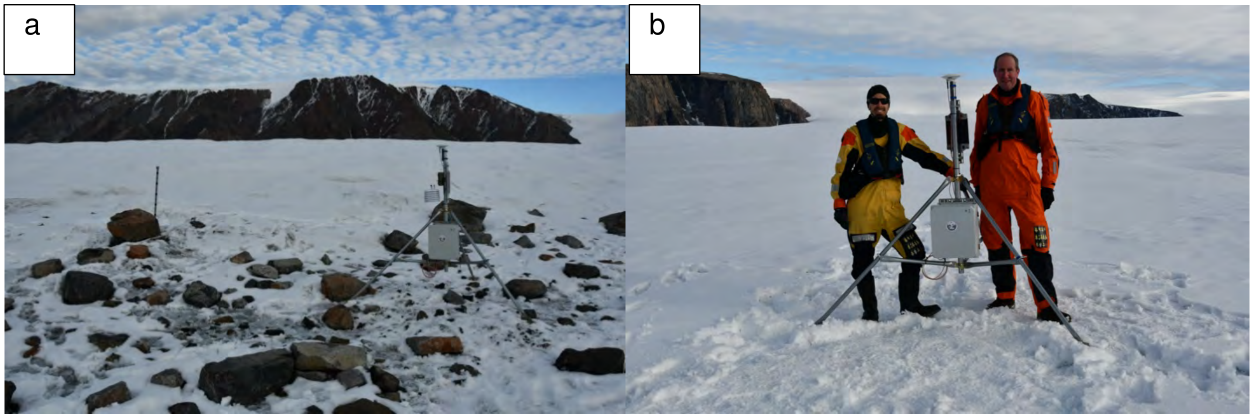

Figure 3-6: Glacier velocity measurement systems deployed on Belcher Glacier, August 30, 2021: (a) Lower station; (b) Upper station.

Table 3-3: Summary of Cryologger glacier velocity measurement system deployments during Leg 3 of the 2021 Amundsen Expedition.

ID	Datetime (UTC)	Latitude	Longitude	Location
1	2021-08-30 20:45	75.600803	-81.432948	Belcher Glacier Lower
2	2021-08-30 19:30	75.531148	-81.467183	Belcher Glacier Upper
3	2021-09-04 20:30	74.972361	-80.840889	Southeast 2 Glacier

0.1.1 *Glacier Mass Balance Measurements*

To assist Parks Canada with their glacier monitoring program, operations were planned on Penny Ice Cap in Auyuittuq National Park and Aktineq Glacier in Sirmilik National Park to perform maintenance on existing glacier mass balance ablation stake networks. This work was to include measuring, re-drilling, and installing a number of ablation stakes on the glaciers. Unfortunately, due to poor weather (Penny Ice Cap) and external constraints on the duration of the 2021 Amundsen Expedition (Aktineq Glacier), it was not possible to conduct this work.

3.2.3 *Oceanographic Buoy Deployments*

Two oceanographic buoys (MetOcean) were deployed from the CCGS *Amundsen* on behalf of the Meteorological Service of Canada (MSC). The buoys were deployed from the stern of the ship while under transit in northern Baffin Bay (Figure 3-7), on the transit between Thule and Manson Icefield. The role of these buoys is to provide Canada's support of the METAREAs program and to fill the gap in atmospheric observations for weather forecasters and modelers. METAREAs are geographical sea regions defined for the purpose of coordinating the transmission of meteorological Maritime Safety Information, in the form of marine weather forecasts and warnings, to mariners navigating international and territorial waters. As a participating member of the International Maritime Organization, Canada has been mandated to be the issuing meteorological information authority for METAREA XVII and XVIII.

Figure 3-7: MetOcean iSVP buoy deployments from the CCGS *Amundsen* during Leg 3 of the 2021 Amundsen Expedition, August 31, 2021.

3.2.4 *Deployment of timelapse cameras and weather station*

On September 3rd, a helicopter flight was made to Talbot Inlet with the intention of installing two timelapse cameras (to monitor iceberg calving and drift), and a small weather station (Hobo temperature and relative humidity sensor in a radiation shield), on a nunatak between Trinity and Wykeham Glaciers. However, upon arrival at the field site it was covered in fog, so the stations were instead installed on the summit of a peak on Easter Island at 77.831417°N, 77.83825°W, near the head of Talbot Inlet (Figure 3-8).

Figure 3-8: Timelapse cameras installed on Easter Island, September 3rd, 2021.

3.3 **Preliminary Results**

3.3.1 *Iceberg Drift Tracking Beacons*

All 12 iceberg drift tracking beacons have successfully transmitted their position and sensor data on an hourly basis since deployment. An initial analysis of the drift tracks from 3 Cryologger beacons deployed on icebergs off the coast of southern Baffin Island (Figure 3-2a) revealed remarkably varied drift patterns and speeds, despite the icebergs having been located relatively near (<90 km) to one another. In the first several days of deployment, beacon #1 (Figure 3-9a) travelled approximately 75 km to the southeast, beacon #3 (Figure 3-9b) travelled over 100 km to the north, while beacon #4 (Figure 3-9c) ended up 20 km to the south of its initial position, after having conducted a 15 km loop to the west and north. Notably, all three beacons recorded the same looping pattern as the icebergs drifted, which had a period of approximately 12 hours, or semidiurnally. These looping motions can be caused by Coriolis Force or inertial or tidal currents, which are characterized by clockwise rotary motion with periods equal to or less than the inertial or tidal periods (El-Tahan et al., 1983).

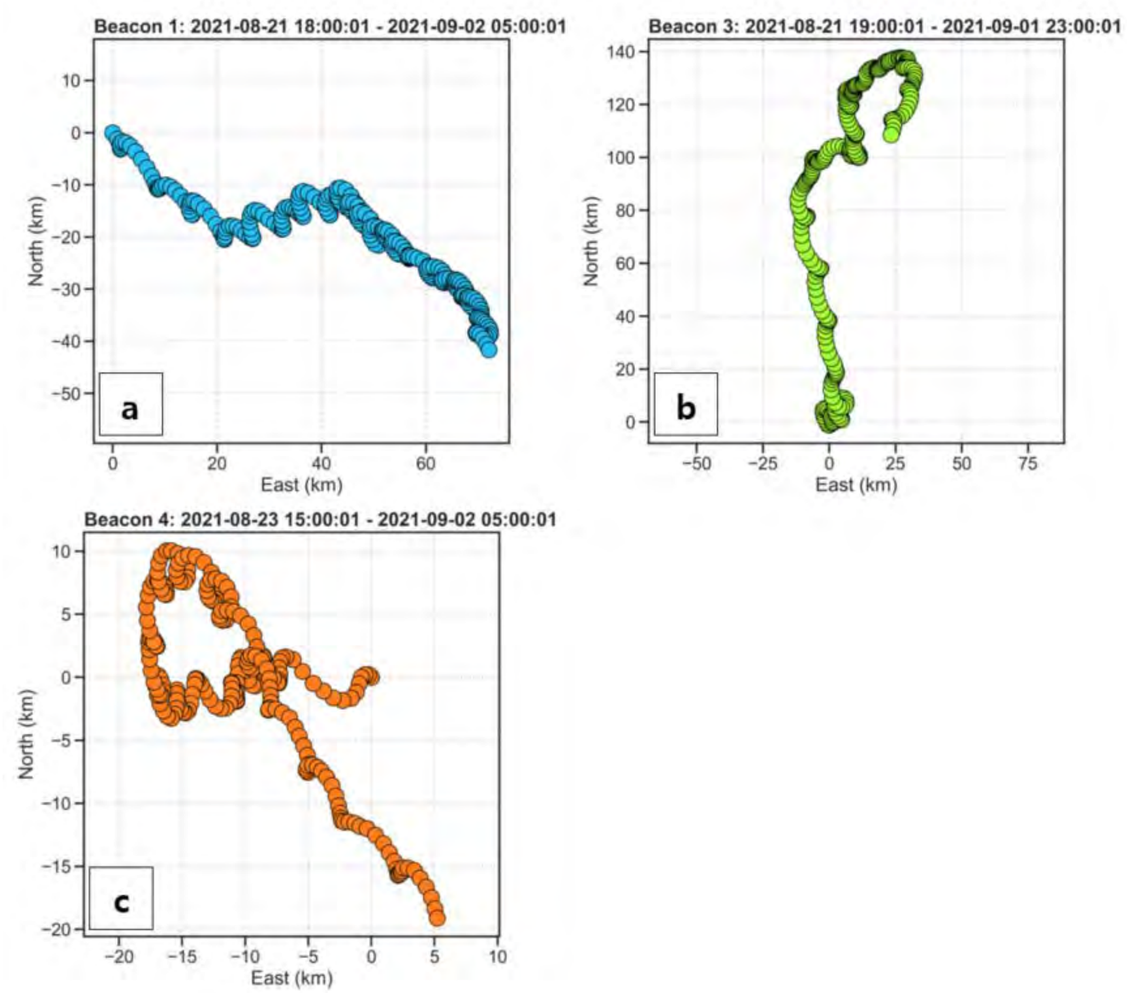

Figure 3-9: Initial plots of iceberg distance travelled between August 22nd and September 2nd, 2021, measured by Cryologger beacons: (a) #1; (b) #3; (c) #4. Deployments were made off the southern coast of Baffin Island, Nunavut.

An analysis of the speeds the beacons experienced during the first several days of deployment (Figure 3-10) indicated that the icebergs generally travelled at speeds between 0.5 – 1.5 km/h. However, beacon #3 was observed to move as fast as 3.5 km/h for short periods of time. The looping motions experienced by the icebergs is evident in the iceberg speeds, as shown by the regular sinusoidal pattern of increasing and decreasing speed in Figure 3-10. Interestingly, the changes in speeds between the 3 beacons were not always in phase. In fact, beacons #1 and #4 appeared to loop 4 times per day, compared to the more regular semidiurnal signal from beacon #3.

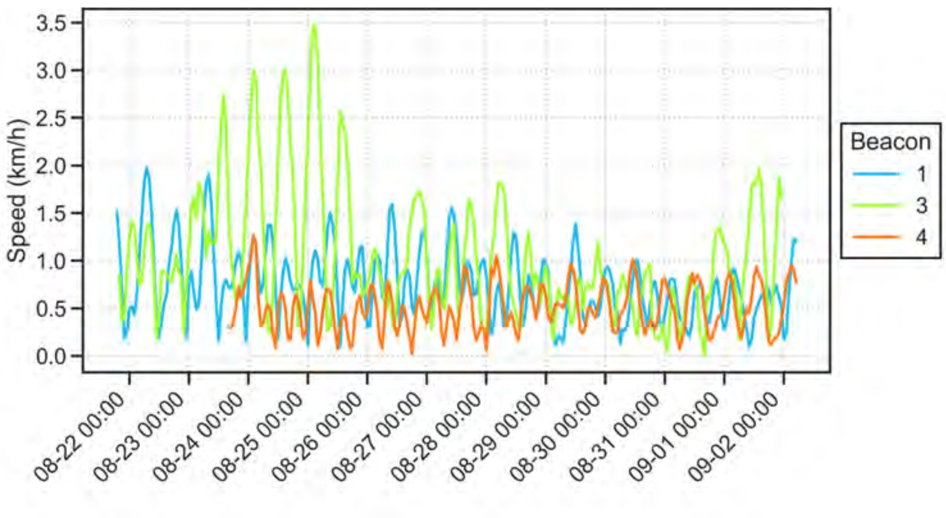

Figure 3-10: Initial plots of icebergs speeds (km/h) between August 22nd and September 2nd, 2021, as measured by 3 Cryologger drift tracking beacons deployed off the southern coast of Baffin Island, Nunavut.

3.4 Recommendations

We would have to liked to receive a detailed schedule of the ship's activities planned for Leg 3 prior to boarding, so that we could better plan out the location and timing of our iceberg and glacier deployments.

3.5 References

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4 Dark Edge Physics

Project leaders: Peter Sutherland[1,3] (peter.sutherland@ifremer.fr), Dany Dumont[2] (dany_dumont@uqar.ca)

Cruise participants – Leg 5: Peter Sutherland[1,3], Dany Dumont[2], Paul Nicot[2], Éloïse Pelletier[2], Emma Bent[1], Hugo Sellet[1]

[1]Laboratoire d'Océanographie Physique et Spatiale (LOPS), IFREMER Centre de Bretagne, Plouzane, France
[2]Institut des sciences de la mer de Rimouski, UQAR, Rimouski, QC.
[3]University of British Columbia, Vancouver, BC.

4.1 Introduction and Objectives

Changes in the Earth's climate are amplified in the Arctic, and evidence suggests that the Arctic sea ice is linked by complicated feedbacks to climate patterns at lower latitudes. Sea ice in the Arctic Ocean has been decreasing both in thickness and extent since the beginning of the satellite era, and that trend is expected to continue for the next several decades. This means that open-water, as opposed to under-ice, oceanographic processes are becoming increasingly important for Arctic dynamics, although the effects of those changes remain uncertain. One of the most fundamental differences between the open and ice-covered oceans is the presence of surface waves. As the area of open water in the Arctic increases, well-known fetch relations show that a more energetic wave field will develop. Recent work has shown that during periods of low ice cover, large waves do indeed develop in the Arctic Ocean. Our contribution to the Dark Edge campaign focussed on the small-scale dynamical processes associated with this emerging wave climate. The goal being to develop the physical intuition and predictive capacity needed to understand the implications for the Arctic basin. The effects of the wave field that were studied during this campaign were primarily:

1. Modification of the ice-formation processes.
2. Modification of the upper-ocean turbulence and mixing by wave and wind forcing.
3. Breakup of existing sea ice by wave mechanical forcing.

The objective was to observe these processes as they occurred in-situ during the autumn freeze-up period. This will then allow us to respond to questions like:

1. What is the relative importance of Langmuir turbulence vs convection for setting the mixed-layer processes? Is wave-driven turbulence indeed able to suppress surface ice formation as expected? Are our theoretical and modelling results able to accurately predict real conditions in this regard?
2. How does ice formation, and the associated strong atmospheric instability, affect wave growth and upper-ocean turbulence? Are those changes related to the presence of frazil ice?
3. How is wave energy attenuated in the marginal ice zone (MIZ)? Does the wave forcing set ice thickness as predicted by Sutherland and Dumont (JPO, 2018)? What is the resulting FSD and thickness distribution?
4. How do waves set the floe size distribution when they breakup existing ice?

In addition to these specific scientific questions, this cruise was also used as a testbed for new technologies and methods:

1. An unmanned remotely-controlled catamaran (Flux-Cat) designed to measure atmosphere-ocean gas, heat and momentum fluxes was specifically built for this cruise. It

is equipped with two pulse-coherent acoustic Doppler current profilers (ADCP), water temperature loggers, high frequency CO_2 probes and sonic anemometers and cameras above and below the water surface. This was used for the time specifically to characterize Langmuir turbulence in freezing conditions during frazil formation.

2. An ice canoe to access thin and high deformed sea ice in the MIZ. It is equipped with a Geonics EM38-MK2 conductivity meter that measures ice thickness. The canoe is used for various operations including: deployment and recovery of wave buoys, manual ice thickness measurements, UAV flights, CTD profiles, ice and water sampling.
3. Unmanned aerial vehicles (UAV) equipped with a high-resolution visible camera. It is used for many purposes including to map ice morphological properties such as floe size, measure wave-induced orbital motion or ice drift and estimate ice freeboard elevation

4.2 Methodology

The Physics team's contributions to Dark Edge were largely a series of process studies as detailed in the following sections.

4.2.1 *DE110 - 2021-10-12 - Open water, off-ice wind.*

The first deployment consisted of an array of buoys extending approximately 150km due south from a patch of combined newly formed and multi-year ice located to the east of Coburg Island (see deployment chart below). The objective of this deployment was to observe the spatial evolution of the surface wave field and momentum flux in off-ice wind conditions.

Instrumentation deployed included:

- Sofar Spotter wave buoys (SPOT-0555, SPOT-0556, SPOT-0554, SPOT-0557, SPOT-0530). Measurements: wave spectra, water temperature. Note that only SPOT-0530 was recovered so raw data is unavailable from the remaining buoys.
- FLAME lite buoys (FL1, FL2). Measurements: 3-axis wind velocity, surface water temperature.

The FLAME-lite and SPOT-0530 were recovered approx. 2021-10-15 0300 Z.

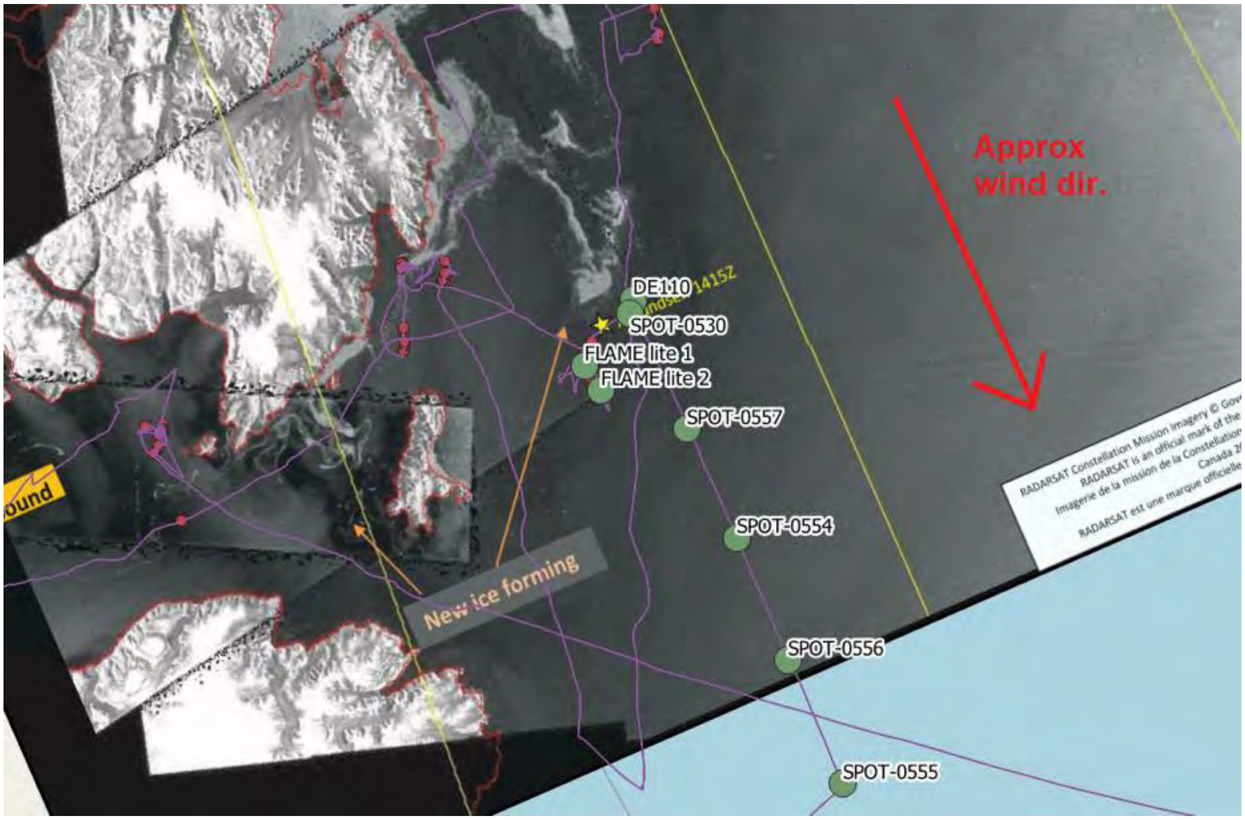

Figure 4-1: Launch locations of five Spotter wave and the two FLAME-lite buoys before reaching DE110

4.2.2 *DE120-130 - 2021-10-13 2021-10-14 - Between Ellesmere Island and Coburg Island*

To our knowledge, this was the first time an ice canoe was deployed from an icebreaker and used in the Arctic. The original plan was to carry out a classic MIZ experiment where we measure waves as they propagate in sea ice while measuring and characterizing sea ice morphology. This was not possible as waves were disorganized, large icebergs scattered the incoming long waves, the ice was mostly thick floes of old ice and the ice concentration was lower than 0.7. Nonetheless, this first mission was the perfect occasion to test 1) canoe deployment from the ship, which was done in open water and using the accommodation stairway, 2) bear watch protocols, 3) ice thickness measurement using the Geonics and possible interferences with our gear and other equipment in the canoe, 4) navigation of the Beluga #40, a fiber-glass and wood canoe with a Epaulard hull owned by Guy Gilbert, and 5) recovery. Overall, thanks to the Coast Guard crew, this mission was a success and paved the way for other successful missions.

Figure 4-2: Measuring ice thickness using a meter stick and drill holes to calibrate the measurements made with EM38 conductivity meter. Wave buoys were deployed to measure the motion and deformation of the floe due to waves. Special thanks to Achim Randelhoff who came with us and complemented the crew formed by Hugo Sellet, Éloïse Pelletier, Peter Sutherland and Dany Dumont. Paul Nicot was the UAV pilot onboard the *Amundsen.*

4.2.3 *DE310 - 2021-10-16 - Nares strait*

The Nares Strait deployment was characterized by a clear MIZ in the SW-NE direction (see Figure 4-3) with approximately N winds and swell from the S. A strong along-edge drift carried ice and equipment towards the SW. Instruments deployed:

- Wave buoy SPOT-0541. Measurements: wave spectra, water temperature.
- FLAME lite (FL1 + T-chain). Measurements: 3-axis wind velocity, surface water temperature, water temperature to 70m.
- Flux-Cat operated in up-down wind transects extending approximately 500m from the ice edge. Measurements: Near surface currents and turbulence (Nortek ADCP), wind velocity, relative humidity, air temperature, down-welling radiation (300-3000nm), note: do to inability for the cat to face the wind, the Irgason flux measurements are likely unusable

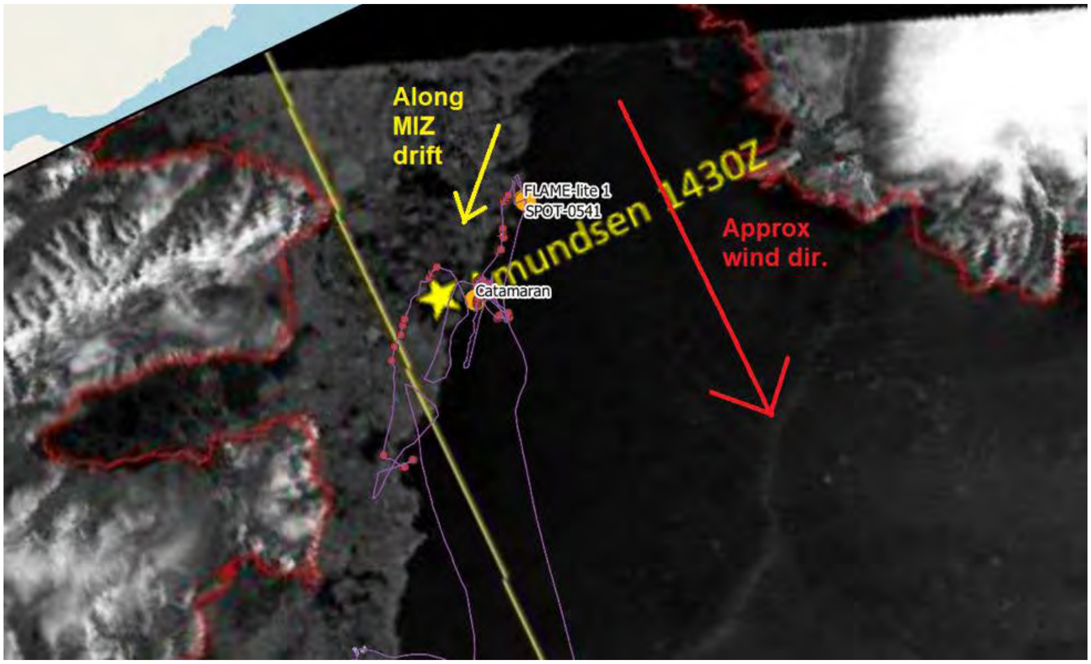

Figure 4-3: Configuration of DE310 Physics deployment. The along-ice drift advected the wave and FLAME-lite buoys in the SW direction, meaning that when the catamaran was deployed, it was in the vicinity of the drifting buoys.

4.2.4 *DE320 - 2021-10-17 - Nares Strait MIZ*

DE320 was a in the marginal ice, in rather calm wind and wave conditions. The canoe was deployed mainly to characterize the floe size and thickness distribution of a large floe of level ice that was broken-up by waves probably during the previous 24 to 36 hours. Analysis of past weather conditions and ice drift will help determine when it most probably occurred, as well as what type this ice was (old landfast ice, a melted old level ice floe or ice that was formed during this season in the pays days or weeks and drifted towards the MIZ).

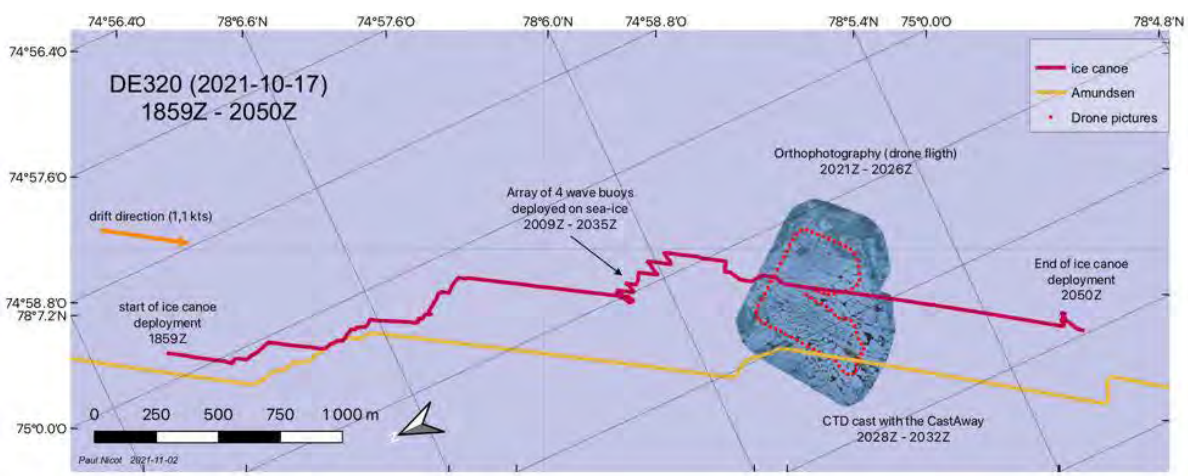

Figure 4-4: Canoe operations at station DE320. Crew members: Emma Bent, Paul Nicot, Éloïse Pelletier, Peter Sutherland and Dany Dumont

4.2.5 *DE330 - 2021-10-18 - Active MIZ, SW of Nares strait*

DE330 was a waves-in-MIZ experiment. An array of buoys was deployed extending from open water approximately 7km into a broken MIZ. The objective of this deployment was to observe wave attenuation in sea ice and to relate that attenuation to ice characteristics (e.g. FSD, ice thickness) and under-ice turbulence. Instruments deployed included:

- Sofar wave buoys (SPOT-0541, contd. from DE 310, SPOT-0522 (not recovered), SPOT-0530, SPOT-0533, SPOT-0141). Measurements: wave spectra, water temperature.
- SKIB High-resolution wave in ice buoys (WB4, + 2 others). Measurements: 3-axis acceleration, rotation, magnetic field, GPS position.
- FLAME lite (FL1 + T-chain, contd. from DE 310) deployed in open water. Measurements: 3-axis wind velocity, surface water temperature, water temperature to 70m.
- Aquadopp HR profiler buoy. Measurements: TKE dissipation under ice.
- UAV imagery. Measurements: ice maps, stereo imagery, ice PIV.

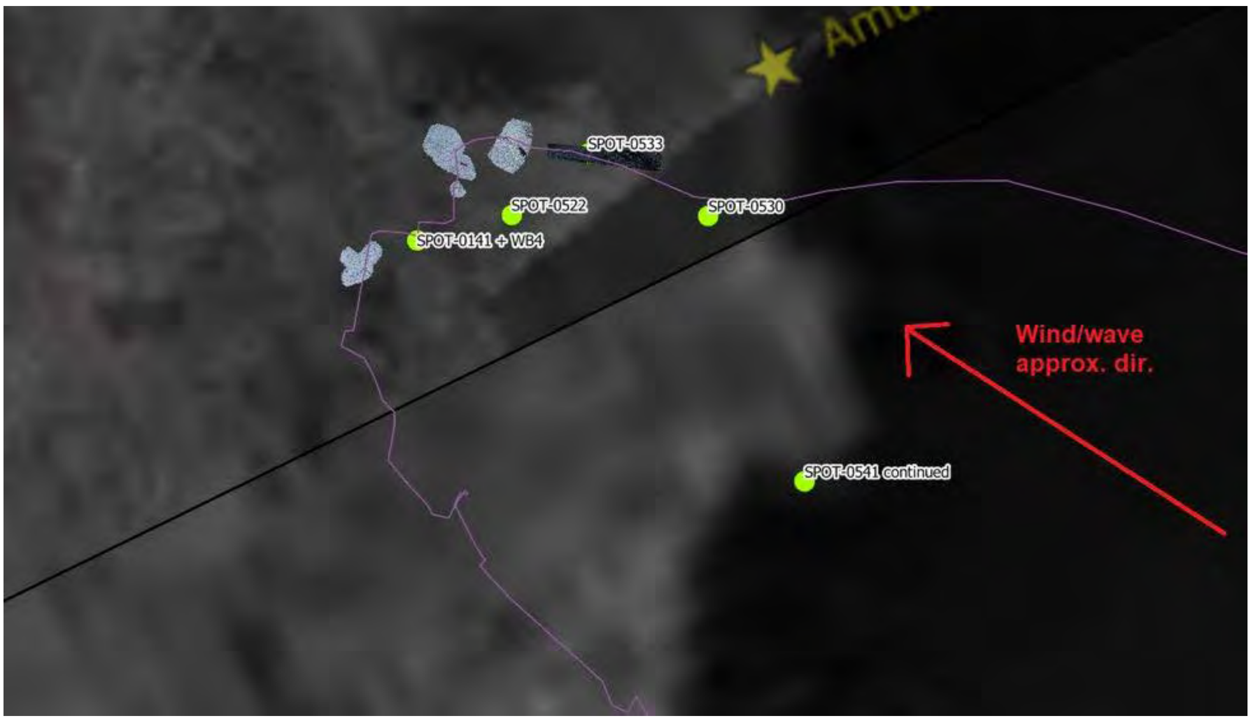

Figure 4-5: Geographical configuration of deployment DE330. A line of wave buoys was deployed from the outer MIZ extending approximately 7km into the MIZ. Note that the MIZ was highly dynamic and neither of the two SAR images in the background were taken at precisely the same time as the deployment or each other.

4.2.6 *DE410 - 2021-10-20 - Central Jones sound*

DE410 was deployed in open water to study ice formation processes. Wave buoys were deployed in a 70km line along the axis of Jones Sound. Station DE410 was conducted at the end of that line. Deployed instrumentation included:

- Sofar wave buoys (SPOT-0530, SPOT-0533, SPOT-0111, SPOT-0141, SPOT-0534 (continued from DE130 after being caught on an iceberg). Measurements: wave spectra, water temperature.
- FLAME lite (FL1 + T-chain, contd. from DE 310) deployed in open water. Measurements: 3-axis wind velocity, surface water temperature, water temperature to 70m.
-

Figure 4-6: Deployment pattern of buoys for station DE410 in Jones Sound

4.2.7 *DE420 - 2021-10-21 - Central Jones Sound*

DE420 was conducted in central Jones Sound and was a Flux-Cat deployment. The catamaran was operated in cross-wind transects as ice crystals forming on the sea surface were mixed downwards by Langmuir-like circulations and ultimately melted. The objective was to observe precisely that.

- Flux-Cat operated in cross-wind transects extending approximately 500m per leg. Measurements: Near surface currents and turbulence (Nortek ADCP), wind velocity, relative humidity, air temperature, down-welling radiation (300-3000nm), 3-axis wind velocity, high frequency humidity and CO_2.

4.2.8 *DE430 - 2021-10-22 - Small Bay in Jones Sound*

DE430 was an experiment designed to follow the freeze-up of open-water leads in a small (approx. 30km x 30 km) bay in NE Jones sound. One FLAME-lite buoy with thermistor chain was deployed in an open-water lead and left to rest for approximately 24-hours. It was then recovered frozen in approximately 10cm ice, having drifted outside of the bay. Deployed:

- FLAME lite (FL1 + T-chain, contd. from DE 310) deployed in open water. Measurements: 3-axis wind velocity, surface water temperature, water temperature to 70m.

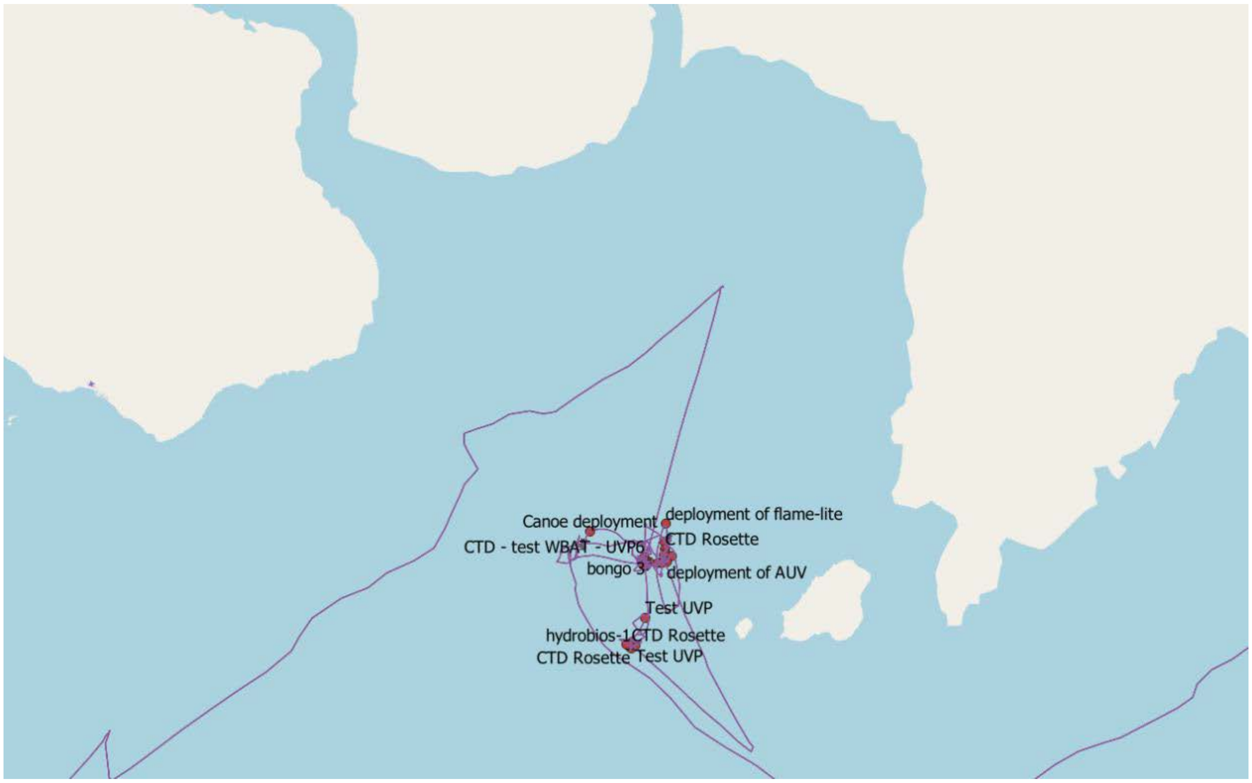

Figure 4-7: Activities surrounding DE430 including the deployment of FLAME lite FL1.

4.2.9 *DE440 - 2021-10-22 - Small Bay in Jones Sound*

DE440 remained in the same embayment shown in the above (DE430) figure. The two major activities for the Physics group were:

1) Deployment of the Flux-Cat in a rapidly-evolving lead system. The catamaran was deployed in an approximately 200 x 200m, initially square lead. Over the following hours, the leads
2) Deployment of the ice-canoe to measure ice thickness and breakup

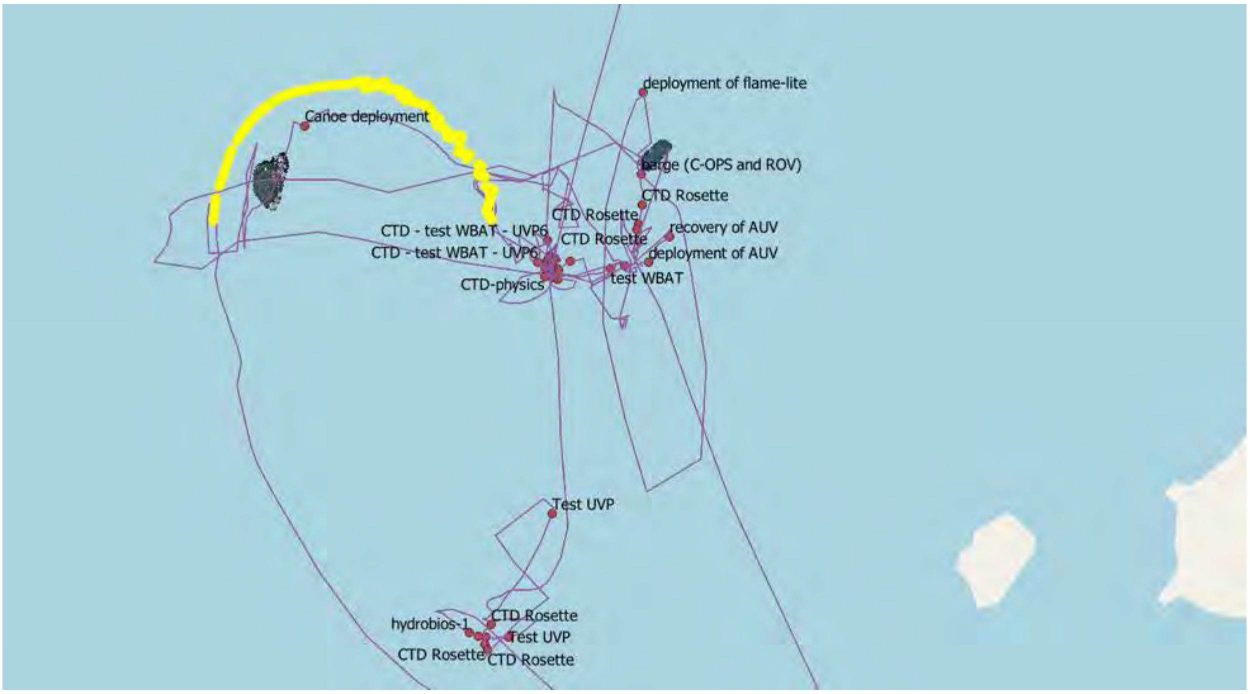

Figure 4-8: Ship (purple) and Flux-Cat (yellow) GPS tracks, superimposed with orthophotos and other operations at station DE440.

4.3 Preliminary Results

The majority of the data produced by our group requires extensive post-processing in order to produce science-grade results. Nonetheless, here are a few preliminary results that indicate that we do indeed have data that will be usable for helping to answer many of the initial questions that motivated our participation.

4.3.1 *Wind forcing and upper-ocean response*

FLAMElite buoys allow us to measure concurrent wind stress and upper ocean temperature evolution. The wind is measured using a 3-axis sonic anemometer sampling at 50Hz coupled to an inertial motion unit (IMU), and the ocean thermal response is measured using temperature sensors mounted both on the buoy and on a 70-m thermistor chain suspended below the buoy. Figure 4-9 illustrates a gradual cooling of the surface mixed layer, expected to be due to upward surface heat flux.

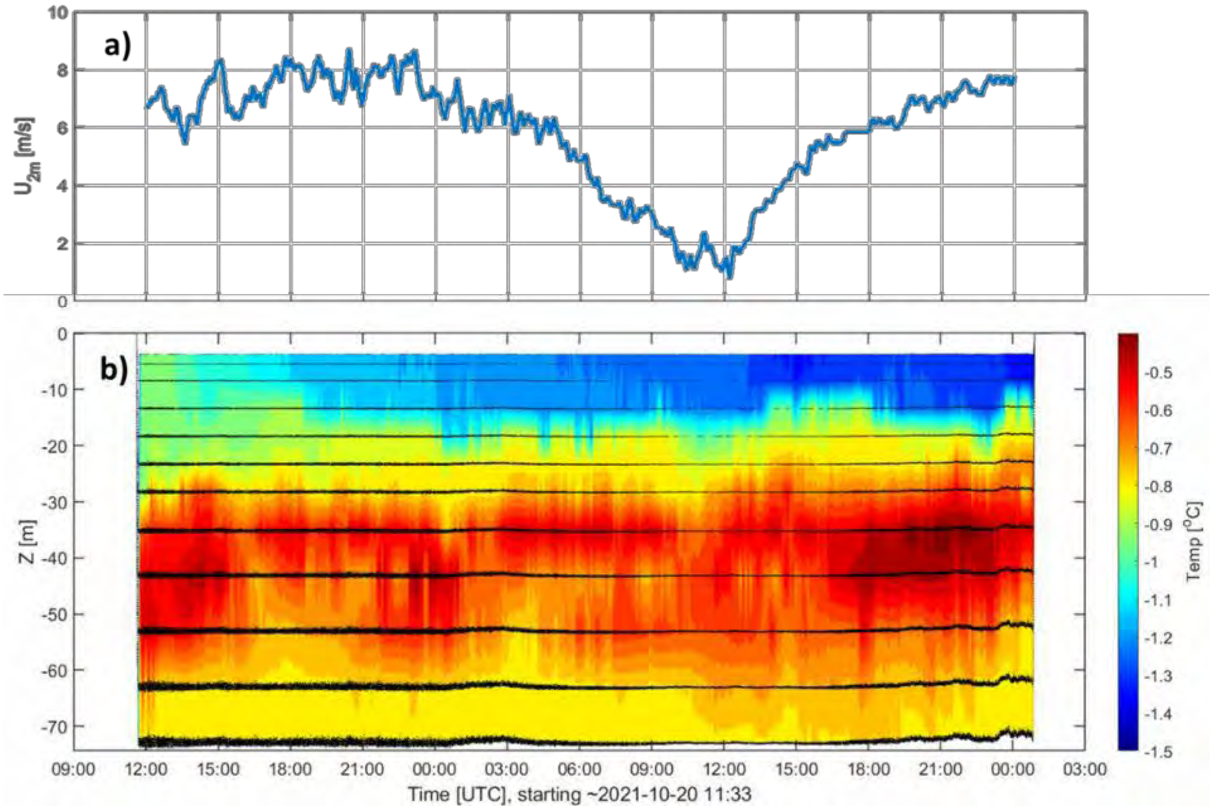

Figure 4-9: Surface wind forcing and upper-ocean evolution during DE410. Panel a) is wind speed at 2m altitude, averaged over 5-min sampling periods. Panel b) is water temperature (colour shading) sampled at 2Hz. The black lines indicate the approximate depth of the thermistor sensors.

4.3.2 *Surface wave field evolution*

Numerous wave buoys were deployed in various configurations (see above) during Dark Edge. These buoys recorded significant wave height as well as the first five Fourier coefficients, including wave frequency energy spectra.

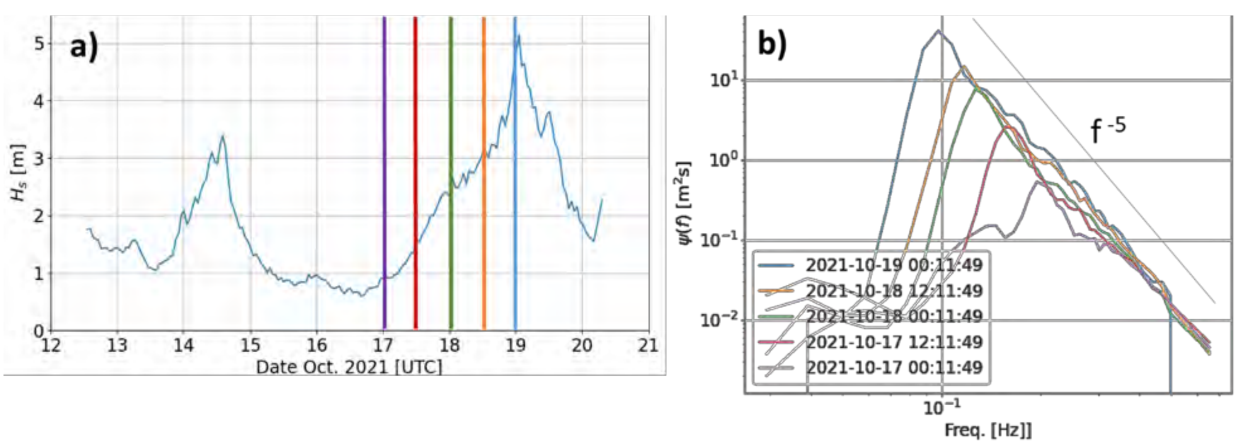

Figure 4-10: Wave evolution in northern Baffin Bay. The data were recorded by Sofar buoy SPOT-0557 from its deployment on 2021-10-12 until the exhaustion of its batteries on 2021-10-21. Panel a) gives significant wave height, Hs, for 30-minute average periods sampled once per hour. Panel b) gives wave energy spectra every 12 hours over the duration of a wind event. The colours of the spectra in panel b) correspond to the times of the vertical coloured lines in panel a).

4.3.3 *In situ ice observation*

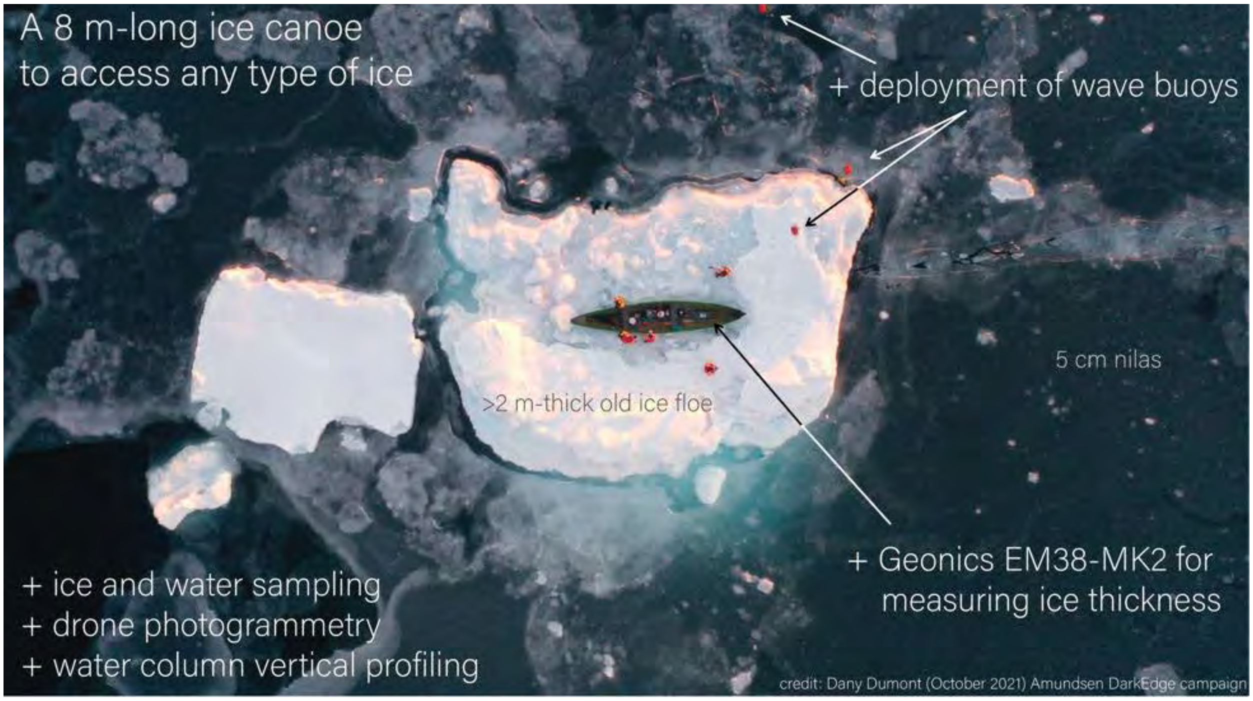

Figure 4-11: Ice canoe and its crew of 5 members on an old ice floe more than 2 m-thick surrounded by 5-cm nilas that is rafted here and there. Three wave buoys are deployed on the nilas and on the ice floe to measure waves produced by the CCGS *Amundsen* steaming at a speed of ~16 kt nearby. The picture is taken by a UAV piloted from the floe, which was also used to film the wave-induced break-up.

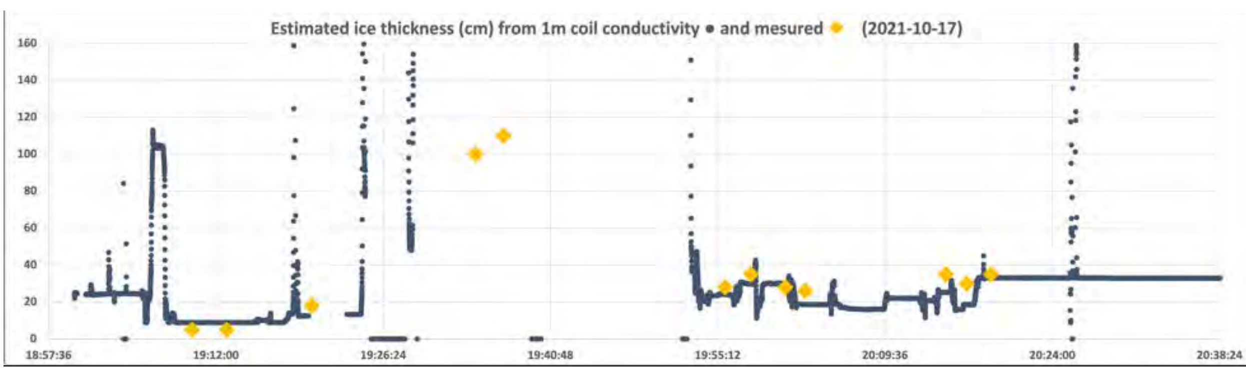

Figure 4-12: Ice thickness (cm) along the canoe track obtained from conductivity measurements from the Geonics EM38-MK2, based on a calibration done in Rimouski in April 2021. Yellow dots are measurements made with a meter stick

5 River Sampling

Project leaders: Jean-Carlos Montero-Serrano[1] (jeancarlos_monteroserrano@uqar.ca), Kristina Brown[2], Brent Else[3]

Participants – Leg 3: Jean-Carlos Montero-Serrano[1], Amélie Desmarais[4], Pascal Guillot[4], Thibaud Dezutter[4], Daniel Amirault[4].

Participant – Leg 4: Maria-Emilia Rodriguez-Cuicas[1]

[1]Institut des sciences de la mer de Rimouski, Université du Québec à Rimouski, Rimouski, QC
[2]Fisheries and Oceans Canada, Institute of Ocean Sciences, Sidney, BC
[3]Department of Geography, University of Calgary, Calgary, AB
[4]Amundsen Science, Université Laval, Quebec City, QC

5.1 Introduction

River and glacier samples were collected from some rivers and glaciers at proximity to ArcticNet stations. River samples are part of the Canadian Arctic Archipelago Rivers Program (CAA-RP) led by Kristina Brown from DFO. Rivers and sediment samples were also collected for Liisa Jantunen lab (ArcticNet Contaminants program). As rivers and glaciogenic sediments represent a key source end-members to the adjacent ocean and marine/glacial sediment regions, understanding the source constituents provides context for observed oceanographic and sedimentological signatures elsewhere within the CAA.

The 2021 Amundsen Expedition represented the sixth year of opportunistic river sampling, and provided an opportunity to extend the geographical extent of previous sampling areas and observations. Proposed field sites were selected based on proximity to key ArcticNet coring and rosette stations and ease of access by helicopter. Most of the stations were sampled previously during the last ArcticNet expeditions, and were known to be suitable for sampling. However, the final sampling locations were selected on board in collaboration between the Amundsen's commanding officer, helicopter pilot, chief scientist, Jean-Carlos Montero-Serrano (leg 3) and Maria-Emilia Rodriguez-Cuicas (leg 4) based on factors such as weather, schedule and remaining helicopter budget.

5.2 Methodology

A total of 10 rivers on a total of 15 were sampled (Table 5-1). At each site, the helicopter landed in an area close to the river mouth, in a region of strong ocean-ward flow (Figure 5-1, left). At each site, river water was collected using pre-rinsed 60-ml syringes (Fisher Scientific) filled directly from just below the water's surface, facing upstream. Samples were filtered through a 0.22-µm Sterivex cartridge (Millipore) into triply rinsed containers and sealed for storage onboard. River water samples were obtained for the determination of dissolved organic carbon (DOC), dissolved major ions (Ca, Mg, Na, K, Cl, SO4) and minor ions (Sr, Ba), stable isotopes of water (oxygen-18 and deuterium), and dissolved nutrient concentrations (Nitrate, Phosphate, Silicate). At the same time, 1 bag (Ziploc) of bedload sediments were sampled in the periphery of the rivers with a spatula. In addition, one glacial till sample was sampled on Belcher glacier moraine (Table 5-1). For this 1 bag (Ziploc) of sediment was collected with a shovel near glacier (Figure 5-1, right). This operation has been done in collaboration with the glacier team (Luke Copland and Adam Garbo).

Because CAA rivers and glacier drain watersheds and bedrock characterized by different geological provinces and petrographic signatures, bedloads and glaciogenic sediments will be used to characterize the mineralogical and geochemical signatures of sediment sources, and thus, to unravel detrital sediment provenance and transport processes within the CAA.

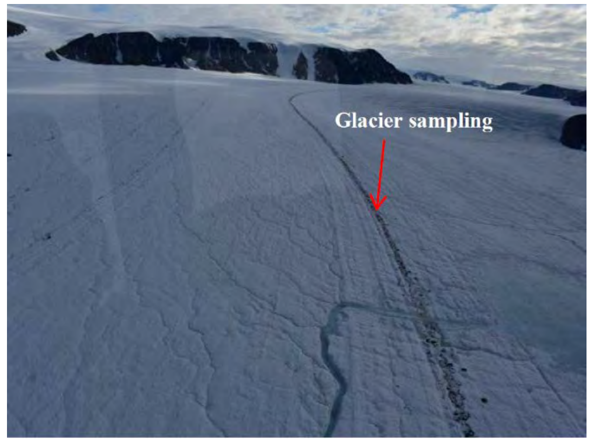

Figure 5-1: (Left) Example of sampling at a river site – Perry River, (right) Localisation of the glacial till sample collected on the medial moraine of the Belcher Glacier.

Table 5-1: Summary of rivers and glacier stations sampled during the 2021 ArcticNet expedition. At each site, samples for biogeochemical (DIC, N2O isotope concentration, DOC, 18-oxgen isotope, CH4/N2O, nutrient concentration, contaminants/ microplastics) measurements and sedimentological analyses were obtained

River ID	Leg	Name	Latitude (°N)	Longitude (°W)	Time (local)	Date
AMD2103-R1	3	Owl River	66.9517	-64.7025	07:52	26/08/2021
AMD2103-Belcher	3	Belcher Glacier	75.6008	-81.4336	15:28	30/08/2021
AMD2103-R2	3	RIDIE River	75.2167	-79.5536	17:53	04/09/2021
AMD2103-R3	3	Cunningham Mountains/Glacier	74.6050	-80.3681	19:25	04/09/2021
AMD2103-R4	3	Glacier River	73.6539	-78.6456	14:24	05/09/2021
AMD2103-R5	3	Charles York River	73.7147	-82.7889	15:55	05/09/2021
AMD2103-R6	3	Maxwell Bay	74.5156	-88.4322	13:29	07/09/2021
AMD2103-R7	3	Blaney Bay	74.5633	-87.2703	14:16	07/09/2021
AMD2104-R1	4	Simpson river	67.6747	-100.5377	11:13	13/09/2021
AMD2104-R2	4	Perry river	67.6811	-102.2113	13:16	13/09/2021
AMD2104-R3	4	Tree river	67.6241	-111.9161	14:20	15/09/2021

5.3 Preliminary results

Not preliminary results are available at the moment. All of sediment samples collected in this expedition will be analyzed in detail in the laboratory at ISMER-UQAR to achieve the objectives of our project. Briefly, sediment samples will be studied for their mineralogical, geochemical (elemental and isotopic), microfossil (benthic and planktonic foraminifera), palynological (dinoflagellate cysts), magnetic, and siliciclastic grain-size signatures. Such studies will to provide foundational information to improving our understanding on the past and present seafloor sediment composition.

5.4 Acknowledgements

We are very pleased with this year's river sampling program. We thank everyone who contributed to making it a successful campaign. In particular, the river sampling team of Leg 4 would like to extend a very big thank you to: 1) Amundsen Science for securing the necessary flight and Parks Canada Permits; and 2) Claude Dion (Leg 4 helicopter pilot), for his willingness and eagerness to fly and for his involvement in the planning and execution of each excursion.

6 Northern Contaminants Program: Assessing Persistent Organic Pollutants (POPs) and Microplastics (MPs) in the Canadian Arctic

Project leaders: Dr Liisa Jantunen[1, 2] (liisa.jantunen@ec.gc.ca)

Cruise participants – Leg 3 : Sarah Bernstein[1]

Cruise participants – Leg 4 : Rachelle Robitaille[1] (rrobitaille052@gmail.com), Maxime Dubeau (dubeaumax@yahoo.ca) [3]

[1] *Centre of Atmospheric Research Experiments (CARE), Environment and Climate Change Canada, Egbert, ON.*
[2] *Department of Earth Sciences, University of Toronto, Toronto, ON.*
[3] *Environmental Technology Program, Nunavut Arctic College, Iqaluit, NU.*

6.1 Introduction and Objectives

The Arctic is known to be an important sink for POPs, as the temperature gradient and prevailing winds bring POPs from emissions sources in warmer climates (mainly North America, Europe, and Asia) to their final resting place in the Arctic. This is of significant concern since POPs partition to organic matter and in the Arctic landscape much of the organic matter is found in the animals which make up a significant part of the diets of the residents. Research in the Canadian Arctic has been critical to developing an understanding of how long-range transport occurs, in crafting legislation (such as Canada's Chemical's Management Plan or Europe's REACH program), and international agreements (such as the Stockholm Convention), which regulate the usage and production of POPs. Further, anthropogenic particles (MPs) have been documented in every region studied, including pristine remote environments such as the Arctic region. Recent research by our team (Adams et al., 2021; Athey et al., 2020; Huntington et al., 2020) have shown that Canadian Arctic sediments have comparable levels of anthropogenic cellulose microfibres as sediments in Lake Ontario nearby Toronto. Anthropogenic microparticles are of concern due to mounting evidence of bioaccumulation and biomagnification in marine ecosystems, while the consequences to animal and human health are not well understood.

The Amundsen has long been an essential platform for our research, and we were lucky to collect samples from and participate in the cruise, allowing us to maintain a unique historical dataset. We intend to continue monitoring the emerging MPs and POPs, as well as new and emerging compounds with POP-like behaviour, to observe their trends over time and any impacts from climate change on the behaviour of MPs and POPs in the Canadian Arctic. Our objectives on this leg were to collect water, air, zooplankton and sediment samples in the Canadian Arctic to measure levels of compounds of concern, as well as new and emerging contaminants.

6.2 Methodology

The sampling team was present during Leg 3 and 4. of the 2021 Expedition. Sampling stations of Leg 3 are not presented, but the methodology was the same.

During Leg 4, we obtained 10 different types of samples for two teams (Table 6-1). We were also able to deploy a passive water sampling cage onto a mooring. Please note the sample IDs described in the following section are continuations of the samples taken from the previous leg.

Table 6-1: Overview of sampling by the contaminants group in leg 4. HV: high volume water sample (~100L); MP: microplastic sample; Sed: sediment; Zoop: zooplankton; PFC: perfluorocarbon water sample; OPE: organophosphate ester water sample; UMN water/sed/zoop: University of Minnesota sample; Pass. Cage: passive sampling cage (deployed on mooring).

Leg	Station/ Location	Date	HV	OPE	PFC	Sed	Air	Zoop	MP	UMN Water	UMN Sed	UMN Zoop	Pass. Cage
4	310E	12-Sep-21		1	1	1		2	1	1	1	2	
4	312	12-Sep-21				1		1			1	1	
4	QMG4/Y3	13-Sep-21				1		1		1			
4	Simpson River	13-Sep-21							1				
4	QMW	13-Sep-21							1				
4	314	14-Sep-21	1	1	2	1							
4	316	15-Sep-21				1		1			1	1	
4	C012	15-Sep-21							1				
4	Tree River	15-Sep-21								1			
4	403	16-Sep-21				1		1			1	1	
4	C014	16-Sep-21							1	1			
4	405/C015	17-Sep-21	1			1		1					
4	407	18-Sep-21		1		1		1		1	1	1	
4	409	18-Sep-21		1		1			1				
4	414	19-Sep-21		1		1		1					
4	420	19-Sep-21		1		1		1				1	
4	416	19-Sep-21							1				
4	PCB-04	20-Sep-21							1				
4	PCB-03	21-Sep-21		1									
4	434	22-Sep-21		1		1		1	1	1	1	1	
4	PCB-06	22-Sep-21				1							
4	PCB-07	22-Sep-21				1							
4	435	23-Sep-21		1		1			1				
4	421	23-Sep-21				2		2			1	2	
4	546	24-Sep-21		1	2					1			
4	PCB-22	25-Sep-21							1				
4	PCB-20	26-Sep-21				2							

4	482	27-Sep-21				1		1				1	
4	PCB-16	27-Sep-21		1	1					1	1		
4	476	27-Sep-21				1		1	2		1	1	
4	480	27-Sep-21							1				
4	470	28-Sep-21						2	1			2	
4	PCB-12	30-Sep-21							1				
4	516	3-Oct-21		1	1	1		2	1	1		2	
4	518N	3-Oct-21				1					1		
4	518	4-Oct-21		1									
On-going							6(+1Blk)						1

6.2.1 *High Volume Water Samples*

High volume of surface water (100L) was collected through bucketing over the side of the ship. The water is brought back to the aft-lab and pumped through a prepacked column containing a filter and a sorbent material (XAD) at 150mL/min (Figure 6-1). The column is stored in the aft temperature-controlled room (~4°C) for later laboratory extraction and analysis. Originally, high volume samples were not supposed to be collected on this leg. However, there was pre-cleaned sorbent material left over from Leg 3. Since metal columns were limited, we transferred some of the samples from their columns into clean amber bottles and refilled the column with pre-cleaned sorbent material. Only 2 samples were collected this leg and 1 blank due to limited supplies.

Table 6-2: High volume sample locations during Leg 4, 2021.

#	Sample ID	Date	Station	Latitude	Longitude
1	AN21 HV 6	14-Sep-21	314	68.97301	-105.48303
2	AN21 HV 7	17-Sep-21	405/C015	70.66539	-122.63433
3	AN21 HV Blk2	5-Oct-21	n/a	n/a	n/a

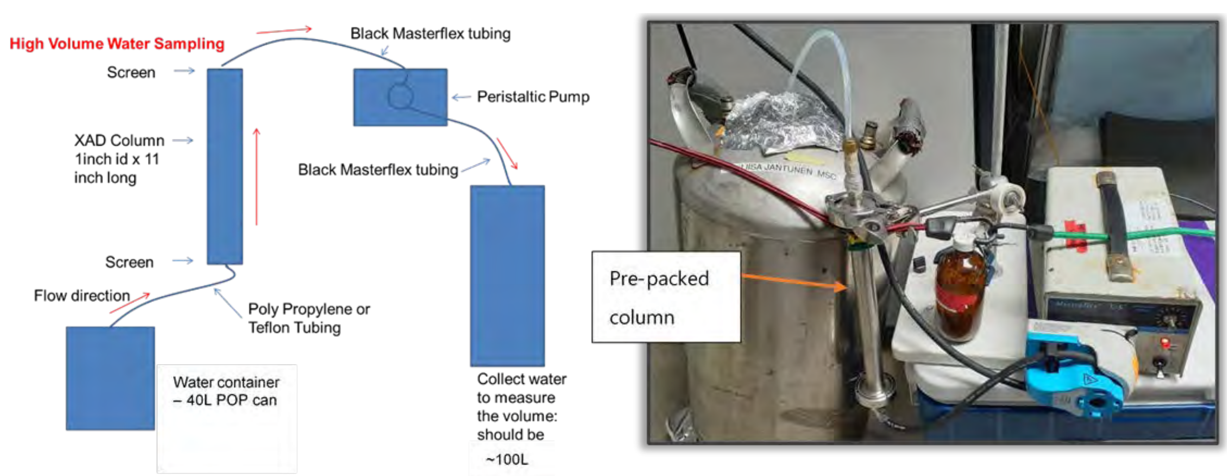

Figure 6-1: High volume sampling via XAD filtration; schematic and set up

6.2.2 *OPE and PFC Water samples*

Low volumes of water were collected to analyze for perfluorocarbons (PFCs) and organophosphate esters (OPEs). These compounds require different storage and analysis methods compared to the high-volume water samples. To analyze OPEs, we collected 1L of surface water in Boston amber bottles with the rosette or through bucketing. For PFCs, we collected 1L at the surface and at the thermocline (when possible) in polypropylene bottles with the rosette. Low volume water samples are stored in the aft temperature-controlled laboratory (~4°C). 13 OPE samples and 1 blank were collected, as well as 7 PFC samples, on this leg of the cruise.

Table 6-3: OPE sample locations during Leg 4, 2021

#	Sample ID	Date	Station	Latitude	Longitude
1	AN21 OPE9	12-Sep-21	310E	71.29208	-97.6986
2	AN21 OPE10	14-Sep-21	314	68.97301	-105.483
3	AN21 OPE11	18-Sep21	407	71.00462	126.0883
4	AN21 OPE12	18-Sep-21	409	71.86753	-125.865
5	AN21 OPE13	19-Sep-21	414	71.42113	-127.379
6	AN21 OPE14	19-Sep-21	420	71.05342	-128.516
7	AN21 OPE15	21-Sep-21	PCB-03	72.11472	131.0402
8	AN21 OPE16	22-Sep-21	434	70.1772	-133.555
9	AN21 OPE17	23-Sep-21	435	71.07752	-133.778
10	AN21 OPE18	24-Sep-21	546	71.74321	-133.947
11	AN21 OPE Blk2	24-Sep-21	n/a	n/a	n/a
12	AN21 OPE19	27-Sep-21	PCB-16	70.50358	-138.834
13	AN21 OPE20	3-Oct-21	516	74.84684	-121.418
14	AN21 OPE21	4-Oct-21	518	74.59714	-121.488

Table 6-4: PFC sample locations during Leg 4, 2021

#	Sample ID	Date	Station	Depth	Latitude	Longitude
1	AN21 PFC11	12-Sep-21	310E	Surface	71.29208	-97.6986
2	AN21 PFC12	14-Sep-21	314	Surface	68.97301	-105.483
3	AN21 PFC13	14-Sep-21	314	22m	68.97301	-105.483
4	AN21 PFC14	24-Sep-21	546	Surface	71.74321	-133.947
5	AN21 PFC15	24-Sep21	546	16m	71.74321	-133.947
6	AN21 PFC16	27-Sep-21	PCB-16	Surface	70.50358	-138.834
7	AN21 PFC17	3-Oct-21	516	Surface	74.84684	-121.418

6.2.3 *Sediment Sample ECCC*

Surface sediment samples were collected directly from the box core and stored in the freezer. These samples will be analyzed for both microplastics and contaminants. We were also able to collect samples from the multicorer when available at ~20m bellow surface. Since they are collected using a plastic coring tube, these sample will only be analyzed for contaminants. Many thanks to Andre, Maria and the CCGS crew for deploying the box corer! We would also like to thank the PeCaBeau team for letting us collect from their core samples when extra was available. We obtained a total of 23 sediment samples along with 2 blanks.

Table 6-5: Sediment sample locations during Leg 4, 2021

#	Sample ID	Date	Station	Depth	Latitude	Longitude
1	AN21 Sed16	12-Sep-21	310E	Surface	71.2916300	-97.7028105
2	AN21 Sed17	12-Sep-21	312	Surface	69.1701725	-100.7023320
3	AN21 Sed18	13-Sep-21	QMG4-Y3	Surface	68.4847867	-103.4307820
4	AN21 Sed19	14-Sep-21	314	Surface	68.9710957	-105.4759128
5	AN21 Sed20	15-Sep-21	316	Surface	68.3892803	-112.1200498
6	AN21 Sed21	16-Sep-21	403	Surface	70.0997908	-120.1119995
7	AN21 Sed22	17-Sep-21	404/C015	Surface	70.6640222	-122.6325753
8	AN21 Sed23	18-Sep-21	407	Surface	71.0017858	-126.0777067
9	AN21 Sed24	18-Sep-21	409	Surface	71.8680288	-125.8666743
10	AN21 Sed25	19-Sep-21	414	Surface	71.4217670	-127.3662463
11	AN21 Sed26	19-Sep-21	420	Surface	71.0503783	-128.5099833
12	AN21 Sed27	22-Sep-21	PCB-06	20-23cm	70.7625592	-131.4345507
13	AN21 Sed28	22-Sep-21	PCB-07	20cm	70.1792180	-133.5542715
14	AN21 Sed29	23-Sep-21	434	Surface	70.1792180	-133.5542715
15	AN21 Sed Blk2	23-Sep-21	n/a	n/a	n/a	n/a
16	AN21 Sed30	23-Sep-21	435	Surface	71.0782738	-133.7765443
17	AN21 Sed31a	24-Sep-21	421	Surface	71.4700498	-133.9090577
18	AN21 Sed31b	24-Sep-21	421	Surface	71.4700498	-133.9090577
19	AN21 Sed Blk3	26-Sep-21	n/a	n/a	n/a	n/a
20	AN21 Sed32	26-Sep-21	PCB-20	5-10cm	70.5498637	-139.8187033
21	AN21 Sed33	26-Sep-21	PCB-20	20-25cm	70.5498637	-139.8187033
22	AN21 Sed34	27-Sep-21	482	Surface	70.5243798	-139.3798400

#	Sample ID	Date	Station	Depth	Latitude	Longitude
23	AN21 Sed35	28-Sep-21	476	Surface	69.9835402	-138.6645670
24	AN21 Sed36	03-Oct-21	518N	Surface	74.6811807	-121.4490283
25	AN21 Sed37	03-Oct-21	516	Surface	74.8450627	-121.3895503

6.2.4 *Zooplankton and Benthic Samples – (i)ECCC and (ii)UMN*

Opportunistic zooplankton samples were collected for contaminant and microplastic analysis (ECCC), as well as for the University of Minnesota (UMN). Please refer to the method describe in Stern's group report. Many thanks to Cathrin Veenaas from the University of Manitoba (Gary Stern group) who speciated the samples! Also, thank you to Cyril, Jennifer, Felix and the CCSG crew for deploying the nets and collecting the bulk samples. We obtained zooplankton samples from a total of 20 nets along with 2 blanks.

Table 6-6: Zooplankton sample locations for each project (i., ECCC, ii., UMN) during Leg 4, 2021.

#	Station	Date	Tow	No. of species/samples collected	Latitude	Longitude
1	310E	12-Sep-21	Tucker	i. 1 ii. 1	71.2891090	-97.6748350
2	310E	12-Sep-21	Monster	i. 1 ii. 1	71.2909165	-97.6940035
3	312	12-Sep-21	Tucker	i. 7 ii. 3	69.1682607	-100.6827802
4	QMG4-Y3	13-Sep-21	Tucker	i. 1 ii. n/a	68.4803078	-103.4756138
5	316	15-Sep-21	Tucker	i. 5 ii. 6	68.3803483	-112.1386452
6	403	16-Sep-21	Tucker	i. 5 ii. 8	70.1096560	-120.1472140
7	405-C015	17-Sep-21	Monster	i. 5 ii. n/a	70.6628712	-122.6376192
8	407	18-Sep-21	Tucker	i. 1 ii. 9	71.0123537	-126.0908060
9	414	19-Sep-21	Tucker	i. 4 ii. n/a	71.0123537	-126.0908060
10	420	19-Sep-21	Monster	i. 1 ii. 6	71.0521787	-128.5140357
11	434	22-Sep-21	Tucker	i. 5 ii. 5	70.1719193	-133.5364913
13	421	23-Sep-21	Tucker	i. 4 ii. 4	71.4680262	-133.8982667
14	421	23-Sep-21	Monster	i. 1 ii. 5	71.4722252	-133.9132220
15	482	26-Sep-21	Monster	i. 5 ii. 4	70.5243328	-139.3752527
16	476	27-Sep-21	Monster	i. 4 ii. 4	69.9985468	-138.6285645
17	470	28-Sep-21	Tucker	i. 3 ii. 3	69.4240468	-137.9740488

18	470	28-Sep-21	Monster	i. 1 ii. 1	69.4325615	-137.9973043
19	516	2-Oct-21	Tucker	i. 5 ii. 8	74.8504515	-121.3851287
20	516	2-Oct-21	Monster	i. 1 ii. 1	74.8504515	-121.3851287

6.2.5 *Air Samples*

A pre-packed airhead consisting of a glass fibre filter, collecting particle phase contaminants, and a glass column 'sandwich' of polyurethane PUFF and XAD sorbent, to collect gas phase, is attached to a vacuum pump on a pole near the bow of the ship. Samples are run continuously for ~48 hours and then stored in the freezer until we can analyze them back at the Egbert facility (CARE). On this leg, we were able to collect 6 air samples and 1 blank. Most of the samples were collected near the end of the trip when there was more transit time between stations.

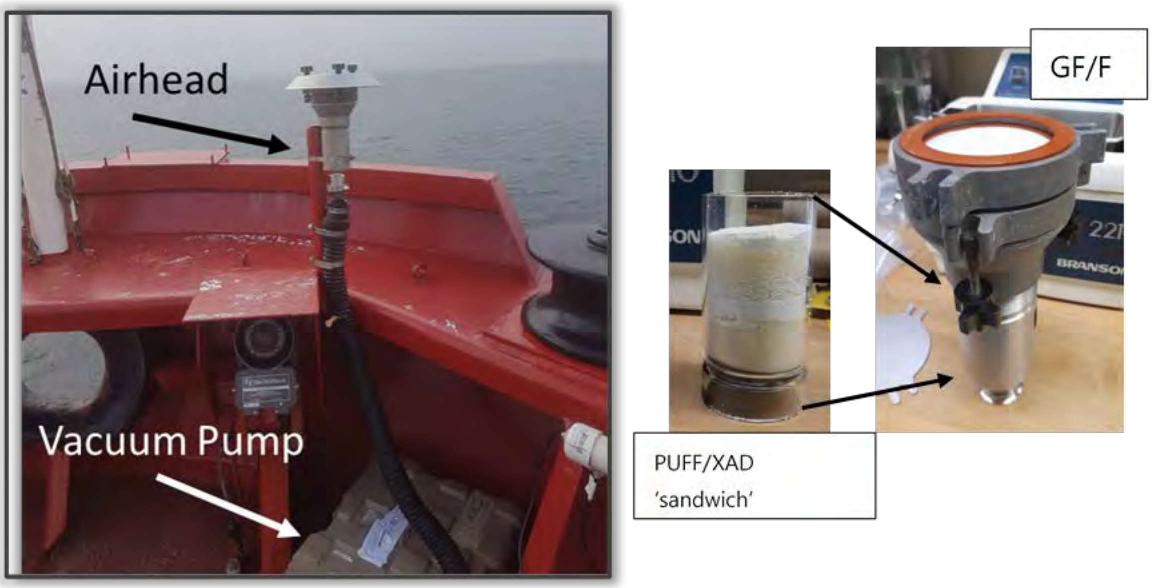

Figure 6-2: Air sampling setup and contents of air head; XAD glass column and glass fiber filter (GF/F).

Table 6-7: Air sample locations during Leg 4, 2021

#	Sample ID	Date	Duration	Latitude/Longitude Start	Finish
1	AN21 Air5	11-Sep-21	47hrs45min	72.1648522 -92.5402708	68.2463080 -101.6741063
2	AN21 Air6	20-Sep-21	48hrs00min	71.5174688 -130.3222695	70.3258213 -132.7103783
3	AN21 Air Blk1	24-Sep-21	n/a	n/a	n/a
4	AN21 Air7	24-Sep-21	42hrs50min	70.9959947 -135.7946953	70.5338303 -139.5568713
5	AN21 Air8	29-Sep-21	44hrs50min	70.5473710 -136.0083390	71.7414150 -133.9568012
6	AN21 Air9	1-Oct-21	47hrs50min	71.7413227 -133.9584402	74.9362307 -120.9770703
7	AN21 Air10	3-Oct-21	46hrs10min	75.0264867 -121.3789033	72.1035647 -119.1790318

6.2.6 *Microplastic Samples*

Microplastic water samples were collected via surface bucketing (40L). Additionally, the rosette team was very accommodating for letting us sample at the thermocline when bottles were available. These samples will allow us to see how microplastics may be distributed throughout the water column based on density. Thank you to Dylan and Christoph for accommodating this request. Moreover, 10L of river water samples were collected for MP filtering by Maria during her sampling operations. We are very grateful to her for collecting samples for us, thank you! Metal 'soda' cans are used for sample collection and then samples are pushed through a 10µm polycarbonate filter. The filters are carefully folded and placed in 40mL vials to be stored until they are brought back to CARE and/or University of Toronto.

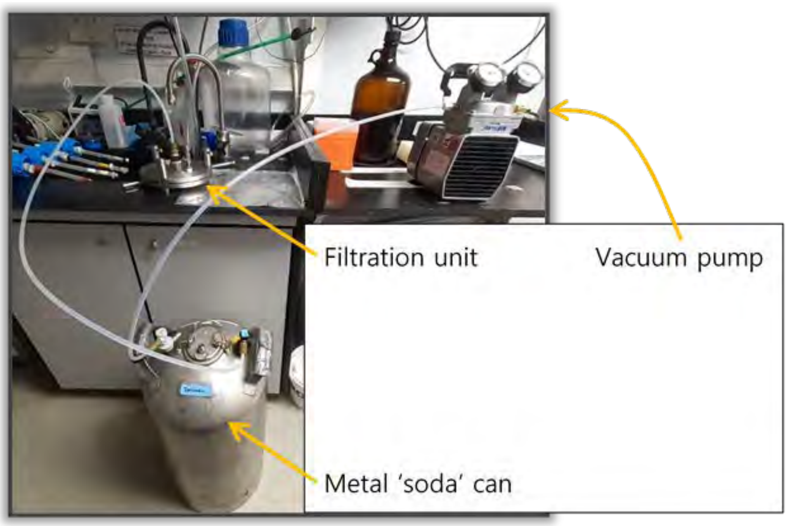

Figure 6-3: Microplastic water filtration setup; 40L metal 'soda' can is pressurized and water flows through filtration unit, filtered at 10µm, and then water is discarded

Table 6-8: Microplastic sample locations during Leg 4, 2021.

#	Sample ID	Date	Station	Depth	Volume	Latitude	Longitude
1	AN21 MP25	12-Sep-21	310E	Surface	40L	71.2921213	-97.7010922
2	AN21 MP26	13-Sep-21	Simpson River	Surface	10L	67°40'29"	100°37'32
3	AN21 MP27	13-Sep-21	QMW	Surface	28.7L	68.7086905	-104.6672445
4	AN21 MP28	15-Sep-21	C012	Surface	40L	68.3287980	-110.2715123
5	AN21 MP29	16-Sep-21	C014	Surface	40L	69.6187973	-118.6030375
6	AN21 MP30	18-Sep-21	409	Surface	40L	71.8689083	-125.8674438
7	AN21 MP31	19-Sep-21	416	Surface	40L	71.2921557	-127.7695548
8	AN21 MP32	20-Sep-21	PCB-04	Surface	40L	71.4531578	-131.2966642
9	AN21 MP33	22-Sep-21	434	Surface	40L	70.1764730	-133.5551227
10	AN21 MP34	23-Sep-21	435	Surface	40L	71.0780790	-133.7768753
11	AN21 MP35	25-Sep-21	PCB-22	Surface	40L	70.1209882	-140.2486018
12	AN21 MP36	25-Sep-21	PCB-22	27m	40L	70.1209882	-140.2486018
13	AN21 MP37	27-Sep-21	480	Surface	40L	70.3344708	-139.1501477
14	AN21 MP38	27-Sep-21	476	Surface	40L	69.9984652	-138.6280930
15	AN21 MP39	27-Sep-21	476	16m	40L	69.9984652	-138.6280930
16	AN21 MP40	28-Sep-21	470	Surface	40L	69.4311347	-137.9989305
17	AN21 MP41	30-Sep-21	PCB-12	Surface	40L	70.2798583	-135.7756210
18	AN21 MP42	03-Oct-21	516	Surface	40L	74.8451157	-121.4122178
19	AN21 MP Blk3	21-Sep-21	n/a	n/a	10L	n/a	n/a
20	AN21 MP Blk4	4-Oct-21	n/a	n/a	3L	n/a	n/a

6.2.7 *UMN Water samples and UMN Sed samples*

Surface water was collected and filtered (4L) through a Solid Phase Extraction cartridge for PFAS analysis at the University of Minnesota. The water was pumped through the cartridge at ~4ml/min (filtration time for one sample: >16hrs). A total of 9 samples were taken along with 1 blank.

Table 6-9: UMN PFAS sample locations during Leg 4, 2021

#	Sample ID	Date	Station	Latitude	Longitude
1	UMN21 water11	12-Sep-21	310E	71.29208	-97.6986
2	UMN21 water12	13-Sep-21	QMG4/Y3	68.48701	-103.4523
3	UMN21 water13	15-Sep-21	Tree River	111°54'58"	111°54'58"
4	UMN21 water14	16-Sep-21	C014	69.62974	-118.60035
5	UMN21 water15	18-Sep-21	407	71.00462	126.0883
6	UMN21 water16	22-Sep-21	434	70.1772	-133.555
7	UMN21 water17	24-Sep-21	546	71.74321	-133.947
8	UMN21 water18	27-Sep-21	PCB-16	70.50358	-138.834
9	UMN21 water19	3-Oct-21	516	74.8451157	-121.4122
10	UMN21 Blank 3	4-Oct-21	n/a	n/a	n/a

Table 6-10: UMN PFAS sample locations during Leg 4, 2021

#	Sample ID	Date	Station	Latitude	Longitude
1	UMN21 sed14	12-Sep-21	310E	71.29163	-97.70281
2	UMN21 sed15	12-Sep-21	312	69.170173	-100.7023
3	UMN21 sed16	15-Sep-21	316	68.38928	-112.12005
4	UMN21 sed17	16-Sep-21	403	70.0997908	-120.1119995
5	UMN21 sed18	18-Sep-21	407	71.0017858	-126.0777067
6	UMN21 sed19	23-Sep-21	434	70.179218	-133.5542715
7	UMN21 sed20	24-Sep-21	421	71.4700498	-133.9090577
8	UMN21 sed21	27-Sep-21	482	70.5243798	-139.37984
9	UMN21 sed22	28-Sep-21	476	69.9835402	-138.664567
10	UMN21 sed23	3-Oct-21	518N	74.6811807	-121.4490283

6.3 Preliminary Results

Samples are not analyzed on-board. Air, sediment, low- and high-volume water, and zooplankton samples will be analyzed at the Environment and Climate Change Canada's Centre for Atmospheric Research Experiments in Egbert, ON, as well as the University of Toronto, for target and non-target analysis of POPs and MP abundance in all media. Zooplankton and benthic samples will be sent to Dr. Gary Stern at University of Manitoba's Centre for Earth Observation Science. Sediment, zooplankton, and water (SPE) cartridges will be sent for PFAS (bioaccumulation) analysis to Drs. Rosie Rushing, Mary Kosuth, and Matt Simcik, at the University of Minnesota.

6.4 References

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7 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 3: Brent Else[1], Gina Nickoloff[1]

Cruise participants – Leg 4: Gina Nickoloff[1]

[1] Centre for Earth Observation Science, University of Manitoba, Winnipeg, MB, Canada
[2] Department of Geography, University of Calgary, Calgary, AB, Canada

7.1 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:

1) Develop a process-level understanding of the exchange of CO2 between the sea surface and atmosphere.
2) Continue a long-term monitoring program to understand how the Arctic marine CO2 sink may be evolving as a result of climate change.
3) Identify areas at-risk for anthropogenically-induced ocean acidification, and collect long-term data to track rates of ocean acidification in the Arctic.

7.2 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 pCO2 system in the engine room.

Table 7-1: 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

7.2.1 *Micrometeorology Tower*

The micrometeorological tower located on the front deck of the Amundsen 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). A pressure sensor on the tower failed, and the ship's AVOS system will need to be used to replace that data stream. 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.

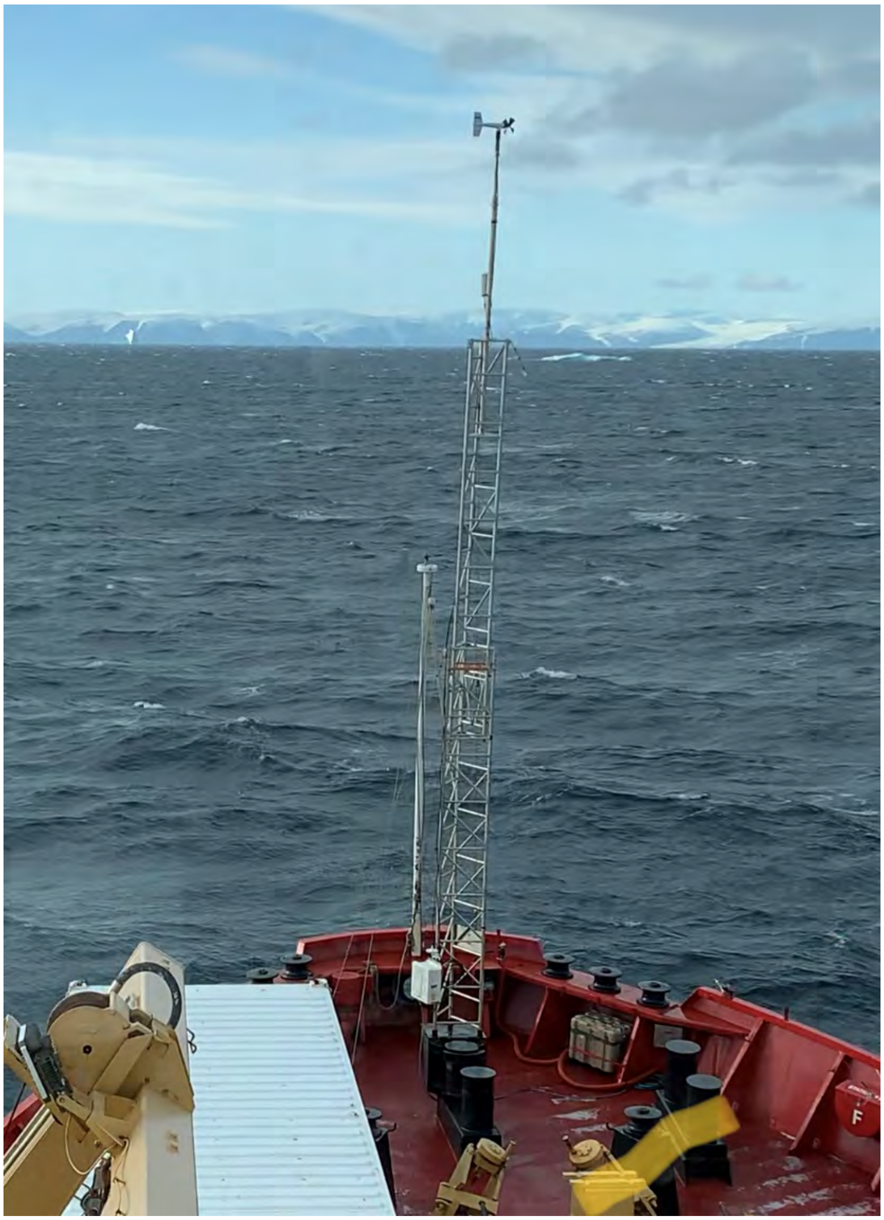

Figure 7-1: Micrometeorology tower

7.2.2 *Underway pCO2 System*

A General Oceanics 8050 pCO2 system was installed on the ship to measure dissolved CO2 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. 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 7-2: General Oceanics 8050 pCO2 system

7.2.3 *Water Sampling*

Discrete samples for Dissolved Inorganic Carbon (DIC)/Total Alkalinity (TA), and O18 were taken from the rosette. Stations sampled during Leg 4 are listed in Table 7-2.

DIC/TA samples were taken following the protocol developed by Dickson *et al* (2007). Samples will be analyzed at the Institute of Ocean Sciences. O18 samples were taken in 2 mL bottles and stored at 4°C. Samples will be analyzed at the University of Calgary.

Table 7-2: Station sampled during Leg 4

Cruise	Station	Region	Sample Type	Niskin	Nominal Depth [m]
AN21-04	C002	Parry Channel	rosette	1	400
AN21-04	C002	Parry Channel	rosette	2	300
AN21-04	C002	Parry Channel	rosette	4	200
AN21-04	C002	Parry Channel	rosette	6	150
AN21-04	C002	Parry Channel	rosette	8	100
AN21-04	C002	Parry Channel	rosette	12	50
AN21-04	C002	Parry Channel	rosette	18	20
AN21-04	C002	Parry Channel	rosette	20	7
AN21-04	C002	Parry Channel	rosette	21	2
AN21-04	C003	Prince Regent Inlet	rosette	2	300
AN21-04	C003	Prince Regent Inlet	rosette	5	200
AN21-04	C003	Prince Regent Inlet	rosette	9	150
AN21-04	C003	Prince Regent Inlet	rosette	11	100
AN21-04	C003	Prince Regent Inlet	rosette	18	50
AN21-04	C003	Prince Regent Inlet	rosette	17	20
AN21-04	C003	Prince Regent Inlet	rosette	23	7
AN21-04	C003	Prince Regent Inlet	rosette	24	2
AN21-04	C004	Peel Sound	rosette	1	400
AN21-04	C004	Peel Sound	rosette	2	300
AN21-04	C004	Peel Sound	rosette	5	180
AN21-04	C004	Peel Sound	rosette	8	140
AN21-04	C004	Peel Sound	rosette	10	100
AN21-04	C004	Peel Sound	rosette	14	50
AN21-04	C004	Peel Sound	rosette	16	30
AN21-04	C004	Peel Sound	rosette	7	7
AN21-04	C004	Peel Sound	rosette	24	2
AN21-04	C009	Larsen Sound	rosette	2	180
AN21-04	C009	Larsen Sound	rosette	4	140
AN21-04	C009	Larsen Sound	rosette	6	100
AN21-04	C009	Larsen Sound	rosette	10	50
AN21-04	C009	Larsen Sound	rosette	15	38
AN21-04	C009	Larsen Sound	rosette	21	7
AN21-04	C009	Larsen Sound	rosette	24	2
AN21-04	312	Larsen Sound	rosette	2	50
AN21-04	312	Larsen Sound	rosette	7	14
AN21-04	312	Larsen Sound	rosette	13	7
AN21-04	312	Larsen Sound	rosette	17	2
AN21-04	QMGM / C010	Queen Maud Gulf	rosette	1	90
AN21-04	QMGM / C010	Queen Maud Gulf	rosette	13	37.5
AN21-04	QMGM / C010	Queen Maud Gulf	rosette	14	20
AN21-04	QMGM / C010	Queen Maud Gulf	rosette	16	7

	QMGM /				
AN21-04	C010	Queen Maud Gulf	rosette	20	2
AN21-04	C011	Dease Strait	rosette	2	100
AN21-04	C011	Dease Strait	rosette	6	50
AN21-04	C011	Dease Strait	rosette	11	30
AN21-04	C011	Dease Strait	rosette	14	7
AN21-04	C011	Dease Strait	rosette	16	2
AN21-04	C012	Coronation Gulf	rosette	1	285
AN21-04	C012	Coronation Gulf	rosette	4	180
AN21-04	C012	Coronation Gulf	rosette	7	140
AN21-04	C012	Coronation Gulf	rosette	9	100
AN21-04	C012	Coronation Gulf	rosette	13	50
AN21-04	C012	Coronation Gulf	rosette	19	23
AN21-04	C012	Coronation Gulf	rosette	22	7
AN21-04	C012	Coronation Gulf	rosette	23	2
AN21-04	C013	Union Strait	rosette	1	83
AN21-04	C013	Union Strait	rosette	10	40
AN21-04	C013	Union Strait	rosette	12	20
AN21-04	C013	Union Strait	rosette	14	7
AN21-04	C013	Union Strait	rosette	15	2
AN21-04	C014	Amundsen Gulf	rosette	2	500
AN21-04	C014	Amundsen Gulf	rosette	3	400
AN21-04	C014	Amundsen Gulf	rosette	4	300
AN21-04	C014	Amundsen Gulf	rosette	7	180
AN21-04	C014	Amundsen Gulf	rosette	9	140
AN21-04	C014	Amundsen Gulf	rosette	11	100
AN21-04	C014	Amundsen Gulf	rosette	20	42
AN21-04	C014	Amundsen Gulf	rosette	21	20
AN21-04	C014	Amundsen Gulf	rosette	23	7
AN21-04	C014	Amundsen Gulf	rosette	24	2
AN21-04	405 / C015	Amundsen Gulf/ Trough	rosette	2	500
AN21-04	405 / C015	Amundsen Gulf/ Trough	rosette	3	400
AN21-04	405 / C015	Amundsen Gulf/ Trough	rosette	4	300
AN21-04	405 / C015	Amundsen Gulf/ Trough	rosette	7	180
AN21-04	405 / C015	Amundsen Gulf/ Trough	rosette	10	140
AN21-04	405 / C015	Amundsen Gulf/ Trough	rosette	12	100
AN21-04	405 / C015	Amundsen Gulf/ Trough	rosette	21	44
AN21-04	405 / C015	Amundsen Gulf/ Trough	rosette	11	20
AN21-04	405 / C015	Amundsen Gulf/ Trough	rosette	23	7
AN21-04	405 / C015	Amundsen Gulf/ Trough	rosette	24	2
AN21-04	407	Amundsen Gulf	rosette	2	300
AN21-04	407	Amundsen Gulf	rosette	3	250
AN21-04	407	Amundsen Gulf	rosette	4	200
AN21-04	407	Amundsen Gulf	rosette	24	155
AN21-04	407	Amundsen Gulf	rosette	9	100
AN21-04	407	Amundsen Gulf	rosette	11	70
AN21-04	407	Amundsen Gulf	rosette	13	50
AN21-04	407	Amundsen Gulf	rosette	15	30
AN21-04	407	Amundsen Gulf	rosette	18	20
AN21-04	407	Amundsen Gulf	rosette	20	7
AN21-04	407	Amundsen Gulf	rosette	22	2
AN21-04	409	Amundsen Gulf	rosette	1	96
AN21-04	409	Amundsen Gulf	rosette	6	70
AN21-04	409	Amundsen Gulf	rosette	8	50
AN21-04	409	Amundsen Gulf	rosette	10	30
AN21-04	409	Amundsen Gulf	rosette	16	20
AN21-04	409	Amundsen Gulf	rosette	18	7
AN21-04	409	Amundsen Gulf	rosette	22	2

AN21-04	414	Beaufort Sea	rosette	1	300
AN21-04	414	Beaufort Sea	rosette	2	250
AN21-04	414	Beaufort Sea	rosette	3	200
AN21-04	414	Beaufort Sea	rosette	4	180
AN21-04	414	Beaufort Sea	rosette	6	140
AN21-04	414	Beaufort Sea	rosette	8	100
AN21-04	414	Beaufort Sea	rosette	10	70
AN21-04	414	Beaufort Sea	rosette	18	50
AN21-04	414	Beaufort Sea	rosette	13	30
AN21-04	414	Beaufort Sea	rosette	19	20
AN21-04	414	Beaufort Sea	rosette	21	7
AN21-04	414	Beaufort Sea	rosette	24	2
AN21-04	420	Beaufort Sea	rosette	3	30
AN21-04	420	Beaufort Sea	rosette	8	20
AN21-04	420	Beaufort Sea	rosette	10	7
AN21-04	420	Beaufort Sea	rosette	14	2
AN21-04	PCB-07	Beaufort Shelf	rosette	30	5
AN21-04	PCB-07	Beaufort Shelf	rosette	12	14
AN21-04	PCB-07	Beaufort Shelf	rosette	7	11
AN21-04	PCB-07	Beaufort Shelf	rosette	2	16
AN21-04	434	Beaufort Shelf	rosette	35	2
AN21-04	434	Beaufort Shelf	rosette	15	12
AN21-04	434	Beaufort Shelf	rosette	7	18
AN21-04	434	Beaufort Shelf	rosette	2	21
AN21-04	435	Beaufort Sea	rosette	294	1
AN21-04	435	Beaufort Sea	rosette	200	3
AN21-04	435	Beaufort Sea	rosette	150	6
AN21-04	435	Beaufort Sea	rosette	100	9
AN21-04	435	Beaufort Sea	rosette	70	11
AN21-04	435	Beaufort Sea	rosette	50	13
AN21-04	435	Beaufort Sea	rosette	30	15
AN21-04	435	Beaufort Sea	rosette	20	20
AN21-04	435	Beaufort Sea	rosette	7	22
AN21-04	435	Beaufort Sea	rosette	2	23
AN21-04	PCB-18	Beaufort Shelf	rosette	4	180
AN21-04	PCB-18	Beaufort Shelf	rosette	5	140
AN21-04	PCB-18	Beaufort Shelf	rosette	7	100
AN21-04	PCB-18	Beaufort Shelf	rosette	11	50
AN21-04	PCB-18	Beaufort Shelf	rosette	14	20
AN21-04	PCB-18	Beaufort Shelf	rosette	16	7
AN21-04	PCB-18	Beaufort Shelf	rosette	21	2
AN21-04	PCB-12	Beaufort Shelf	rosette	1	45
AN21-04	PCB-12	Beaufort Shelf	rosette	9	12
AN21-04	PCB-12	Beaufort Shelf	rosette	17	7
AN21-04	PCB-12	Beaufort Shelf	rosette	18	2
AN21-04	546/C018	Beaufort Sea Deep	rosette	1	1730
AN21-04	546/C018	Beaufort Sea Deep	rosette	2	1500
AN21-04	546/C018	Beaufort Sea Deep	rosette	3	1200
AN21-04	546/C018	Beaufort Sea Deep	rosette	4	1000
AN21-04	546/C018	Beaufort Sea Deep	rosette	6	800
AN21-04	546/C018	Beaufort Sea Deep	rosette	8	600
AN21-04	546/C018	Beaufort Sea Deep	rosette	10	400
AN21-04	546/C018	Beaufort Sea Deep	rosette	11	300
AN21-04	546/C018	Beaufort Sea Deep	rosette	13	200
AN21-04	546/C018	Beaufort Sea Deep	rosette	15	100
AN21-04	546/C018	Beaufort Sea Deep	rosette	17	50
AN21-04	546/C019	Beaufort Sea Deep	rosette	20	30
AN21-04	546/C020	Beaufort Sea Deep	rosette	23	7

AN21-04	546/C021	Beaufort Sea Deep	rosette	24	2
AN21-04	514		rosette	4	400
AN21-04	514		rosette	5	300
AN21-04	514		rosette	8	180
AN21-04	514		rosette	10	140
AN21-04	514		rosette	11	100
AN21-04	514		rosette	18	35
AN21-04	514		rosette	15	25
AN21-04	514		rosette	20	7
AN21-04	514		rosette	24	2
AN21-04	518		rosette	4	400
AN21-04	518		rosette	5	300
AN21-04	518		rosette	8	180
AN21-04	518		rosette	10	140
AN21-04	518		rosette	11	100
AN21-04	518		rosette	13	50
AN21-04	518		rosette	14	30
AN21-04	518		rosette	20	7
AN21-04	518		rosette	24	2

7.3 Recommendations

New recommendations for Leg 4:

Insufficient seawater standards were purchased for Amundsen Science during this leg, as a result we have shared our standards and been very conservative with use. This solved the problem but did create a large backlog of salinity samples for analysis and a shortage of bottles. Bringing additional buffer standards would solve this unexpected shortage.

The salinometer frequently experienced issue with bubble formation after processing of around 50-100 samples (often Amundsen Science would process ~50 and then I would process ~50 at which point the bubble would occur). This took a lot of time by Amundsen Science in repair as well as added to our problem of limited seawater standards in order to re-standardize after repair.

Many DIC bottles in storage were found broken upon opening totes, this could have happened during shipment or at any time when samples were moved. Ensure careful handing of ‘fragile’ containers to limit future breakage.

Recommendations from Leg 3:

Fittings for seawater intake are non-stainless and are producing a lot of rust which infiltrates into the underway pCO_2 system. The fittings when taken apart showed heavy amounts of rusting and should be replaced with stainless.

The pCO_2 instrument was operated in the previous leg (Leg 2) by an Amundsen Science technician, which we are very grateful for. However, we noticed a problem in that leg whereby there was periodic water temperature cycles on the order of 3-6 degrees C. This problem stopped when we arrived on the ship, but the technicians (Daniel & Thibaud) were unable to determine why the temperature cycling was happening. We suspect the sample line was being contaminated by a large pressure cylinder that holds a reservoir of water and may periodically backflush into our instrument if the pressure in the seawater sample line is out of balance. Obviously it is difficult to make recommendations without being sure what the problem was, but the pressure cylinder seems like a bad idea from the standpoint of potentially contaminating all of the underway systems with water that has been stored for a long period of time.

7.4 References

Dickson, A. G., Sabine, C. L., & Christian, J. R. (2007). Guide to Best Practices for Ocean CO2 measurements. PICES Special Publication. In *Guide to Best Practices for Ocean CO2 measurements. PICES Special Publication* (Vol. 3, Issue 8).

8 Moorings

Project leaders: David Cote[1], Alexandre Forest[2] (alexandre.forest@as.ulaval.ca)

Participants – Leg 2 : Shawn Meredyk[2](Lead), Maxime Geoffroy[3]

Participants – Leg 4 : Luc Michaud[2]

Report Author: Shawn Meredyk[2]

[1]North Atlantic Fisheries Centre, Fisheries and Oceans Canada, St. John's, NL
[2]Amundsen Science, Pavillon, Université Laval, Quebec City, QC
[3]Marine Institute, Memorial University of Newfoundland, St. John's, NL

8.1 Executive summary

The 2021 Amundsen Science - DFO Mooring Program (Integrated Studies and Ecosystem Characterization of the Labrador Sea Deep Ocean - ISECOLD) operations in the Labrador Sea and Baffin Bay were productive and executed without incident. The CCGS *Amundsen* mission saw 100% equipment recovery and 96 % data recovery. Leg 2 mooring operations onboard the Amundsen had 4 successful recoveries (MkB1-20, HiBioA-20, HiBioC-20, NRCAN Southwind Fjord) and 6 successful deployments (SagBank-21, SagBank-21-CROM, HiBioA-21, HiBioA-21-CROM, JASCO-MacBeth Fjord, JASCO Scott Inlet) for the ISECOLD and JASCO-Clyde River programs. Leg 4 mooring operations saw a successful deployment of a benthic tripod requested by the community of Uluhaktok (PKC-UluBluff-21).

8.2 Introduction and Regional Setting

Sampling year 2021 was part of a summer-fall campaign involving two legs onboard the vessel Amundsen. Leg 2 was studying the underwater sound ecology, ocean circulation variability and shelf sedimentation in the Labrador Sea. Leg 4 was studying the underwater sound ecology, wave and current regime out-front (~12Km from the beach) the community of Uluhaktok in the Amundsen Gulf.

Amundsen mooring operations during Leg 2 (July 15 – Aug 12) were co-financed by Amundsen Science, DFO and the Marine Institute of Memorial University (nfld) concerning the recovered MkB1, HiBioA and HiBioC moorings along with the new mooring deployment site on Saglek Bank (SagBank). HiBioA-21 was deployed at 497m while SagBank-21 was deployed at 450m. 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 Saglek Bank.

Mooring operations during between September 9 – October 7, during Leg 4, saw the single deployment of a benthic tripod (PKC-UluBluff-21) co-financed by Amundsen Science and Polar Knowledge Canada (PKC).

The total of the Amundsen Science managed mooring operations, during leg 2 onboard the Amundsen, included four moorings recovered (one for NRCAN – Alexandre Normandeau) and six moorings that were deployed in the Labrador Sea and Baffin Bay (two were for JASCO-Clyde River project) and additionally, one benthic mooring tripod deployment during leg 4 for the community of Uluhaktok.

8.2.1 *Labrador Sea*

A new mooring (SagBank) was deployed to examine the water and acoustic properties on the shelf break on the eastern edge of Saglek Bank in the Labrador Sea, for DFO-nfld. The mooring was equipped with a current meter and CT sensor examining the water layer 10m off-bottom. The

SagBank-21 and HiBioA-21 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 new addition of SPMDs to the SagBank and HiBioA moorings were 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 masters research of students supervised by Dr. Liisa Jantunen (Env.Can.).

8.2.2 *Amundsen Gulf*

The Amundsen Gulf is an area where the air-sea interactions occurring near-shore were investigated, to monitor the wave and currents affecting the shoreline out-front the Inuit community of Uluhaktok. Ocean circulation is highly variable in the Amundsen Gulf, but the along-shelf flow of Pacific-derived water entering the Amundsen Gulf can be potentially monitored along with the vocalizations of marine mammals.

Ice cover, examined by moored current profilers and satellite imagery, plays a significant role in terms of affecting momentum transfer from wind to water, constrained (in the case of landfast ice) and enhanced (in the case of drift ice) by wind.

The underwater sound ecology was of interest as well and a hydrophone from the Wildlife Conservation Society of Canada (WCS) was provided by Dr. Bill Halliday for the PKC-UluBluff mooring / benthic lander mooring.

8.3 Methodology

8.3.1 *Labrador Sea*

The ISECOLD (HiBio, SagBank) moorings are a continuation of a shelf – slope break mooring array started with HiBioA-17 and now includes HiBioA, HiBioC, MkB1 and SagBank moorings to examine the water properties affecting invertebrate megafaunal settlement, marine mammal presence, shelf-slope carbon fluxes, persistent organic pollutants, zooplankton dynamics and submarine acoustics monitoring.

New mooring types in the format of a compact float package called a CROM were deployed ~1km away from moorings at SagBank and HiBioA. These CROMs were also equipped with a new smaller hydrophone (Ocean Instruments – SoundTrap), Vemco VR2W acoustic tag receivers and near bottom current meters and CTD sensors, which will help answer questions about near-bottom sedimentation while listening for marine mammal and Greenland Shark and Salmon activity.

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.

Mooring HiBioA-21 (510m) was redeployed along with new mooring SagBank-21 (450m), 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 – Labrador Sea – Makovik Bank (Figure 8-1).

At the HiBioA and SagBank sites at ~1km away from the moorings was a new compact benthic mooring called a CROM, which was new for 2021, in-order to get even clearer underwater sound recordings and better bottom current readings in very fast currents which are known at the HiBioA site and expected to be similar at the new SagBank site.

8.3.2 *Amundsen Gulf*

Polar Knowledge Canada (PKC) mooring PKC-UluBluff-21, in the Amundsen Gulf, was deployed in 2021 to collect the annual time-series wave and current regime out-front (west) the village of Uluhaktok. This is a new project for Amundsen Science and the community of Uluhaktok however, there are other moorings in this area studying the underwater sound ecology as well lead by the WCS and this lander is a new collaboration between Amundsen Science and WCS and the community of Uluhaktok.

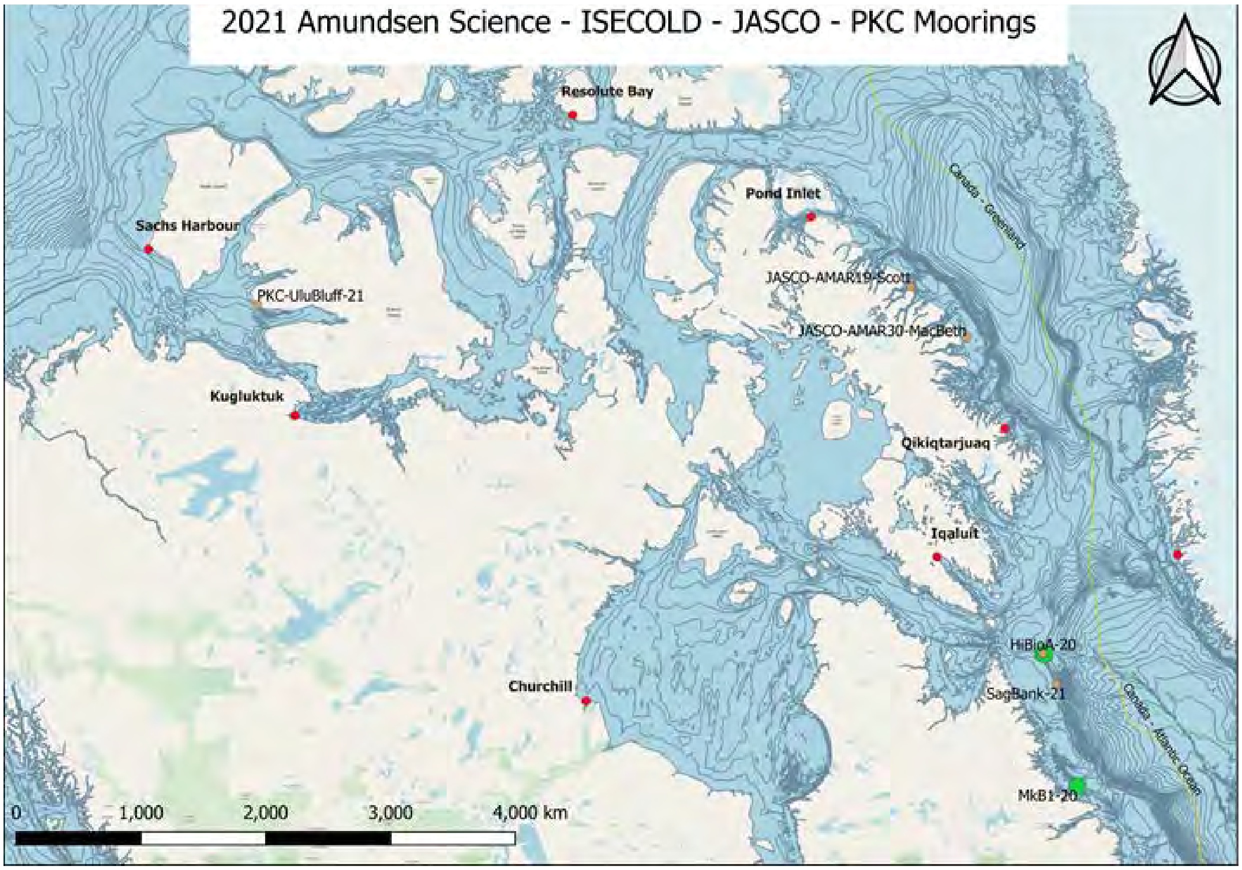

Figure 8-1: Amundsen Science Mooring Locations 2021 (orange), 2020 (green).

A detailed list of oceanographic equipment deployed on the individual moorings can be provided. Typical mooring configuration for the three programs consisted of:

a) The ISECOLD-Amundsen Science moorings were designed to be of a taut-line configuration and consisted of the following key components:
   i. An AZFP 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. A JASCO AMAR G3 or OceanInstruments SoundTrap hydrophone unit was installed in-line. This hydrophone was installed to listen for marine life and vessel traffic, for this proposed Marine Protected Area (MPA).
   iv. 32-inch spherical Mooring Systems International (MSI) syntactic foam float provided a low-mid water float solution.

v. Ten meters above the bottom, a high frequency short-range (<1m) Nortek Aquadopp Profiler (AQP) current profiler was used to measure water velocities in 1m bins above bottom.
vi. RBR Temperature – Salinity sensors were mounted on the mooring with other current and plankton sensors.
vii. A string of 4x Benthos glass sphere floats were placed above the acoustic releases.
viii. Tandem EdgeTech CART acoustic releases were used as the primary recovery devices.
ix. Two train wheels were used as an anchor.

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b) 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 benthic water velocities.
iii. RBR XR-420 Temperature – Salinity sensor
iv. An EdgeTech CART acoustic release as the primary recovery device.
v. A manhole-cover with a CROM support stand used as an anchor.
vi. The CROM itself is of syntactic foam and will float to the surface after released. The outer drum of the CROM contained 600m of Oletec-12 polypropylene rope tied to the anchor and to the top of the acoustic release, enabling anchor recovery.

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c) Benthic Lander mooring configuration for the PKC – Amundsen Science – WCS project:

i. RDI Sentinel V100 (300 KHz) current profiler with waves profiling capabilities and external battery pack (2 lithium x 1900 WHr)
ii. RBR Concerto – CTD-Tu-FL (temperature – salinity – Turbidity – Chlorophyll sensor)
iii. OceanInstruments SoundTrap STD500 (hydrophone)
iv. Pop-up buoy frame recovery system (custom made for EdgeTech CART release)

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*The SPMDs are small passive water samplers that clamp directly to the mooring line or instrument cage (Figure 8-2). The goal of the SPMDs was to monitor concentrations of persistent organic pollutants (POPs) in the Labrador Sea.

Figure 8-2: SPMD POPs trap ready for deployment on SagBank-21

8.3.3 *Field Compass Calibrations*

Compass accuracy is essential for current meters in general, however above the Arctic Circle, reduced magnitude of the horizontal component and erratic magnetic meridians make it difficult for the internal magnetic compass to point to magnetic north. Therefore, it is ideal to calibrate internal compasses near the approximate latitude where they were deployed, be verified and / or calibrated in similar total geomagnetic field strength. Additionally, all efforts were taken to eliminate all ferrous material in the mooring cages and in the calibration environment. A list of oceanographic equipment that contains internal compasses can be found in Table 8-2.

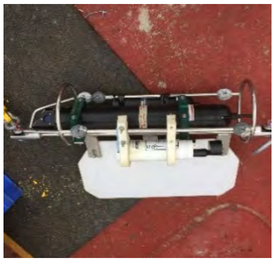
The recovered Nortek Aquadopp current meters were verified and then post-calibrated in Southwind Fjord, which was the nearest possible landing relative to the mooring sites that was permissible during Leg 2 operations (Figure 8-3). Table 8-1 identify the pre-calibrated results performed in 2020 on the Université Laval campus and the 2021 verification results from the nearest land site to the ISECOLD moorings recovered in 2021 (HiBioA, HiBioC, MkB1).

Table 8-1: 2020 Pre-Calibrations and 2021 Verifications of Nortek Aquadopp current meters for ISECOLD moorings

Unique_ID	Mean HDG Offset	Std Dev Err	Location	Date
Nortek_AQD_8418	1.82	1.06	Ulaval - Grassy Plain	2020-06-03
Nortek_AQD_8448	2.76	1.51	Ulaval - Grassy Plain	2020-06-03
Nortek_AQD_9494	2.70	1.51	Ulaval - Grassy Plain	2020-06-03
Nortek_AQD_8418	5.66	3.43	Mouth of Southwind Fjord - Baffin Island	2021-07-31
Nortek_AQD_8448	5.89	3.41	Mouth of Southwind Fjord - Baffin Island	2021-07-31
Nortek_AQD_9494	10.14	4.90	Mouth of Southwind Fjord - Baffin Island	2021-07-31

Figure 8-3: Pre-Calibration and Verification Sites (Ulaval, Southwind Fjord) from ISECOLD Nortek Aquadopps.

Table 8-2: Oceanographic Equipment that required Compass Calibration, including calibration Procedures

Equipment	Location	Purpose	Equipment Used	Calibration Procedure
Nortek Aquadopp 	Université Laval Campus (2020),	Single-Point water velocity profiler	Calibration Table 1 with Satellite Compass	Nortek software does not correct compass bias for soft iron effects. The hard iron effects are negligible for the ISECOLD project due to non-magnetic frame designs and lithium batteries ~50cm away from the transducer heads; thereby, negating hard-iron effects and removing the need to perform hard-iron calibrations on these devices.

8.4 Preliminary results

The releases of all moorings responded without major issues and the sea state was calm to wavy but easily manageable to throw a grappling hook to recover the top instrument / buoy. No zodiac was used due to good weather and manageable surface currents. The deckbox responses weren't clear as to the reception and execution of the wake-up and release commands, but worked none-the-less. The transducer needed to be weighted with a heavy shackle due to surface currents at the HiBioA and NRCAN Southwind Fjord sites to a depth of ~10m.

The moorings MkB1, HiBioA and HiBioC all performed well considering the intense currents that they are exposed to all year and only one instrument had a defective battery issue after 4 months of recordings.

The NRCAN mooring recovery in Southwind Fjord was not made aware to the Amundsen Science mooring professional but recovery services were provided none-the-less and without any problems. The details of the NRCAN turbidity currents mooring can be discussed with Project Investigator / Researcher Dr. Alexandre Normandeau at the Bedford Institute of Oceanography (BIO) in Dartmouth, NS, Canada.

Instrument RBR_XR-420-CTD_17352 from HiBioC-20 only recorded 4 months of data as only one of the four batteries functioned correctly. All CR123A batteries in all RBR devices in the 2020-2021 moorings came from the same order / batch and no other instruments had recording or battery issues.

Table 8-3: Data Recovery Summary from Recovered Moorings 2020-2021 data year.

MooringID	InstrumentID	Clock Drift	First Good Record (UTC)	Last Good Record (UTC)	% Data Recovery	Mooring AVG
HiBioA-20	JASCO_AMAR-G3_704	00:00:00 fast	01-Sep-2020 21:10:00	24-Jul-2021 08:40:00	100%	88%
HiBioA-20	Technicap_PPS_3-3_motor_12-23	03:44:39 fast	03-Sep-2020 00:00:00	16-Jul-2021 00:00:00	100%	
HiBioA-20	RBR_XR-420-CTD_17352	00:00:00 fast	01-Sep-2020 21:10:00	08-Jan-2021 04:40:00	40%	
HiBioA-20	Vemco_VR2W_108140	00:10:27 slow	01-Sep-2020 21:10:00	24-Jul-2021 08:40:00	100%	

HiBioA-20	Nortek_Aquadopp _8448	00:00:46 slow	01-Sep-2020 21:20:00	24-Jul-2021 08:40:00	100%	
HiBioC-20	ASL_AZFP_5513 4	00:00:00 slow	02-Sep-2020 13:40:00	24-Jul-2021 10:20:00	100%	100%
HiBioC-20	Technicap_PPS_3 -3_motor_11-17	03:39:21 fast	03-Sep-2020 00:00:00	16-Jul-2021 00:00:00	100%	
HiBioC-20	Seabird_SBE37-SM_10850	00:00:05 slow	02-Sep-2020 13:40:00	24-Jul-2021 10:20:00	100%	
HiBioC-20	RBR_Concerto-CTD-Tu_65774	00:00:15 slow	02-Sep-2020 13:40:00	24-Jul-2021 10:20:00	100%	
HiBioC-20	Vemco_VR2W_12 4206	00:01:21 slow	02-Sep-2020 13:40:00	24-Jul-2021 10:20:00	100%	
HiBioC-20	Nortek_Aquadopp _8418	00:00:17 fast	02-Sep-2020 13:40:00	24-Jul-2021 10:20:00	100%	
MkB1-20	Nortek_Aquadopp _9494	00:00:54 slow	27-Aug-2020 19:00:00	20-Jul-2021 11:40:00	100%	100%
MkB1-20	RBR_XR-420-CT_15281	00:00:37 slow	27-Aug-2020 18:50:00	20-Jul-2021 11:40:00	100%	
MkB1-20	Vemco_VR2W_12 2181	00:04:02 fast	27-Aug-2020 18:50:00	20-Jul-2021 11:40:00	100%	
MkB1-20	Vemco_VR2W_12 4355	00:04:19 fast	27-Aug-2020 18:50:00	20-Jul-2021 11:40:00	100%	
MkB1-20	OceanInstruments _STD500-STD_6849	00:01:15 slow	27-Aug-2020 18:50:00	20-Jul-2021 11:40:00	100%	
				Mission Total Avg=	96%	

8.4.1 *MkB1-20*

MkB1-20 saw 100% recovery of all deployed equipment and 100% data recovery. Mooring MkB1-20 had significant hydrozoan growth on the mooring line and instrumentation 140m above the bottom. The location of the hydrophone happened to be just below (~5m) the distinction of the two different water masses.

8.4.2 *HiBioA-20*

HiBioA-20 saw 100% recovery of all deployed equipment and 88% data recovery.

HiBioA-20 also had a sediment trap that was programmed to collect 24 sediment samples in 2-week intervals for the duration of a year. The trap successfully collected 22 x 2-week samples as the mooring was recovered a month earlier than planned (Figure 8-4). Samples 2 and 5 were unique in the sense that the sediment contained within the bottles contained hydrogen-sulphate gas. This is the first time this site has recorded such type of sediment, 45m above-bottom.

HiBioA-20 also had a hydrophone that had a full (100%) record (1TB) for the deployment duration of the mooring. However, the data quality couldn't be verified after recovery onboard the Amundsen and will need to be verified and downloaded by DFO – nfld.

The fastest current pulses (up to 0.8m/s) were observed in a Northerly heading while the slowest currents were in South Easterly direction. North Easterly waters were cool and averaged ~ 30 cm/s while Westerly currents were warm and were associated with the fastest pulses that appeared to have a 2-week periodicity. The Aquadopp pitch and roll readings throughout the year were often near / outside the preferred manufacturer's limits. The roll of the instrument frame due the very high and sustained currents at this site was observed during the Westerly current pulses.

Sites HiBioA and HiBioC are only a couple nautical miles separated but bathymetrically, they differ by 500m (offshore from shelf-slope).

Figure 8-4: HiBioA-20 Sediment Trap (452m) 2-week samples in series

Mooring HiBioA was successfully re-deployed. The AZFP frame that was recovered had one buoy that had cracked and was leaking water and thus the spare frame, that was prepared during the winter by Amundsen Science, was used for the 2021 redeployment. The AZFP communication cable was not the proper cable for the housing bulkhead due to an instrument sharing issue between Maxime and his Norwegian collaborator and possibly an ASL mix-up. The unit was able to be programmed at the board level with the expertise of the Amundsen Science technical team (Marcia and Simon). Marcia's historical experience with the AZFP units was instrumental to getting the unit back into the water the following morning

8.4.3 *HiBioC-20*

HiBioC-20 saw 100% recovery of all deployed equipment and 100% data recovery, of the recovered instruments.

HiBioC-20 had an AZFP and Seabird SBE37-SM CTD unit that was fully recovered with full datasets.

The preliminary plots from the AZFP-link software indicate a mid-water planktonic mass extending ~120m above the unit's deployed Depth (550m) (Figure 8-5), which is what was observed in the 2019-2020 dataset from this site as well. Just like in the 2019-2020 dataset, the strong currents (tidally actuated) caused pull-downs of the AZFP by 50m and at the on-set of spring down to 150m. The semidiurnal tidal signal can be seen along with a temperature range between 3-5 °C and the mid-water salinity was between 34.85 and 34.65 PSU. The trend indicates that colder, fresher episodes / pulses are tidally actuated and can accompany increases in turbidity in late summer until late winter, when the strongest of downwelling currents were observed by the deepest of pull-down. Historical data from this site had identified a tidally actuated SE current in excess of 0.8m/s at times which was confirmed within the 2020-2021 dataset as well.

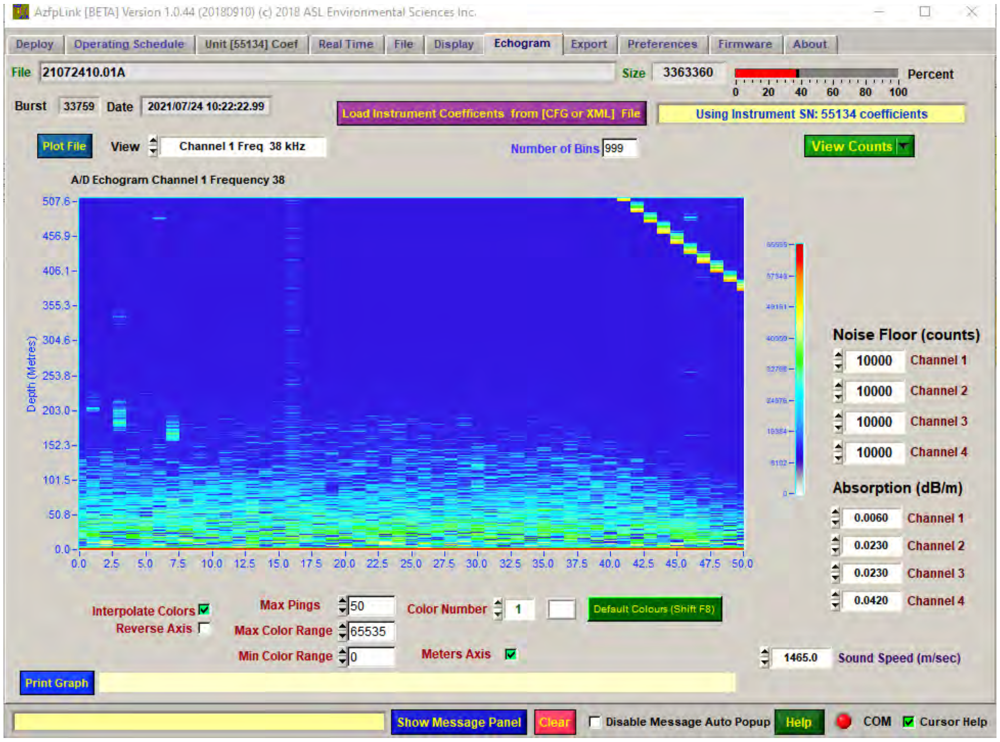


Figure 8-5: AZFP link software plotting HiBioC-20 during recovery (July) time series of 2020-2021 data year plankton mass between 600m and 750m off the Hatton Shelf /Labrador Sea. Data in plot has not been pressure-corrected.

HiBioC-20 also had a sediment trap that was programmed to collect 24 sediment samples in 2-week intervals for the duration of a year. The trap successfully collected 22 x 2-week samples as the mooring was recovered a month earlier than planned ()

HiBioC-20 also had a hydrophone that had a full (100%) record (112GB 3x compressed) for the deployment duration of the mooring. The data quality was verified as good and some seal calls were heard from a randomly selected sound file.

The fastest current pulses (up to 0.8m/s ~ May 1st, 2020) were observed in a West-Northwesterly heading while the 2nd fastest currents were in Westerly direction. The Aquadopp pitch and roll readings throughout the year were within acceptable limits.

Figure 8-6. HiBioC-20 Sediment Trap time-series samples (2 weeks) fall – summer at 877m depth

8.4.4 *New Deployment Summary*

Six new moorings (SagBank, SagBank-CROM, HiBioA-CROM, JASCO-AMAR30-MacBeth, JASCO-AMAR19-Scott, PKC-UluBluff) were successfully deployed (Table 8-4). Leg 2 saw the deployment of SagBank mooring site along with the new CROM moorings that were deployed in an effort to get better current and hydrophone data quality.

The JASCO – Clyde River moorings were a last-minute addition to the mission plan and the Amundsen Science technical staff successfully deployed the moorings for JASCO at the request of the community of Clyde River. Foggy weather conditions prevented a local member of the community from directly observing the operations.

The PKC-UluBluff mooring /lander tripod was successfully deployed during leg 4.

Table 8-4 Mooring deployments summary of 2021

Leg	Mooring ID	Latitude	Longitude	Latitude (DD)	Longitude (DD)	Depth (m)
2	SagBank-21	59 22.494 N	60 18.574 W	59.3749	-60.309567	450
2	SagBank-21-CROM	59 23.030 N	60 19.150 W	59.38383	-60.319167	450
2	JASCO-AMAR30-MacBeth	69 54.66 N	66 48.42 W	69.911	-66.807	227
2	JASCO-AMAR19-MacBeth	71 08.125 N	70 48.108 W	71.1354167	-70.8018	155
4	PKC-UluBluff-21	70 42.6381 N	117 50.743 W	70.710635	-117.8457167	32

8.5 Mooring Operations - Annual Lessons Learned Summary

The Brass ring induced corrosion of the galvanized steel drop ring from the 2020 moorings confirmed again that the brass rings shouldn't be used for any more mooring deployments (Figure 8-7). A regular galvanized ring would be better, with galvanized chain.

Figure 8-7. Drop ring corrosion from MkB1-20

8.6 Acknowledgements

I would like to acknowledge the teamwork and co-operation of the Coast Guard crew of the CCGS *Amundsen*. Working together as a team and performing admirably and the moorings were successfully deployed, recovered and re-deployed efficiently and safely as possible.

9 Hugin-1000 AUV ("Marvin") deployments

Project leaders: Marie-Hélène Forget[1] (Marie-Helene.Forget@takuvik.ulaval.ca) Achim Randelhoff[1]

Cruise participants – Leg 5 : Guislain Bécu[1], Achim Randelhoff[1], Jørgen Dalsmo Stray[2], Christopher Morissey[3], Christian Katlein[4]

[1] Takuvik, ULaval/CNRS, Quebec City, QC
[2] Kongsberg Maritime, Norway
[3] Amundsen Science, Université Laval, Quebec City, QC
[4] Alfred Wegener Institute, Germany

9.1 Introduction and Objectives

We hypothesize that autumn PP at high latitudes will increase in the coming decades because of a northward expansion of the SIZ and increased underwater light availability later in the year due to later freeze-up4. The light field under sea ice is notoriously heterogeneous but easily disturbed by vessels, especially when sea ice is too thin to have people work directly from it.

9.2 Methodology

We deployed Université Laval's HUGIN-1000 Autonomous Underwater Vehicle (AUV) "Marvin" (Kongsberg Maritime), flying straight horizontal transects at shallow, fixed depths under the sea surface. Marvin has an extensive environmental payload comprising, among other things, sensors for temperature, conductivity, nitrate concentration, irradiance, chlorophyll and CDOM fluorescence, and particulate backscattering (along 4 channels). Prior to the cruise, we had also integrated a newly developed highly sensitive photosynthetically available radiance (PAR) sensor (Biospherical Inc.) to conduct light measurements under sea ice at lower light levels than can usually be detected by more standard sensors like the OCR504.

We performed three deployments: on 15 October at station DE210 (Northern Baffin Bay), on 22 October at station DE430 (Jones Sound) and on 23 October at station 440 (Jones Sound), see the mission plan schematics on Figure 9-1, Figure 9-2 and Figure 9-3

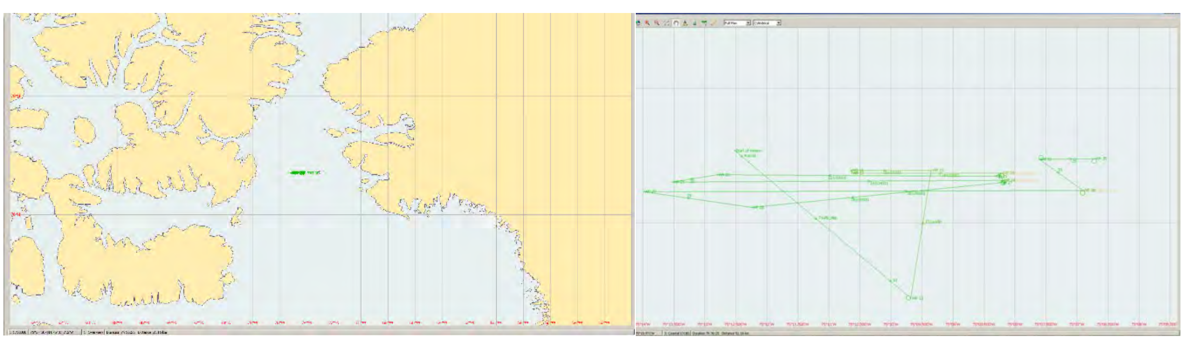


Figure 9-1: Deployment site (station DE210) on 15 October 2021 (left : zoom out, right: zoom in that shows the mission plan lines)

Figure 9-2: Deployment site (station DE430) on 22 October 2021 (left : zoom out, right: zoom in that shows the mission plan lines)

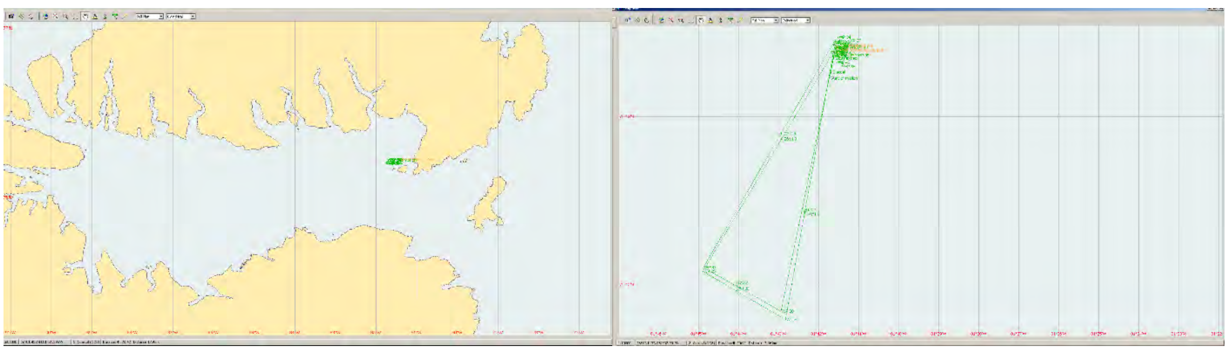


Figure 9-3: Deployment site (station DE440) on 23 October 2021 (left : zoom out, right: zoom in that shows the mission plan lines)

9.3 Preliminary Results

Apart from testing (for the 1st time) under-ice navigation capabilities of the AUV (with a seabed-moored acoustic beacon (cNODE used as a UTP beacon), no-surfacing mode, back-tracking and rendez-vous point features, for example), we performed a few light level measurements, both in open waters and under-ice, see Figures 4 (under-ice measurements) and 5 (open water) below.

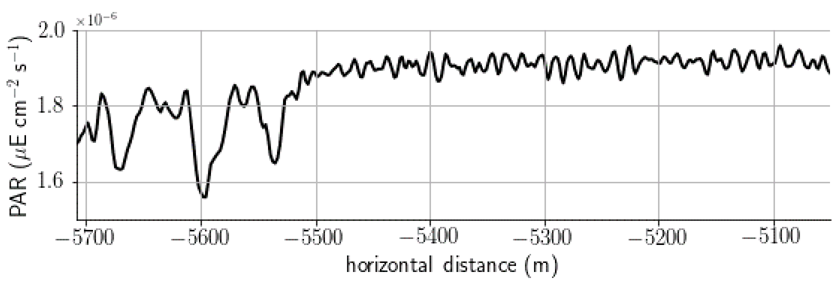


Figure 9-4: Transect at 40 m depth at station DE210. Left of -5500 m, the sea surface was covered by newly forming pancake ice

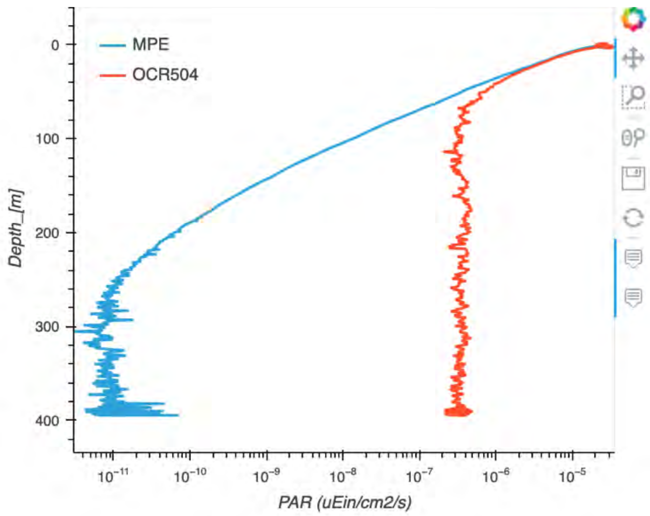


Figure 9-5: Comparison between the newly integrated highly sensitive PAR sensor (MPE) and a PAR sensor conventionally deployed on autonomous platforms (OCR504) at station DE2

9.4 Recommendations

Hugin-1000 deployments are complex and require fast and efficient communication between acquisition room, deck, bridge and zodiac. Toolbox meetings so far have mostly focused on task distribution on deck, but additional procedures or toolbox meetings should be arranged involving the bridge, specifying all communication channels. For example, during deployment, the Hugin operator should always be able to talk directly to a science participant or crew member (on the deck and in the Zodiac) who knows how the Hugin is operated and about its constraints.

Second, the Hugin operator in the acquisition room has as of now very limited situational awareness of things other than the relative position of Hugin and the Amundsen and their headings. This concerns mostly awareness about sea ice and icebergs, but can also be about whirls created by the thrusters or ship propellers that could quickly flip around the Hugin, as happened during the second deployment (station DE430). A non-distorting camera view on the starboard and portside of the Amundsen (e.g. towards 1-3 and 9-11 o'clock) would greatly alleviate this for judging safe distances to e.g. ice floes directly by the Hugin operator. One could also consider having a science team member familiar with Hugin operation on the bridge for better communication. A direct NMEA phrase feed of tracked radar targets into the acquisition room would also help iceberg awareness, just as would an operational ice radar.

Future deployments on the Amundsen should include a so-called GPS repeater on the AUV container (approx. cost NOK 25,000) to reduce reliance on sometimes finicky integration with the Ship network (1PPS, ship's positioning, etc.). Before an AUV deployment, the so-called AUV navigation estimator has to be started, approximately 30 min before the deployment, provided the ship is still moving for that time (the more acceleration and turning, the quicker the initialisation). This step, whose goal is to position the AUV accurately and to reduce its heading error under 0.1 degree, requires a good GPS signal to be acquired, along with an accurate heading measurement. The AUV, being stored in its work-container, does not receive any GPS signal. The ship GPS is therefore sent to the AUV over the ShipNet network. From time to time, the ship GPS signal was not optimal (for very brief periods), which may affect the navigator estimator, or at least, increase the time it requires to be performed. But more importantly, to reduce the heading error, the ship would ideally need to take turns as often as possible. This was not always possible as the AUV was prepared for diving while other operations were carried out, so that the ship didn’t always have the possibility to maneuver freely. In addition, transferring the vessel's 1PPS (needed for overall synchronization) into the Hugin container has proven finicky. All these issues could be addressed if the AUV equipment would include an additional GPS receiver which would be sent inside the AUV container with a GPS repeater. With that kind of equipment, the AUV would receive a good GPS signal inside the container (the heading can be estimated from the GPS fixes).

Some of the sensors, which were originally supposed to be integrated to the AUV before it was delivered to UL, are still not properly integrated, software wise. For example, the BB3 sensor's data are not completely parsed when the *.txt files are created from the *.log files. Indeed, only 1 channel out of 3 is parsed, so that only 1 channel's data are timestamped and geolocalized. We need to address that with Kongsberg.

10 Optics: Light availability during the fall freeze-up

Project leaders: Marcel Babin[1] (marcel.babin@takuvik.ulaval.ca)

Cruise participants – Leg 5: Lisa Matthes[1], Edouard Leymarie[2], Christian Katlein[3], Bastian Raulier[1], Guislain Bécu[1]

[1] *Takuvik Joint International Laboratory, Université Laval and CNRS (France), Quebec City, QC.*
[2] *Laboratoire d'Oceanographie de Villefranche (LOV) and CNRS (France), Villefrance-sur-Mer, France*
[3] *Alfred Wegener Institute, Helmholtz Centre for Polar and Marine Research, Bremerhaven, Germany*

10.1 Introduction and Objectives

The significant decline in Arctic sea ice extent and volume, and the associated enhanced light availability in the ocean has lengthened the phytoplankton growth season and increased Arctic pelagic production by 57% between 1998 and 2018 (Lewis et al., 2020). Additionally, delayed sea ice formation into fall (Lebrun et al., 2019) and more open sea surface exposed to wind-induced vertical mixing can initiate historically uncommon second bloom events at the end of the Arctic growth season (Ardyna et al., 2014). Therefore, fall blooms have the potential to increase total production of the Arctic Ocean, to provide a food source for higher trophic levels before polar night and to support an additional carbon export.

A new study by Babin et al. (in prep.) of a fall bloom in Baffin Bay describes the time period between the onset of convection driven by a negative heat flux balance and the disappearance of light in winter as 'window of opportunity' for phytoplankton to bloom. Within this short window, the increased vertical mixing replenishes surface nutrient concentrations and promotes production, while the strong reduction in surface light levels caused by low sun angles and sea ice formation increasingly limits photosynthesis. Phytoplankton can acclimate to reduced light levels by maximizing light absorption and form large under-ice blooms in spring. Additionally, microalgae have been observed to grow at extremely low light levels during polar night due to low respiration rates and metabolic activity (Johnsen et al., 2020). However, the physical and photophysiological processes that control the timing and magnitude of a fall bloom are not well understood.

This research project focuses on the decreasing light availability in the surface layer during fall and aims to answer the pending question if sea ice formation or the onset of polar night terminate underwater light availability for phytoplankton growth. Therefore, our goal during this expedition was to investigate the underwater light climate in the open and ice-covered surface water layer during the fall-freeze-up in northern Baffin Bay and Nares Strait, when sun elevation rapidly declined, and sea ice started to form.

10.2 Methodology

To collect *in situ* optical data over larger spatial scales, a remotely operated vehicle (Blueye ROV, Blueye Robotics) and an autonomous underwater vehicle (Hugin AUV, Kongsberg Maritime) was deployed in the ice-free and ice-covered water. The Blueye ROV was equipped with a hyperspectral radiometer (InSitu Marine Optics), a new low-light PAR (photosynthetically available radiation) sensor (MPE, Biospherical Instruments Inc.), an altimeter to measure ice draft, and a 360-degree camera to monitor ice bottom characteristics and was deployed in ice-covered areas to record light levels beneath different types of sea ice along horizontal transects of up to 100 meter (Figure 10-1). The Hugin AUV was equipped with radiometers including the MPE sensor, bio-optical sensors for chlorophyll a (chl a) fluorescence, particle concentration and particle backscattering to estimate chl a concentration and calculate phytoplankton growth rates, and with a nitrate optical sensor to measure nutrient uptake and primary production. For the first time in the Canadian Arctic, this vehicle was deployed to document the spatial distribution of physical properties and biogeochemical stocks in the upper 100 meters of the ocean both in open water and close to the ice edge over several kilometers. Additionally, our team deployed a free-falling compact optical profiling system (C-OPS, Biospherical Instruments Inc.) from the front of the ship or the barge to record vertical light profiles in the upper 100 meter (Figure 10-2). Sea ice surface characteristics (ice coverage, floe size, ice types) was captured by a ship-launched remotely piloted aircraft systems (RPAS), which was piloted by a member of the participating physics team under the leadership of Dr. Dany Dumont (UQAR). Daily surface irradiance was recorded with a hyperspectral radiometer (Ramses-ACC, TriOS GmbH), mounted at the top of the bridge, throughout the sampling period.

Additionally, to support the sampling of general parameters for the cruise, our team also collected water samples between 8 and 12 depths from all stations for the analysis of colored dissolved organic matter (CDOM, Table 10-1).

Figure 10-1: Remotely operated vehicle (ROV, Blueye Robotics) and attached sensors.

Figure 10-2: Deployment of the compact optical profiling system (C-OPS, Biospherical Instruments Inc.) from the barge.

Table 10-1: List of sampling stations and measurements during leg 5 in October 2021

Station	Date	C-OPS	Surface reference	Blueye ROV	CDOM
DE110	2021-10-12	X	X		X

DE120	2021-10-13	X	X	X	X
DE130	2021-10-14	X	X		X
DE210	2021-10-15	X	X		X
DE310	2021-10-16	X	X		X
DE320	2021-10-17	X	X	X	X
DE410	2021-10-20	X	X		X
DE420	2021-10-21	X	X		X
DE430	2021-10-22	X	X	X	X
DE440	2021-10-23	X	X		X
DE450	2021-10-24		X	X	
BB2	2021-10-25				X
DE500 (Glider)	2021-10-27				

10.3 Preliminary Results

The availability of photosynthetically active radiation (PAR, 400 – 700 nm) at the water surface varied between 15 and 150 μmol photons m^{-2} s^{-1} between 12 October and 24 October in northern Baffin Bay (Jones Sound) and Nares Strait (Figure 10-3). These low PAR levels at the water surface resulted in a shallow euphotic zone in the open water with the 1% euphotic depth (1% of surface PAR) being situated between 42 and 60 m. A list of deployed instruments at each station is shown in Table 10-1. For more information about the AUV deployments, please refer to the AUV cruise report.

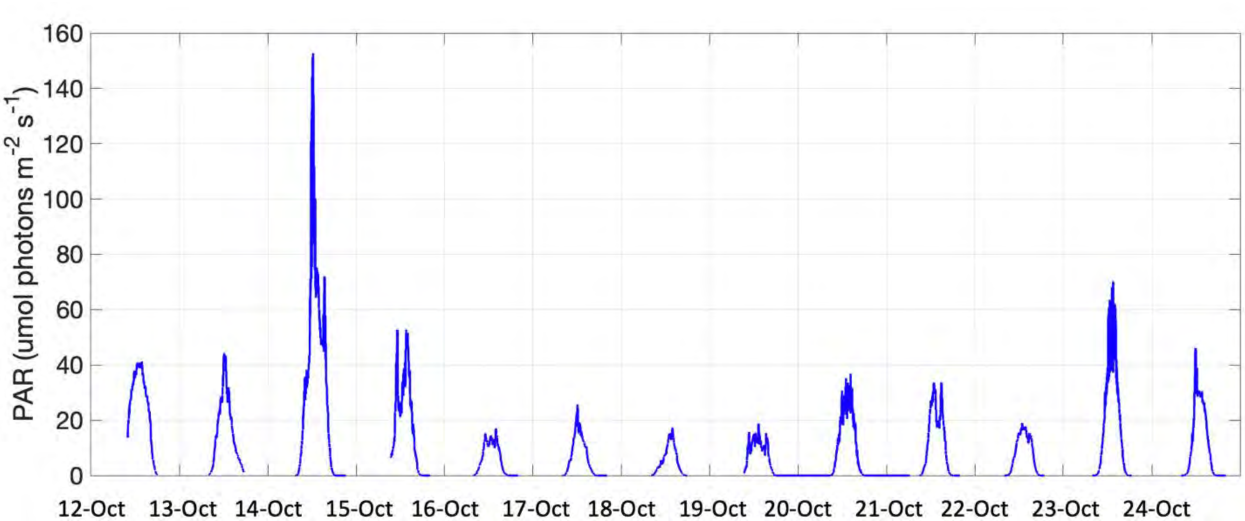


Figure 10-3: Daily surface PAR (photosynthetically active radiation) during the sampling period

10.4 Recommendations

The C-OPS deployment from the front of the ship requires several repositioning maneuvers of the ship. Therefore, we recommend that the exact deployment procedures are explained to each watch-keeping officer on the bridge, so that wave movement and bubble creation due to thruster movements are minimized. The C-OPS team should also have a radio to communicate with the bridge.

10.5 References

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11 BGC Argo floats

Project leaders: Marcel Babin[1] (marcel.babin@takuvik.ulaval.ca)

Cruise participants – Leg 5 : Claudie Marec[1,2], Edouard Leymarie[3]

[1] *Université Laval - UMI Takuvik, Quebec City, QC.*
[2] *IUEM, UMS3376, rue Dumont Durville 29280 Plouzané, France*
[3] *IMEV Laboratoire d'Océanographie de Villefranche-LOV, Villefranche-sur-Mer, France*

11.1 Introduction and Objectives

In the continuity of Takuvik's BGC (biogeochemical) Argo floats deployments for the study of phytoplankton blooms study, we deployed 4 floats during the Amundsen's AN21 leg5 cruise. The BGC Argo floats are autonomous platforms equipped with numerous sensors dedicated to characterize the water column. In our case, they are used to document the "ice edge spring and fall blooms". During its life (up to 2-3 years depending on the frequency of profiles) a float will drift, following oceanic currents (Lagrangian platform) and will profile between the surface and down to the bottom (or a programmed depth: 1000m for our study) then back to the surface. When in the surface, the float is geo-localized and transmits its data using the Iridium communication system. An Ice detection system (algorithm based on seawater temperature-ISA Ice Sensing Algorithm) implemented on our BGC floats ensures a safer navigation in icy waters (avoid surfacing when sea-ice is present). So, the floats provides us with year-long time series of data including data that can't be collected by oceanographic cruises during winter-time in Arctic.

We underline that 3 or the 4 BGC floats are "recycled". They "navigated" in 2017 or 2018, and were refurbished after their recovery by the CCGS *Amundsen* or the St Louis before end of battery.

We also deployed 3 Arvor-ice Argo floats provided by DFO (Blair Greenan).

11.2 Methodology

4 BGC floats were deployed from the ship's A frame. During Darkedge it was decided to deploy in the central Baffin Bay (station BB2, located in the very center of the cyclonic gyre in Baffin Bay). Previously, we deployed floats at BB2 in 2017 and 2019. This area for deployment was one of the two places selected after a study of the global Baffin Bay circulation taking into account the global cyclonic circulation. The chosen strategy is to avoid the floats to be ejected from BB through Davis' straight. BB2 Position: 72°45.000N 67°00.000W

In the previous years, deployments occurred in July, so we had to cope with sea-ice. During the Darkedge cruise, we didn't encounter sea-ice on the deployment area. Nevertheless in the coming days, we'll go on consulting composite maps from remote-sensing (AMSR2 for sea-ice concentration) that are daily generated by Takuvik (thanks to P.Massicote-Takuvik).

Description of the scientific payload of the floats:

A new PAR sensor (high sensitivity) was developed by BSI on request of Takuvik (see link): http://www.biospherical.com/index.php?option=com_content&view=article&id=157&Itemid=120#MPE

This MPE sensor is implemented on each of the 4 floats in addition to the scientific payload. Each float is equipped with the following sensors:

- CTD,

- Radiometer: OCR wavelengths:380, 412, 490nM, PAR,
- MPE (high sensitivity) PAR
- fluorescence chla,
- fluorescence CDOM,
- Backscattering,
- Suna (nitrates),
- Optode (Oxygen)

Moreover one float (takuse001b) is equipped with a UVP6 (Underwater Visio profiler). Here are the deployements realisez during Leg 5, for Takuvik:

- **Takuse001b** (WMO 6903125) deployed on 25th, October 2021
- lat: 72°44.98878N/ Long 067°00.02868W bathymetry 2310m
- **Takuse002b** (WMO 4902602) deployed on 25th, October 2021
- lat: 72°44.94613N/ Long 066°59.15615W bathymetry 2310m
- **Takuse003b** (WMO 6903126) deployed on 25th, October 2021
- lat: 72°44.49034N/ Long 066°58.50677W bathymetry 2310m
- **Takuse004b** (WMO 6903127) deployed on 25th, October 2021
- lat: 72°44.65596N/ Long 066°58.84502W bathymetry 2310m

for the Arvor-ice floats (DFO):

- (WMO 4902530) deployed on 25th, October 2021
- Lat 72°44,6N / Long 66°58,6W bathymetry 2310m
- (WMO 4902531) deployed on 25th, October 2021
- Lat 72°44,0N/ Long 66°58,0W bathymetry 2310m
- (WMO 4902532) deployed on 25th, October 2021
- Lat 72°44,2N / Long 66°58,3W bathymetry 2310m

A CTD cast was performed at the site of deployment as well as sampling for HPLC, chl*a*, Ultrapath (CDOM), Nutriments, for cross checking of the sensors. A UVP6 as well as an optical package (ECO triplet) were installed on the rosette too, for cross validation.

11.3 Preliminary Results

Since their deployment, the navigation functionalities of all floats have worked as expected and continue to do so (see example in Figure 11-1). Their diving pattern down to 1000m (programmed daily for the moment will be changed in the coming days for a 3 days or 4 days during winter. Data are collected on a remote server and made available to the scientific and general community. These profiles will provide data from the different sensors measuring the water column between 1000m and surface. The resolution of each sensor is set accordingly to specific depths, for instance high resolution in the euphotic zone, compared to the depth layer between 1000m and 350m.

Unfortunately we encountered a problem with a MPE PAR sensor (takuse003b) and the UVP6 of takuse001b started to disfunction on the 6th profile and we suspect a water leakage in the sensor.

11.4 Recommendations

A stable internet connection is compulsory for our deployments and follow-up of the platforms. A sensible improvement of the system onboard was appreciated.

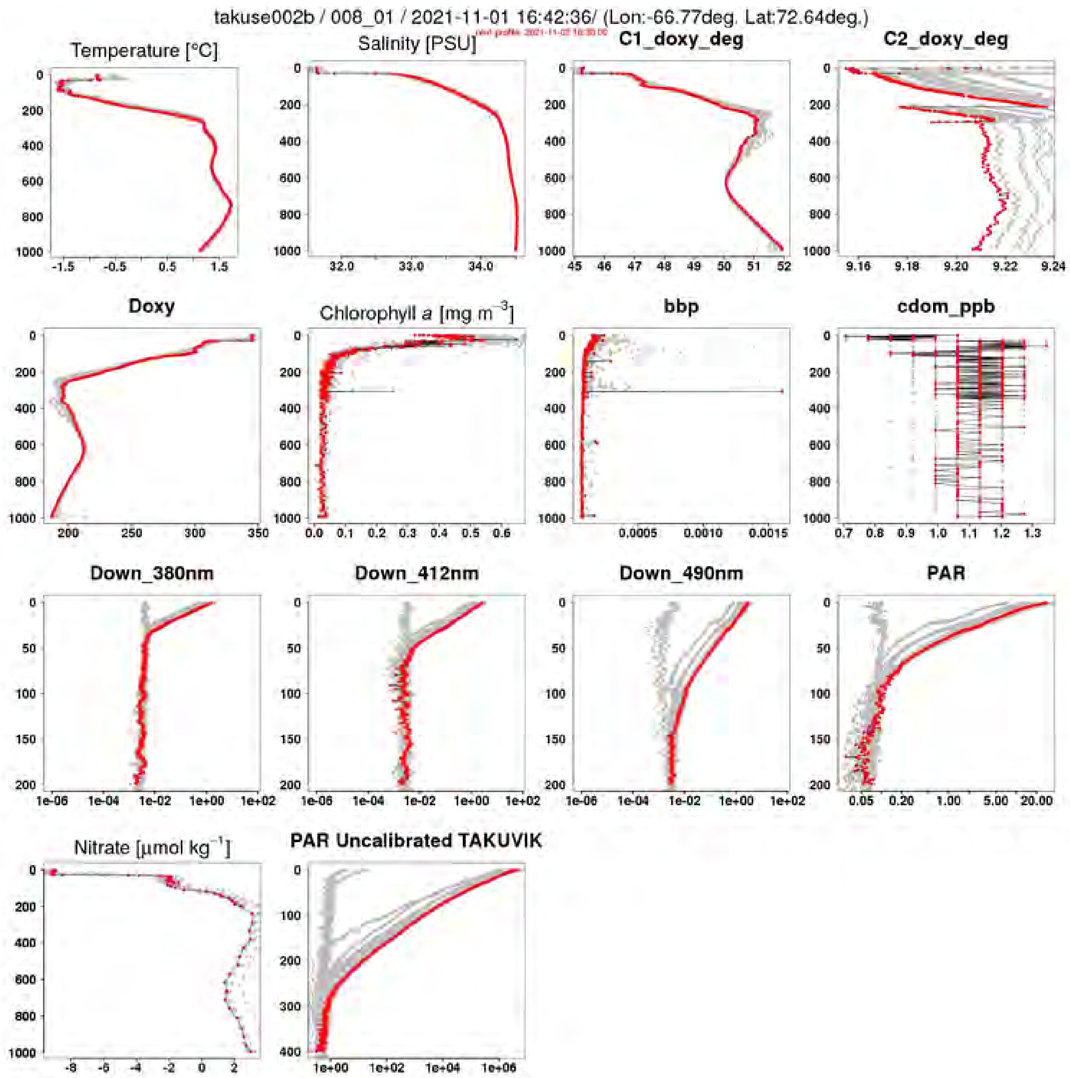

Figure 11-1: Data received from takuse002b

12 Underway measurements of phytoplankton productivity and trace gases

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

Cruise participants – Leg 3: Yayla Sezginer[1], Katrina Schuler[1]

[1] *Dept. Earth Oceans and Atmospheric Science, University of British Columbia, Vancouver, BC*

12.1 Introduction

During Leg 3 of the 2021 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 sampled surface and subsurface chlorophyll maxima water from the rosette at several stations (see below) to validate our underway measurements with discrete sample measurements of [insert variables measured], 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.

12.1.1 *Underway Dissolved Gases*

Atmospheric concentrations of these greenhouse gases 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 (5th IPCC report, 2013). 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 (Fenwick and Tortell, 2018). Research has suggested that these low-oxygen zones are expanding in response to anthropogenic climate change (IPCC, 2019), 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 over relevant scales (Fenwick et al., 2017). One of the objectives of this cruise was to deploy, for the first time, 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.

Another key objective of our underway gas sensor measurements is to continue a dataset obtained previously, where measurements of O_2 and N_2 were made to obtain high-resolution measurements of mixed layer net community production (NCP). NCP is a useful ecological metric that represents the balance between gross photosynthetic organic C-production and community-wide (i.e. autotrophic and heterotrophic) aerobic respiration, and is equivalent to carbon export on annual timescales. The dataset obtained this year will be compared to data obtained on Leg 2 of the 2019 cruise to begin to get a sense of the temporal variability, in addition to the spatial.

12.1.2 *Underway phytoplankton photophysiology and productivity sampling*

We employed continuous flow-through measurements with a Fast Repetition Rate Fluorometer for high-resolution mapping of a suite of photophysiological diagnostics, including photosynthetic quantum yields and electron transport. We also conducted parallel incubation experiments with 13C and 18O tracers to measure rates of phytoplankton carbon fixation and oxygen evolution. 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

12.2 Methodology

Table 12-1: Sampling locations for Leg 3 of the 2021 Amundsen Expedition. For all stations, the sample type used is PP incubation.

Region	Station ID	Type	LAT (N)	LONG (W)	Depth (m)
Baffin Bay	A4 (BB1)	KEBABB Basic	66.80170	58.76423	803
Baffin Bay	196	Basic	66.98333	56.06667	130
Baffin Bay	B3	KEBABB Full	67.33110	60.27758	1082
Baffin Bay	C2	KEBABB Basic	67.55238	61.90118	335
Baffin Bay	C5	Kebbab Full	68.14958	59.96658	1375
Baffin Bay	D4	KEBABB Basic	68.62100	62.00798	1810
Baffin Bay	E1	KEBABB Full	68.27860	65.13960	435
Baffin Bay	E4	KEBABB Basic	69.21027	63.33812	1575
Baffin Bay	116	Nutrient	76.37965	70.51880	150
Baffin Bay	110	Nutrient	76.29902	73.63352	528
Baffin Bay	108	Full	76.26395	74.59995	446
Ellesmere Island	Mit-1.02	Basic + Coring	76.93632	79.31792	58
Ellesmere Island	Mit-1.01	Basic + Coring	77.03008	78.82833	113
Lancaster Sound	300	Nutrient	74.31722	80.49825	723
Lancaster Sound	323	Basic	74.15637	80.47415	792

12.2.1 *Underway Nutrients*

Underway NO_3^- concentrations were measured with a SeaBird SUNA. Halfway through the leg, this SUNA was switched out for a spare lent by Amundsen Science after data acquisition was paused on our SUNA due to instrument difficulties (likely lamp failure). Discrete samples were periodically collected from the seawater line and chemically analyzed by the JET lab to account for instrument drift.

12.2.2 *Photophysiology and Primary Productivity*

A Fast Repetition Rate Fluorometer (FRRF) was applied to analyze characteristic excitation/relaxation responses in chlorophyll *a* fluorescence by applying a series of rapid light flashes to a seawater sample. A biophysical model, described by Kolber et al., (1998), was fit to the resulting excitation/relaxation Chl*a* fluorescence curves to determine the functional absorption cross section of the Photosystem II 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 parameters, photosynthetic electron transport can be calculated as a proxy for gross photosynthesis (Suggett, Prá\vsil, and Borowitzka 2010; Gorbunov and Falkowski 2021). Electron transport rates determined by FRRF were conducted at light levels increasing from 0 – 250 μmol photons m^{-2} s^{-1} to describe photosynthesis – irradiance relationships of underway surface phytoplankton assemblages, and incubated samples collected from the SCM. To provide information on the taxonomic and pigment composition of the assemblages sampled, SCM samples were filtered for HPLC analysis.

Primary productivity was measured using ^{13}C and ^{18}O tracers in water samples collected from the SCM incubated over 12 hour periods in on-deck flow through tanks. Fluorescence-based measurements of productivity were acquired by subsampling incubations at 4-hour intervals for photosynthesis – irradiance relationship measurements. Photosynthetic electron transport rates calculated as a function of irradiance were scaled by measured in-situ surface PAR to interpolate electron transport rates throughout the incubation period.

12.2.3 *Underway Gas Sampling*

We deployed a cavity ring-down gas analyzer (CRDS) and O_2 optode / Gas Tension Device (GTD) system in the Amundsen's paleo/geology laboratory during leg 3 of the 2021 Expedition (Figure 12-1). Water was pumped continuously from the ocean surface into the laboratory, and through the respective instruments. The CRDS and optode/GTD systems were run parallel to one another, and provided high spatial resolution measurements of the seawater CH_4 and N_2O and O_2/N_2 ratios, respectively. Approximately 90% of all stations with a rosette with water were sampled, taking discrete samples of surface water to calibrate the underway data (O_2/N_2 CH_4/N_2O and Nitrate).

The optode was calibrated by obtaining discrete samples for O_2 analysis from the seawater tap in the paleo/geology laboratory. Additional samples were obtained from surface of 10 m Niskin bottles, during Rosette sampling, to characterize potential changes in gas concentrations inside the ship's seawater supply lines. Discrete O_2 samples were analyzed onboard using our custom-built Winkler titration system. We observed a consistent offset between optode-derived and discrete O_2 samples. This offset was applied to the underway data to calibrate for instrument drift.

Calibration samples to determine the extraction efficiency of the gas equilibrator were also obtained from the Niskin (by K. Schuler) (serum bottles, with no bubbles, no headspace, poisoned with mercuric chloride and crimp sealed) and will be analyzed later. Discrete samples were also taking directly from the seawater line, just upstream of the equilibrator. These data will be used to calibrate the measurements made by the CRDS coupled with the equilibrator.

Figure 12-1: Underway Gas sampling set up

12.3 Preliminary results

12.3.1 *Underway Variable Fluorescence*

Result form the Underway Variable Fluorescence system are shown in Figure 12-2.

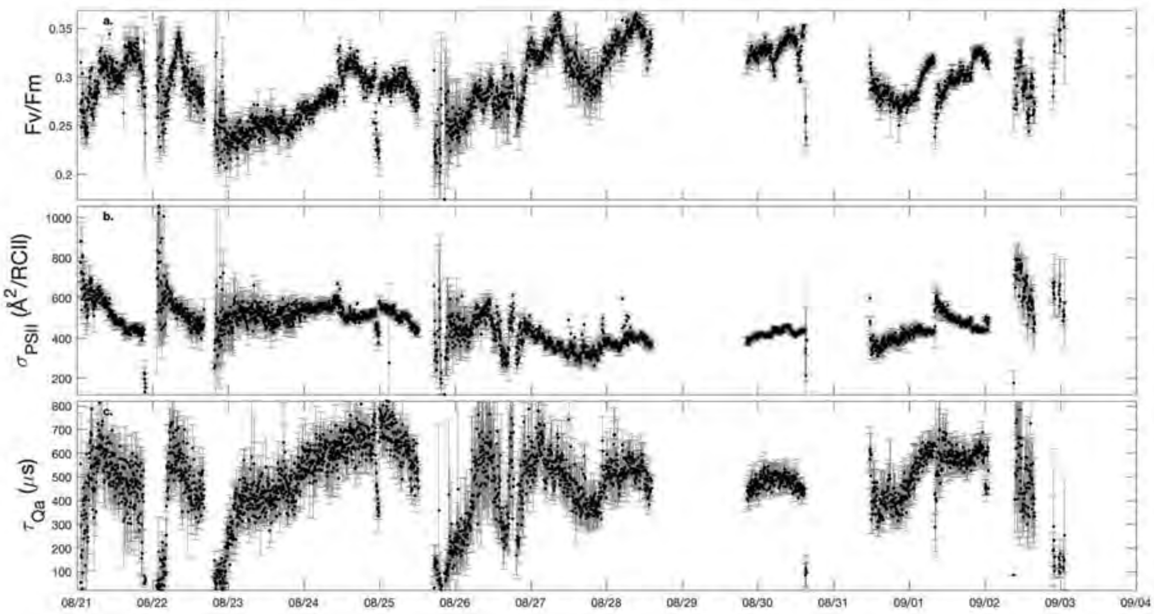

Figure 12-2: (a) Photosystem II photochemical efficiency, (b) Photosystem II functional cross sectional area, and (c) the turnover rate of the primary electron acceptor, Q_a, measured underway

12.3.2 *CH_4/N_2O*

The objective of measuring high-resolution methane and nitrous oxide was met. The accuracy obtained will be determined back in the laboratory in Vancouver, once the discrete samples have all been analyzed on the GCMS, however previous tests in the lab show good agreement. The objective of evaluating the stability of the extraction efficiency of gases in the membrane will also be evaluated with these discrete samples. However, preliminary measurements of air-equilibrated water (carboys bubbled with air) do not show any deterioration in extraction efficiency and discrete measurements are likely to follow the same pattern. Preliminary results show elevated methane concentrations in areas recently covered by ice (where the ice is breaking) and in a fjord where a glacier had rapidly and recently retreated (Mittie Glacier). Preliminary data shows that nitrous oxide values were remained very close to atmospheric equilibrium.

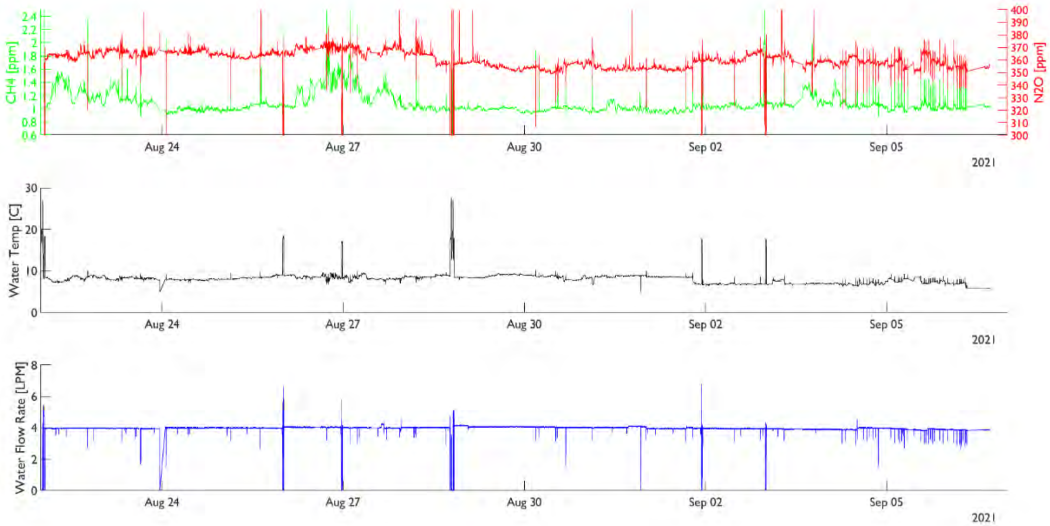

Figure 12-3: Raw data from ICOAS and equilibrator along the cruise track.

12.3.3 *O_2/N_2*

Data will be analyzed in more detail upon arrival to Vancouver. Overall, higher productivity was observed when on the Greenland side of Baffin Bay and Davis Strait.

12.4 Recommendations

- Bring more gloves, kimwipes, and pipette tips than you think you need!
- If all else fails, turn everything off and on again.
- When taking samples for trace gas analysis, leaving samples uncapped while transiting from the rosette shack to the fume hood two floors down may affect the final readings obtained (they can only be capped once they have been poisoned with mercuric chloride).

12.5 References

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13 Photosynthetic Parameters measurements during Polar Fall season

Project leaders: Marcel Babin[1] (marcel.babin@takuvik.ulaval.ca)

Cruise participants – Leg 5: Flavienne Bruyant[1]

[1]*Université Laval, UMI3376 Takuvik, Québec QC*

13.1 Introduction and Objectives

With the lengthening of the phytoplankton growth season in the Arctic, which includes the latening of the ice formation date, one seems to observe the emerging of a fall phytoplankton bloom (Ardyna et al., 2014). Questions about the functioning and potential impact of that fall bloom on the biology of the Arctic Ocean were the center of focus of the Dark Edge research cruise. Mainly one of the questions was to clearly quantify the potential primary production resulting from these events, as they might be bound to become more frequent in the future due to the effects of climate change. To answer these questions, photosynthetic parameters (potential maximum carbon fixation rate, low light carbon fixation rate efficiency and saturation parameter) were determined during the cruise using the P *vs.* E curve method.

13.2 Methodology

During the cruise, sea water samples were treated according to Babin et al. (1994) to determine the photosynthetic parameters. Briefly, sea water samples are inoculated with radioactive sodium bicarbonate ($NaH^{14}CO_3$) and incubated at 24 different light levels in temperature-controlled growth chambers for 2 hours. After incubation and filtration, inorganic carbon is removed from the samples by acidification, then the amount of radioactive ^{14}C incorporated into phytoplankton cells during incubation is counted on board using a liquid scintillation counter. Further calculations allow the fitting of a model (we use Jassby and Platt, 1976) describing photosynthesis from irradiance and the determination after normalization of the photosynthetic parameters, the specific maximum carbon fixation rate (P^b_{max}, mg C mg Chl *a*$^{-1}$ h^{-1}), the initial slope of the curve (α^b, mg C mg Chl *a*$^{-1}$h^{-1} (µmol Quanta m^{-2}s^{-1})$^{-1}$) describing the low light efficiency of the photosynthesis and the saturation parameter (Ek, µmol Quanta m^{-2}s^{-1}), an indicator of the light acclimation state of the phytoplankton population contained in the sample.

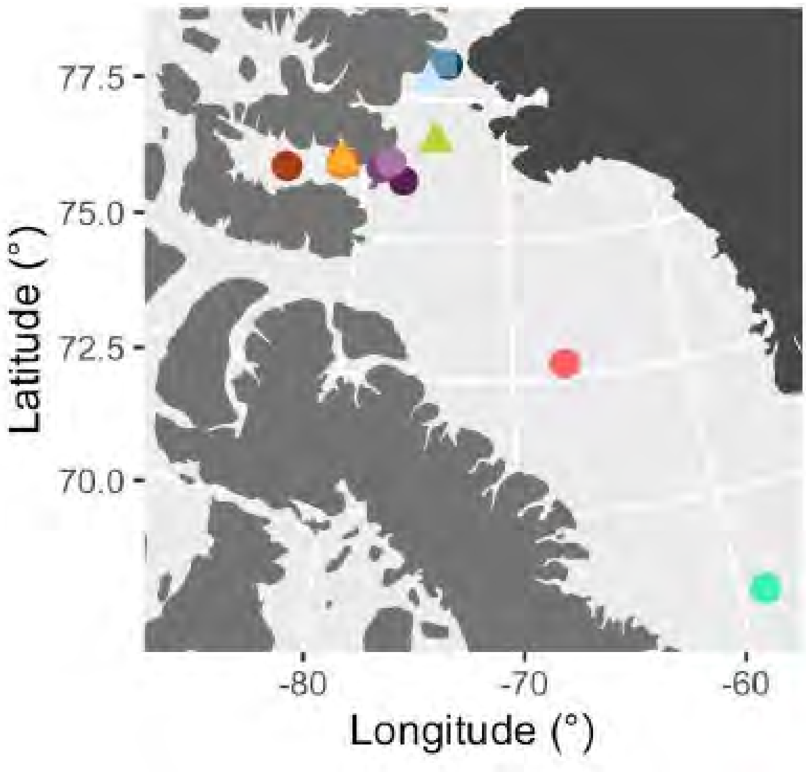

Figure 13-1: Map of the station sampled during the Dark Edge cruise.

During the leg 5 of the 2021 Amundsen science expedition, we performed this experiment at 4 depths at each stations sampled with a rosette around noon. Samples from sea ice (melted using filter sea water salinity compensation system) coming from the barge or from the canoe were analyzed as well. We also participated at a 36h long circadian cycle sampling by incubating water from the surface and the SCM every 3 hours (see

Table 13-1 for full list).

13.3 Preliminary results

Even though radioisotope samples can be counted on board, other data are necessary to interpret ours, including pigments concentrations and corrected absorption spectra which are not available yet. The only parameter we can look at is Ek (the saturation parameter, µmol quanta $m^{-2}s^{-1}$) which is only affected by the light level. Ek presents values that are higher at the surface and lower at higher depths which is expected. Although values of Ek are in general higher than expected at the surface (we measured values up to 60 µmol quanta $m^{-2}s^{-1}$ which is higher than the ambient light). The most striking part of our experiment was the amount of light that was necessary to obtain samples to present photoinhibition (up to 800 µmol quanta $m^{-2}s^{-1}$, which is far above the summer ambient light).

Table 13-1: Full list of station and depth sampled

Station	Cast #	# of depth sampled	Comment
DE110	002	4	
DE120	005	4	
DE130	007	4	
DE210	Ice/Water	NA	From Zodiac
DE310	010	4	
DE320	013	4	
DE320	Ice	NA	From Canoe
DE410	018	2	36h start
DE410	019	2	
DE410	020	2	
DE410	021	2	
DE410	022	2	
DE410	024	2	36h stop
DE420	027	4	
DE430	031	4	
DE430	Ice/Water	NA	From Barge (2 samples)
DE440	Ice/Water	NA	From Canoe (2 samples)
BB2	040	2	
DE500	041	2	

13.4 Recommendation

The radvan water pipes froze. Twice. To my knowledge (and to the senior's as well) this is the first time it happens. Problem was fixed by installing a heating cable around the pipes all the way to the inside of the radvan under the sink. This should be made mandatory for the radvan installation, as lack of running water presents a hazard for people in the radvan.

13.5 References

Babin, M., Morel, A., & Gagnon, R. (1994). An incubator designed for extensive and sensitive measurements of phytoplankton photosynthetic parameters. Limnology and Oceanography, 39, 694–702.

14 Distributions of Trace Metals in the Canadian Arctic Archipelago and Baffin Bay

Project leaders: Jay Cullen[1] (jcullen@uvic.ca)

Cruise participants – Leg 3: Tia Anderlini[1]

Cruise participants – Leg 4: Tia Anderlini[1], Grayson Soetaert[1]

[1] *University of Victoria, School of Earth and Ocean Sciences, Victoria, BC*

14.1 Introduction

This work will act as a continuation and expansion of 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. Furthermore, the proposed research will contribute to the ArcticNet-supported project NTRAIN (Nutrient Transports and living marine Resources Across the Inuit Nunangat), lead by Dr. Jean-Éric Tremblay. 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 increasing Arctic warming, and subsequent sea ice and glacial melt.
iii. To gauge the change in trace metals 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 will cover 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 more detailed picture of the points of entry and exit of trace metals of interest will be presented. For instance, the research conducted in 2019 demonstrated that a high concentration of Pb is swept into Baffin Bay from the Atlantic with the West Greenland Current. This is due to the use of leaded gasoline in Europe and North America up until the 1990s, and its subsequent high concentration in the Atlantic Ocean (Boyle et al., 2014). Additionally, the high concentrations of dissolved Fe observed along the western coast of Greenland, as well as off the coast of Devon Island, may influence productivity. It is therefore important to continue to measure and record changes to these concentrations as the melt of sea-ice, glaciers, and permafrost continues to increase

14.2 **Methodology**

14.2.1 *Sample Collection*

Five trace-metal quality GO-FLO bottles were deployed on a Kevlar line at five depths per cast. Two casts were conducted per station for a total of 10 discrete depths from 12 m to a maximum of 504 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 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 (save 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.” Table 14-1 present a list of samples.

Additionally, surface samples were collected from the zodiac at most stations. Due to contamination from the ship, surface samples had to be 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 250 and 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 samples were then acidified to pH 1.7 using Seastar Baseline grade hydrochloric acid (Seastar Chemicals, Sidney, BC). 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 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). Salinity samples were periodically taken to verify depths, and filtered macronutrient samples were taken at every depth for comparison to rosette data.

14.2.2 *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.

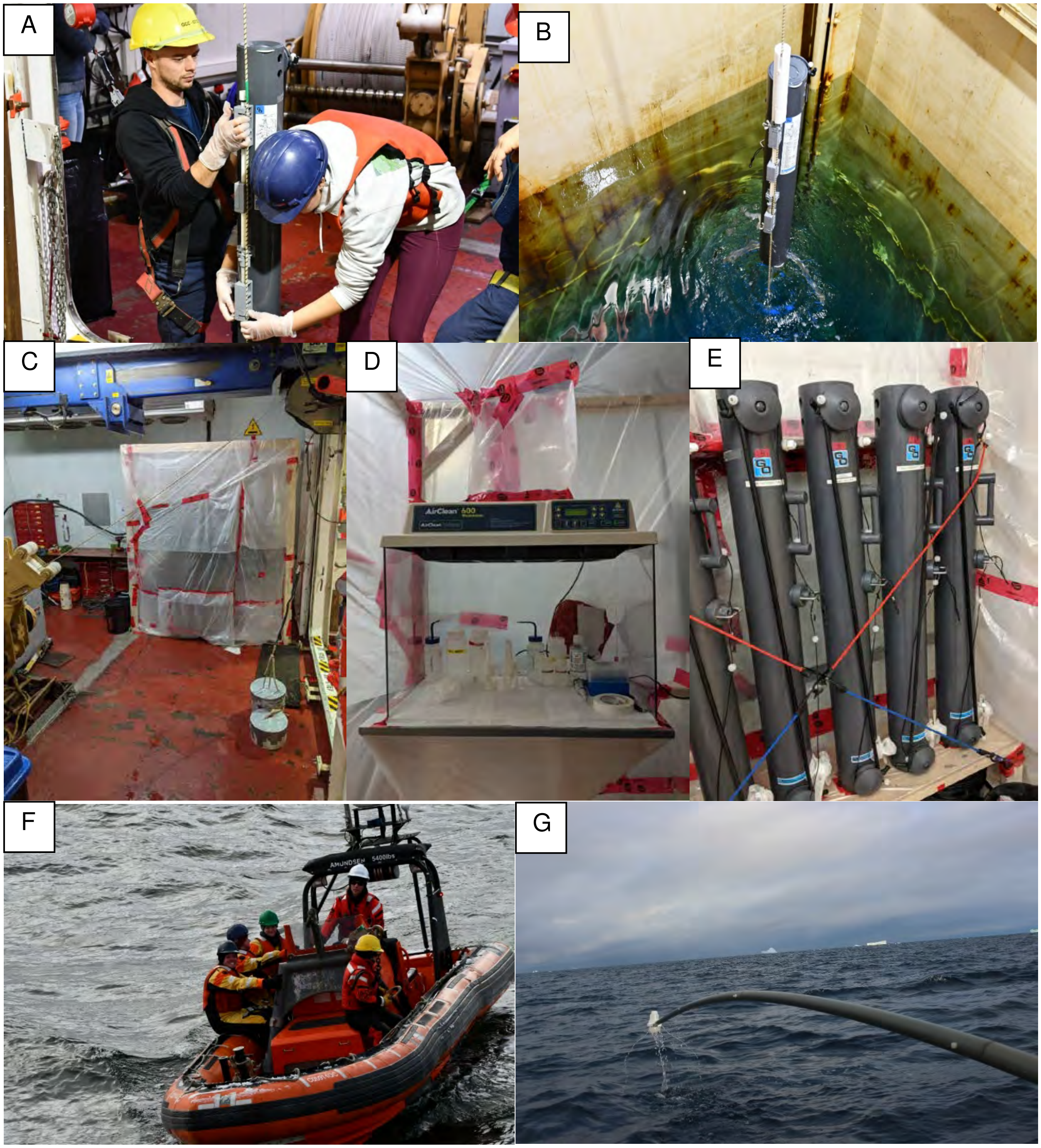

Figure 14-1: A) Attachment of GO-FLO bottle to Kevlar line, B) Recovery of GO-FLO bottle and messenger, C) Trace metal “cleanroom bubble, D) HEPA-filtered bench top. A “chimney” connected the input of the HEPA hood directly to the outside (moonpool room) air, E) GO-FLO stand, F) Returning from trace metal sampling on the zodiac, G) Trace metal pole sampling from the zodiac.

Table 14-1: List of samples taken during Leg 3 of the 2021 Expedition

Station	Depths (m)		
	Filtered	Unfiltered	Macronutrients
A1 (190)	12, 24, 36, 48, 60	0, 12, 24, 36, 48, 60	0, 12, 24, 36, 48, 60
A4 (BB1)	12, 24, 36, 48, 60, 72, 84, 108, 132, 180	0	0, 12, 24, 36, 48, 60, 72, 84, 108, 132, 180
196	12, 24, 36, 48, 60, 72, 84, 108	0	0, 12, 24, 36, 48, 60, 72, 84, 108
198	17, 29, 41, 53	17, 29, 41, 53	17, 29, 41, 53
B1	12, 24, 36, 48, 60, 72, 84, 96	12, 24, 36, 48, 60, 72, 84, 96	12, 24, 36, 48, 60, 72, 84, 96
B2	12, 24, 36, 48, 60, 72, 84, 108, 132, 180	0	0, 12, 24, 36, 48, 60, 72, 84, 108, 132, 180
D1	12, 24, 36, 48, 60, 72, 84, 108, 132, 180	0, 12, 24, 36, 48, 60, 72, 84, 108, 132, 180	0, 12, 24, 36, 48, 60, 72, 84, 108, 132, 180
D2	12, 24, 36, 48, 60, 72, 84, 108, 132, 180	0	0, 12, 24, 36, 48, 60, 72, 84, 108, 132, 180
E1	12, 24, 36, 48, 60, 72, 84, 108, 132, 180	0, 12, 24, 36, 48, 60, 72, 84, 108, 132, 180	0, 12, 24, 36, 48, 60, 72, 84, 108, 132, 180
E3	12, 24, 36, 48, 60, 72, 84, 108, 132, 180	0	0, 12, 24, 36, 48, 60, 72, 84, 108, 132, 180
E5	12, 24, 36, 48, 60, 72, 84, 108, 132, 180	0, 12, 24, 36, 48, 60, 72, 84, 108, 132, 180	0, 12, 24, 36, 48, 60, 72, 84, 108, 132, 180
116	12, 24, 36, 48, 60, 72, 84, 96, 108, 120	0, 12, 24, 36, 48, 60, 72, 84, 96, 108, 120	0, 12, 24, 36, 48, 60, 72, 84, 96, 108, 120
115	12, 24, 36, 48, 60, 108, 132, 180, 300, 504	0	0, 12, 24, 36, 48, 60, 108, 132, 180, 300, 504
111	12, 24, 36, 48, 60, 108, 132, 180, 300, 504		12, 24, 36, 48, 60, 108, 132, 180, 300, 504
108	12, 24, 36, 48, 60, 108, 132, 180, 300, 408	0, 12, 24, 36, 48, 60, 108, 132, 180, 300, 408	0, 12, 24, 36, 48, 60, 108, 132, 180, 300, 408
101	12, 24, 36, 48, 60, 108, 132, 180, 300, 324	0	0, 12, 24, 36, 48, 60, 108, 132, 180, 300, 324
100	12, 24, 36, 48, 60, 84, 108, 132, 144, 204	12, 24, 36, 48, 60, 84, 108, 132, 144, 204	12, 24, 36, 48, 60, 84, 108, 132, 144, 204
SB1	43, 67, 163, 199	43, 67, 163, 199	43, 67, 163, 199
325	12, 24, 36, 48, 60, 108, 132, 180, 300, 504	12, 24, 36, 48, 60, 108, 132, 180, 300, 504	12, 24, 36, 48, 60, 108, 132, 180, 300, 504
305D	12, 24, 36, 48, 60, 72, 84, 96, 108		12, 24, 36, 48, 60, 72, 84, 96, 108
305B	12, 24, 36, 48, 60, 72, 84, 96, 120, 144		12, 24, 36, 48, 60, 72, 84, 96, 120, 144
S10	12, 24, 36, 48, 60, 72, 84, 108, 132, 168	0	0, 12, 24, 36, 48, 60, 72, 84, 108, 132, 168
S8	12, 24, 36, 48, 60, 70, 82, 106, 130, 178		12, 24, 36, 48, 60, 70, 82, 106, 130, 178
S5	12, 36, 60, 108, 216		12, 36, 60, 108, 216
S3	13, 25, 37, 49, 61, 81, 93, 105, 117, 141	0	0, 13, 25, 37, 49, 61, 81, 93, 105, 117, 141

Table 14-2: List of samples taken during Leg 4 of the 2021 Expedition

Station	Depths (m)

	Filtered Trace Metals	Macronutrients
310E	12, 24, 36, 48, 60, 72, 84, 96, 108	12, 24, 36, 48, 60, 72, 84, 96, 108
312	0 (unfiltered), 12, 24, 36, 48	0, 12, 24, 36, 48
C010	0 (unfiltered), 12, 24, 36, 48, 60, 72, 84	0, 12, 24, 36, 48, 60, 72, 84
QMG4	0 (unfiltered), 12, 24, 36, 48, 60	0, 12, 24, 36, 48, 60
314	12, 24, 36, 48, 60	12, 24, 36, 48, 60
316	0 (unfiltered), 12, 24, 36, 48, 60, 84, 108, 132, 144, 156	0, 12, 24, 36, 48, 60, 84, 108, 132, 144, 156
403	12, 24, 36, 48, 60, 96, 132, 204, 300, 384	12, 24, 36, 48, 60, 96, 132, 204, 300, 384
C015 (405)	12, 24, 36, 48, 60, 132, 204, 300, 408, 504	12, 24, 36, 48, 60, 132, 204, 300, 408, 504
407	12, 24, 36, 48, 60, 96, 132, 204, 300, 372	12, 24, 36, 48, 60, 96, 132, 204, 300, 372
409	0 (unfiltered), 12, 24, 36, 48, 60, 72, 84	0, 12, 24, 36, 48, 60, 72, 84
414	12, 24, 36, 48, 60, 84, 108, 156, 204, 288	12, 24, 36, 48, 60, 84, 108, 156, 204, 288
420	0 (unfiltered), 12, 24	0, 12, 24
434	12, 24	12, 24
430	9, 21, 33, 45, 57	9, 21, 33, 45, 57
435	0 (unfiltered), 12, 24, 36, 48, 60, 81, 105, 141, 189, 285	0, 12, 24, 36, 48, 60, 81, 105, 141, 189, 285
421	12, 24, 36, 48, 60, 84, 204, 300, 408, 504	12, 24, 36, 48, 60, 84, 204, 300, 408, 504
482	12, 24, 36, 48, 60, 84, 204, 300, 408, 504	12, 24, 36, 48, 60, 84, 204, 300, 408, 504
476	0 (unfiltered), 12, 24, 36, 48, 60, 84, 108, 132, 180, 252	0, 12, 24, 36, 48, 60, 84, 108, 132, 180, 252
470 (PCB-17)	12, 24, 36	12, 24, 36
PCB-17A	12	12
516	0 (unfiltered), 12, 24, 36, 48, 60, 84, 132, 180, 300, 456	0, 12, 24, 36, 48, 60, 84, 132, 180, 300, 456
518	12, 24, 36, 48, 60, 84, 132, 180, 300, 408	12, 24, 36, 48, 60, 84, 132, 180, 300, 408

14.3 Recommendations

It is recommended to not use the moonpool for future deployment of trace metal equipment. 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 data is 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, trace metal sampling had to be cancelled at several stations due to strong currents and the risk of the bottles being unrecoverable. In such cases, the line was pulled by the current at such an angle that the GO-FLO bottles would be at risk of hitting and scraping along the moonpool opening. In one instance, a bottle was severely broken when it hit the moonpool during recovery.

It is also recommended to check that the winch is properly reading the line prior to the expedition. 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.

It is recommended to use the water pump to remove ice and snow when visibility is limited. This is 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 bottle and be brought into the clean lab, resulting in a contamination source for everything else in the clean lab. Hot water from the aforementioned outlet was released during the first cast of station 518. Therefore, the results of this cast may show the impacts of this contamination.

If a trace metal rosette is used in the future, it is possible the same problems of sampling in the moonpool will not occur, due to the greater weight of the rosette vs. individual bottles (i.e. greater resistance to the current). However, the rosette will not be able to sample at 10 m depth due to its position in the moonpool. The shallowest depth again would be 12 m.

It is recommended to save the bucket weights for future trace metal sampling.

Finally, it is recommended that the science cruise participant deploys the messenger rather than the crew. In one instance, excessive force was used when deploying the messenger, which resulted in part of a GO-FLO lever breaking off. Furthermore, the science cruise participant should be able to hold the line to confirm bottle closures. While this was possible in 2019, sampling from the moonpool caused safety concerns in terms of leaning too far over the moonpool edge when not latched in (due to the need to move frequently in and out of the lab).

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15 Water sampling during Leg 2

Project leader: Owen Sherwood[1]

Cruise participants – Leg 2: Shao-Min Chen[1], Simone Booker[1], Judith Vogt[2]

[1]Department of Earth and Environmental Sciences, Dalhousie University, Halifax, NS
[2]Department of Earth Sciences, St. Francis Xavier University, Antigonish, NS

15.1 Pelagic POM sampling in seawater (Chen)

Compound-specific isotope analysis (CSIA) of amino acids (AAs) is an emerging tool to trace carbon (C) and nitrogen (N) origins and their biogeochemical processing in food webs. Stable carbon isotopes of AAs (δ^{13}C-AA) reflect phylogenetic origins of fixed carbon in primary producers, while stable nitrogen isotopes of AAs (δ^{15}N-AA) reflect baseline sources of N as well as eukaryotic and bacterial heterotrophic processing in consumers and detrital organic matter. To establish the δ^{13}C-AA and δ^{15}N-AA "fingerprints" of pelagic algae in the Northern Labrador Sea and the Arctic, pelagic particulate organic matter (POM) was collected from seawater samples for CSIA, High-performance liquid chromatography (HPLC), and taxonomy identification (Table 1).

Seawater samples were collected from the surface and the deep chlorophyll maximum (DCM) using the CTD-rosette sampler. Seawater was drawn directly into 20-L jugs and stored in dark in the lab. Immediately after the collection, up to 1 L of seawater from each depth was gently filtered through 0.2-µm GF/F filters using a vacuum pump within 40 min (Fig. 1a). The filters were flash-frozen in liquid nitrogen and stored immediately at the -80℃ freezer until analysis for HPLC. At stations of HiBio-A, HiBio-C, Disko Fan and Scott Inlet, ~750 ml of seawater from the surface was transferred to a 1-L plastic bottle and stored at the -20℃ freezer for further taxonomy identification. The remaining 18-19 L seawater in the jugs was filtered through the size-fractionated filtration system with filters of 180-µm, 20-µm, 3-µm, and 0.2-µm pore size sequentially (Fig. 1b). Filters were swapped after 3 hours allowing for filtration for up to another 3 hours. Filters were stored at the -80℃ freezer until analysis for CSIA of amino acids.

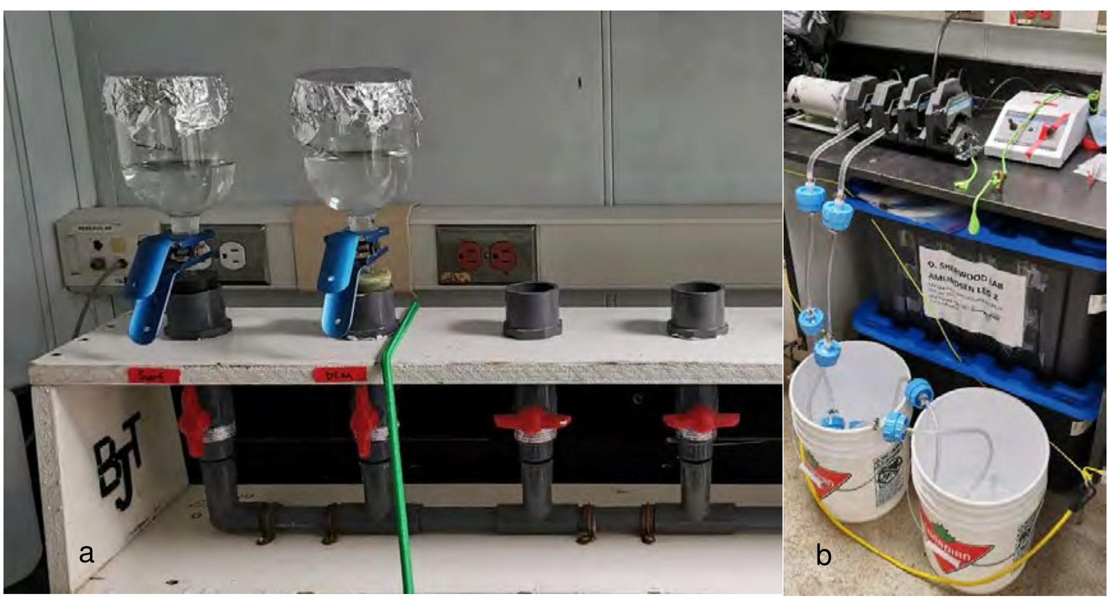

Figure 15-1: Filtration setup for HPLC samples (a) and the size-fractionated filtration system for CSIA samples (b).

15.2 Nutrient and δ^{15}N-NO_3 sampling in seawater (Booker, Vogt)

To characterize the nutrient and δ^{15}N-NO_3 profiles in the water column, seawater samples were collected from different depths across the water column using the CTD-rosette sampler (Table 1, Fig. 2). For surface, 10 m and 20 m, only one 60-ml bottle was filled for nutrient. For other depths from the top 200 m, seawater was filtered through a 0.45-μm filter using a 60-ml syringe and filled ¾ full of the two 60-ml bottles, one for nutrient and one for δ^{15}N-NO_3, leaving headspace for expansion during freezing. The cap was sealed using electrical tape and placed in a dark plastic bag immediately. A new filter was used for each depth. For each depth from below 200 m, the two 60-ml bottles were directly rinsed for three times. Seawater was directly drawn into the bottles and filled ¾ full. The cap was sealed using electrical tape and placed in a dark plastic bag immediately. Samples in 60-ml bottles were stored upright at the -20℃ freezer immediately.

Figure 15-2: Nutrient and δ^{15}N-NO_3 sampling at the CTD-Rosette.

Table 15-1: Nutrient, d^{15}N-NO_3, and pelagic POM samples collected from the CTD-Rosette during the expedition. Depth here is the bottom depth from the rosette log. Samples taken are marked by symbol "x"

Station ID	Latitude	Longitude	Depth (m)	Nutrient	δ^{15}N-NO_3	Pelagic POM
644	54.82	-53.21	978	x	x	x
652	55.65	-55.54	2408	x	x	
Makkovik	55.54	-58.95	776	x	x	x
HiBio-A	60.45	-61.27	460	x	x	x
HiBio-C	60.46	-61.17	967	x	x	x
Hatton Sill	61.44	-60.65	643	x	x	
David Strait	63.35	-58.27	1287	x	x	x
SF-3.1	66.76	-62.33	242	x	x	x
Disko Fan	67.88	-59.37	931	x	x	x
Scott Inlet Deep	71.39	-70.30	698	x	x	x
Clark Fjord	71.05	-71.58	679			x

15.3 Sympagic POM sampling in sea ice (Chen)

To fingerprint the δ^{13}C-AA and δ^{15}N-AA patterns of sympagic (sea-ice associated) algae and compare them with those of pelagic algae, sympagic POM was collected from surface brash ice pieces for CSIA, HPLC, and taxonomy identification (Table 2).

Surface brash ice pieces were picked up by hand or a shovel in a cage which was lowered by a crane from the bow of the ship (Fig. 3a). The sea ice was immediately covered in dark and transferred to the lab. Filtered seawater was added to the buckets of sea ice to allow for melting at room temperature for ~24 hours (Fig. 3b). Immediately after melting, up to 1 L of melted water was gently filtered through 0.2-μm GF/F filters using a vacuum pump within 40 min. The filters were flash-frozen in liquid nitrogen and stored immediately at the -80℃ freezer until analysis for HPLC. About 750 ml of melted water was transferred to a 1-L plastic bottle and stored at the -20℃ freezer for taxonomy identification. The remaining melted water was filtered through the size-fractionated filtration system with filters of 180-μm, 20-μm, 3-μm, and 0.2-μm pore size sequentially. Filters were swapped after 3 hours allowing for filtration for up to another 3 hours. Filters were stored at the -80℃ freezer for CSIA of amino acids.

Figure 15-3 Sea ice sampling in the cage lowered by the crane at station SF-3.1 © Eugenie Jacobsen (a) and collected sea ice melting at room temperature in filtered seawater in buckets (b).

15.4 Zooplankton/fecal pellet collection (Chen, Booker)

To characterize the δ^{13}C-AA and δ^{15}N-AA patterns of zooplankton and their fecal pellet, and investigate their contribution to export production, zooplankton was collected from the Hydrobios plankton net sampling for CSIA (Table 2).

After the net was retrieved, the zooplankton in the net was gently poured into the incubation chambers filled with filtered seawater, which consisted of an interior container with a mesh bottom of 308 μm pore size and an intact exterior bucket. The zooplankton was incubated in the filtered seawater above the mesh and their fecal pellets fell through the mesh into the exterior bucket. After incubation of 6-12 hours, zooplankton was transferred into a labeled plastic bag from the mesh of the interior container. The filtered seawater containing fecal pellets in the exterior bucker was sieved though a 53 μm sieve and the fecal pellets were collected into a labeled plastic bag. Both zooplankton and fecal pellets were immediately frozen at the -20℃ freezer for CSIA of amino acids.

15.5 Core-top sediment collection (Booker)

To estimate the relative contribution of phytoplankton and sea ice algae to export production and to characterize the spatial variability of the $\delta^{13}C_{AA}$ and $\delta^{15}N$-AA signatures of export production, core-top sediment samples were taken from each box core (Table 2). A spoonful of sediment was taken from the undisturbed top 1-cm surface. The sediment was transferred to a plastic bag and stored at -20℃ until further analysis.

Table 15-2 Sympagic POM samples collected from melted surface sea ice, zooplankton and fecal pellets collected from the Hydrobios net, and core-top sediment samples collected from the box cores during the expedition. Depth here is the bottom depth from the rosette log. Samples taken are marked by symbol "x".

Station ID	Latitude	Longitude	Depth (m)	Sympagic POM	Zooplankton	Surface sediment
644	54.82	-53.21	978			x
652	55.65	-55.54	2408			x
Makkovik	55.54	-58.95	776		x	x
Kelp 2021	58.67	-62.60	140		x	x
HiBio-A	60.45	-61.27	460		x	
HiBio-C	60.46	-61.17	967		x	
David Strait	63.35	-58.27	1287		x	x
SF-3.1	66.76	-62.33	242	x		x
Disko Fan	67.88	-59.37	931		x	x
Scott Inlet Deep	71.39	-70.30	698		x	x
Clark Fjord	71.05	-71.58	679	x		
Cum-8.2	64.97	-64.85	798			x

15.6 Total inorganic carbon (TIC) and total alkalinity (TA) sampling in seawater

(Booker and Vogt on behalf of Azetsu-Scott)

Water samples were collected at stations 652, Makkovik Bank, mooring stations HiBio-A and HiBio-C, Hatton Sill, Davis Strait, Southwind Fjord (SF-3.1), Disko Fan, and Scott Inlet Deep. At all sites water was collected into glass jars (500 mL) at consistent depths throughout the water column (Table 1). These samples were fixed with mercuric chloride ($HgCl_2$) following established protocols and kept in a cold room (4°C). Samples will be sent to the Bedford Institute of Oceanography (BIO, Dartmouth) for analysis (K. Azetsu-Scott).

Table 15-3: pCO2 and CH4 water samples collected from the CTD-Rosette during the expedition.

Station	Lat	Lon	Depth
Station 652	55.64	-55.52	0, 10, 20, 30, 50, 80, 100, 150, 200, 220, 300, 500, 700, 1000, 1500, BTM-10, 2x surface Judith
MAK	55.54	-58.96	0, 10, 20 30 50, 80, 250, 500, BTM, 2x surface Judith
Kelp	58.67	-62.60	0, 10, 20, 50, BTM-20, BTM
HiBioA	60.44	-61.27	0, 10, 50, 100, 300, BTM-10
HiBioC	60.47	-61.19	0, 10, 20, 20, 50, 100, 300, 600, 900, BTM-10
HAT	61.43	-60.69	0, 10, 20, 30, 50, 100, 300, 500, BTM-10
Davis	63.36	-58.27	0, 10, 20, 30, 50, 100, 500, 700, 900, BTM
SF3.1	66.76	-62.33	0, 10, 20 30 50, BTM
Disko	67.88	-59.36	0, 10, 20, 30, 50, 100, 200, 500, 700, BTM-10
Scott	71.39	-70.30	0, 10, 20, 30 ,50 100, 150, 200, 300, 500, BTM-10

15.7 pCO_2 and CH_4 sampling in seawater (Booker and Vogt on behalf of Azetsu-Scott)

Water samples were collected at stations 652, Makkovik Bank, mooring stations HiBio-A and HiBio-C, Hatton Sill, Davis Strait, Southwind Fjord (SF-3.1), Disko Fan, and Scott Inlet Deep. At all sites, water was collected into glass jars (160 mL) at consistent depths throughout the water column (Table 2). These samples were fixed with mercuric chloride ($HgCl_2$) following established protocols and kept in a cold room (4°C). Samples will be sent to the Bedford Institute of Oceanography (BIO, Dartmouth) for analysis (K. Azetsu-Scott).

Table 15-4: pCO2 and CH4 water samples collected from the CTD-Rosette during the expedition

Station	Lat	Lon	Depth
Station 652	55.64	-55.52	0, 10, 20, 30, 50, 80, 100, 150, 200, 220, 300, 500, 700, 1000, 1500, BTM-10, 2x surface Judith
MAK	55.54	-58.96	0, 10, 20 30 50, 80, 250, 500, BTM, 2x surface Judith
Kelp	58.67	-62.60	0, 10, 20, 50, BTM-20, BTM, 2x surface Judith
HiBioA	60.44	-61.27	0, 10, 50, 100, 300, BTM-10, 2x surface Judith
HiBioC	60.47	-61.19	0, 10, 20, 20, 50, 100, 300, 600, 900, BTM, 2x surface Judith
HAT	61.43	-60.69	0, 10, 20, 30, 50, 100, 300, 500, BTM, 2x surface Judith
Davis	63.36	-58.27	0, 10, 20, 30, 50, 100, 500, 700, 900, BTM, 2x surface Judith
SF3.1	66.76	-62.33	0, 10, 20 30 50, BTM, 2x surface Judith
Disko	67.88	-59.36	0, 10, 20, 30, 50, 100, 200, 500, 700, BTM-10, 2x surface Judith
SI1.1	71.38	-70.08	0
SI1.2	71.38	-70.08	0
Stn0t2	71.38	-70.07	0, 10, 20, 30, 50, 80, 100, 150, 200, BTM-10, surface Judith
SE-1K	71.37	-70.05	0, surface Judith
NE-1K	71.39	-70.06	0, surface Judith
NE-5K	71.41	-69.98	0, surface Judith
Scott	71.39	-70.30	0, 10, 20, 30 ,50 100, 150, 200, 300, 500, BTM-10, surface Judith
Stn0t1	71.38	-70.08	surface Judith
Gib-3.1	70.65	-72.48	0, surface Judith

16 RADCARBBS Program Field Report

Radiocarbon ($\Delta^{14}C$) and stable carbon ($\delta^{13}C$) isotopic measurements of dissolved inorganic carbon (DIC), dissolved organic carbon (DOC), and particulate organic carbon (POC) in seawater between Baffin Bay and the Beaufort Sea

Project leaders: Brett Walker[1] (brett.walker@uottawa.ca)

Cruise participants – Leg 4: Aislinn Fox[1], Liam Jasperse[1], Kayla McKee[1]

[1] *Department of Earth and Environmental Sciences, University of Ottawa, 25 Templeton St., Ottawa, ON K1K 6N5*

16.1 Introduction and Objectives

Dissolved inorganic and organic carbon (DIC, DOC) make up the vast majority of carbon in the ocean. The DIC reservoir is ~38,000 GtC, DOC reservoir is ~662GtC, comparable to the total C content in the atmosphere. The particulate organic carbon (POC) reservoir is a small (~35 GtC) but rapidly cycling (<10 yr) pool of marine carbon (Beaupré, 2019). Radiocarbon and stable carbon measurements of these marine carbon pools are powerful tools, which can inform us of water mass ages and ventilation rates, fluxes of anthropogenic carbon into the marine environment, and the role of the biological and microbial carbon pumps in mitigating Earth's climate on modern to millennial timescales. Little radiocarbon currently exists regarding the major marine carbon pools in the Arctic, with none for the Canadian Arctic Archipelago (Griffith et al., 2012; Druffel et al., 2017).

This study addresses fundamental gaps in our knowledge Arctic carbon cycling by providing much needed quantitative information on the timescale of water mass ventilation, and the cycling of DOC and POC in the western Canadian Arctic. Our specific focus is the radiocarbon age distribution of all marine carbon pools within the Northwest Passage and the southwestern Beaufort Sea. Our work will help to further understand the marine carbon cycle in a rapidly changing Canadian Arctic. More specifically, these results will tell us: 1) how and where most marine carbon is produced in the Northwest Passage (i.e. by marine phytoplankton or by riverine input from land), 2) how long it will persist (i.e. how marine carbon forms can sequester atmospheric carbon dioxide) and 3) how microbes can use this marine carbon, respiring it back into the atmosphere as carbon dioxide (a powerful greenhouse gas), or instead transforming it into stable forms that can be stored in deep sea. These results will represent the very first radiocarbon measurements of marine carbon pools in the Canadian Arctic Archipelago, as well as providing new data regarding carbon pools in the southwestern Beaufort Sea.

16.2 Methodology

All water samples were collected via CTD-Rosette system. Samples were collected directly from Niskin bottles via acid cleaned silicone tubing to minimize the addition of extraneous carbon and the potential for radiocarbon contamination.

$DO^{14}C$ (as $\Delta^{14}C$) samples were sampled in pre-combusted (540°C/2h) 1L borosilicate bottles (amber boston rounds). $DO^{14}C$ duplicates were collected at every station at varying depths. Samples above 400m depth were filtered using pre-combusted 70mm GF/F filters (<0.7µm), acid cleaned silicone tubing and a custom built 316 stainless steel 70mm filter manifold. Samples were immediately frozen after collection and stored at -20°C for analysis at the University of California, Irvine. Once in the lab, samples will be acidified and sparged of dissolved inorganic carbon, and DOC will be converted to CO_2 gas via UV oxidation and vacuum line extraction (Beaupre et al., 2007; Walker et al., 2019). This CO_2 gas will be graphitized, and its radiocarbon content measured via AMS at the Keck Carbon Cycle AMS laboratory at UCI. DOC $\delta^{13}C$ will also be measured in a split of the CO_2 from each sample using light isotope mass spectrometry.

$DI^{14}C$ samples were collected in pre-cleaned (10% HCl soak and MQ water rinse) and combusted (540°C/2h) 250 mL round Pyrex media bottles. Depths sampled for $DI^{14}C$ were the same as those for $DO^{14}C$. Samples were overfilled 3x and collected with zero headspace, poisoned in the lab with 1 drop (50µl) saturated $HgCl_2$ and stored in the dark at room temperature until analysis at the University of Ottawa. DIC samples were not filtered for fear of introducing gas bubbles. Once in the lab, $DI^{14}C$ samples will be acidified and the resulting CO_2 from dissolved inorganic carbon sparged, cryogenically purified and manometrically quantified following the methods of Gao and co-workers (Gao et al., 2014). This CO_2 gas will be graphitized, and its radiocarbon content measured via AMS at the Keck Carbon Cycle AMS laboratory at UCI. DIC $\delta^{13}C$ will also be measured in a split of the CO_2 from each sample using light isotope mass spectrometry.

Depth integrated samples of suspended POC ($PO^{14}C_{susp}$) were collected onto pre-baked (540°C/2h) 70mm QMA filters (2.0µm) stacked on top of a pre-baked GFF (0.7µm) in a custom manifold. POC_{susp} samples comprise a depth integrated (10-14 L) signature of all sampled Niskin bottles above 400m, and in some instances a minor contribution of bottom water (filtered when the Niskin was fired at a depth less than 100 meters above bottom to avoid nepheloid layer POC contributions to our DOC samples). In addition to depth-integrated samples, POC_{susp} was collected from two Niskins fired at the deep chlorophyll maximum (DCM). In cases where no DCM existed, Niskins were fired at the surface or at the oxygen maximum. 70mm QMA filters stacked on top of GF/F filters in a custom manifold were attached directly to the Niskin bottle via acid-cleaned silicone tubing and the Niskin allowed to drain completely. Approximately 10-12L passed through each filter. QMA and GF/F filters were removed following sampling and frozen immediately at -20°C for later analysis at the University of Ottawa.

Samples for TOC/TN were collected in 40ml amber vials. Sample depths above 400m were filtered in the same manner described above. After collection, 1 drop of 12N HCl was added and the samples frozen at -20°C. Two 10ml glass ampules were taken from each Niskin sampled. Triplicates were taken for one depth per station. After collection, 1 drop of satured $HgCl_2$ was added and the ampules flamed sealed using a butane torch. These samples will be measured using nuclear magnetic resonance spectroscopy at the University of Ottawa.

Table 16-1: Samples collected for the RADCARBBS program during Leg 4, 2021

Station	Region	Lat	Lon	Date	Time UTC	Depth (m)	Cast No.	Depths Sampled
C002	Parry Channel	73.965	-88.803	2021-09-11	23:58	411	2	Rosette; 0, 7, 10, 20, 30, 40, 50, 60, 70, 80, 100, 125, 150, 175, 200, 250, 300, 400m
C003	Prince Regent Inlet	72.364	-91.397	2021-09-11	12:41	388	3	Rosette; 0, 7, 10, 20, 30, 40, 50, 60, 70, 80, 100, 120, 145, 180, 200, 250, 300m
C004	Peel Sound	71.955	-95.840	2021-09-11	22:13	419	4	Rosette; 0, 7, 10, 20, 27.5, 30, 40, 50, 60, 70, 80, 100, 120, 140, 160, 180, 200, 250, 300, 411m
C009	Larsen Sound	70.705	-98.967	2021-09-12	13:50	201	6	Rosette; 0, 7, 10, 20, 30, 38, 40, 50, 60, 70, 80, 100, 120, 140, 160, 180m
312	Larsen Sound	69.171	-100.700	2021-09-13	0:56	68	7	Rosette; 0, 7, 10, 14, 20, 30, 40, 50, 60m
C010/ QMGM	Queen Maud Gulf	68.251	-101.628	2021-09-13	10:12	105	8	Rosette; 0, 7, 10, 20, 30, 37.5, 40, 50, 60, 70, 80, 90m

Station	Region	Lat	Lon	Date	Time UTC	Depth (m)	Cast No.	Depths Sampled
C011	Dease Strait	69.018	-106.621	2021-09-15	4:41	113	12	Rosette; 0, 7, 30, 40, 50, 60, 70, 80, 100m
C012	Coronation Gulf	68.328	-110.274	2021-09-15	13:45	292	13	Rosette; 0, 7, 10, 23, 30, 40, 50, 60, 70, 80, 100, 140, 180, 200, 250, 285m
C013	Union Strait	69.056	-114.785	2021-09-16	8:53	83	15	Rosette; 0, 10, 20, 40, 30, 50, 60, 83m
C014	Amundsen Gulf	69.620	-118.603	2021-09-16	18:13	517	16	Rosette; 0, 20, 42, 100, 140, 180, 300, 400, 500m
C015/405	Amundsen Gulf	70.667	-122.622	2021-09-17	11:59	586	18	Rosette; 0, 20, 30, 44, 70, 100, 140, 180, 300, 400, 500m
C016/414	Amundsen Gulf	71.424	-127.374	2021-09-19	6:36	304	27	Rosette; 0, 20, 30, 50, 70, 100, 140, 180, 300m
PCB-07	Beaufort Shelf	70.535	-131.495	2021-09-22	16:36	51	51	Rosette; 0, 10, 12, 20, 30, 40m
434	Beaufort Shelf	70.176	-133.555	2021-09-23	0:17	45	52	Rosette; 0, 7, 10, 20, 15, 30, 35m
435	Beaufort Slope	71.078	-133.776	2021-09-23	17:48	301	62	Rosette; 40m
482	Beaufort Shelf	70.524	-139.381	2021-09-27	0:48	820	76	Rosette; 56m
PCB-18/476	Beaufort Shelf	69.998	-138.629	2021-09-28	5:11	270	82	Rosette; 0, 10, 25, 30, 50, 70, 100, 140, 180m
PCB-17a	Beaufort Shelf	69.288	-137.279	2021-09-28	9:03	15	88	Rosette; 0m
PCB-12	Beaufort Shelf	70.277	-135.774	2021-09-30	18:19	54	93	Rosette; 0, 7, 10, 12, 30, 40, 45m
C018/546	Beaufort Sea Basin	71.742	-133.953	2021-10-01	19:33	1607	97	Rosette; 0, 10, 20, 30, 50, 100, 200, 300, 400, 500, 600, 700, 800, 900, 1000, 1200, 1500, 1600m
515	M'Clure Strait Central	75.007	-121.392	2021-10-04	7:43	488	101	Rosette; 0, 10, 25, 35, 50, 70, 100, 140, 180, 250, 300, 400m
518	M'Clure Strait South	74.599	-121.457	2021-10-04	17:32	435	103	Rosette; 0, 10, 20, 30, 50, 70, 100, 140, 180, 250, 300, 400m

16.3 Preliminary Results

No preliminary results to report, as all actual analyses will be performed either at the University of Ottawa André E. Lalonde Accelerator Mass Spectrometer Facility (AEL-AMS) or at the University of California, Irvine Keck Carbon Cycle Accelerator Mass Spectrometer Laboratory (KCCAMS).

16.4 References

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17 Knowledge and Ecosystem-Based Approach in Baffin Bay & Barrow Strait (KEBABB & KEBABS)

Project leaders: Christine Michel[1] (christine.michel@dfo-mpo.gc.ca)

Co-leads and Collaborators: Kevin Hedges[1], Zou Zou Kuzyk[2], Virginie Roy[3], Bill Williams[4], Jane Eert[4], Connie Lovejoy[5], Jean-Éric Tremblay[5], Brent Else[6], Maxime Geoffroy[7], Clark Richards[8]

Project Coordinator: Monika Pućko[1]

Cruise participants – Leg 3: Monika Pućko[1], Joannie Charette[1], Vincent Villeneuve[1], Pascal Tremblay[1], Lenore Vandenbyllaardt[1], Catherine Marcil[1], Stephen Ciastek[2], Sylvie Brulotte[3], Bruno St-Denis[3]

[1] *Freshwater Institute, Fisheries and Oceans Canada, 501 University Crescent, Winnipeg, MB*
[2] *Centre for Earth Observation Science (CEOS), University of Manitoba, Winnipeg, MB*
[3] *Maurice Lamontagne Institute, Fisheries and Oceans Canada, Mont Joli, QC*
[4] *Institute of Ocean Sciences (IOS), Fisheries and Oceans, Sidney, BC*
[5] *Laval University, Quebec City, QC*
[6] *University of Calgary, Calgary, AB*
[7] *Memorial University of Newfoundland, St. John's, NL*
[8] *Bedford Institute of Oceanography, Fisheries and Oceans Canada, Dartmouth, NS*

17.1 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.

In 2021, DFO conducted an additional program onboard the CCGS *Amundsen* – Knowledge and Ecosystem-Based Approach in Barrow Strait (KEBABS). The development of this program was connected to the creation of Tallurutiup Imanga National Marine Conservation Area (TN MCA) in Lancaster Sound and the associated mandate to monitor this newly created conservation area. The conservation target of the TN MCA is to conserve the biodiversity and cultural heritage of the region. The KEBABS objective in 2021 was to collect oceanographic data along the sampling line (line S) already established by DFO, which includes long-term oceanographic moorings and previous oceanographic sampling.

17.2 Methodology

The KEBABB program in 2021 was carried out during leg 3 of the CCGS *Amundsen* 2021 expedition by four teams:

1. Filtration team – Monika, Vincent (working on a shift-based schedule; Rosette sampling and filtrations), and Joannie (chlorophyll readings, operating the Fast-Repetition Rate Fluorometer, FRRF, and performing genomics sampling and filtrations as a collaboration with Connie Lovejoy's team),
2. Zooplankton team – Pascal, Lenore (working on a shift-based schedule; zooplankton nets deployments and taxonomy samples preservation), and Catherine (zooplankton sorting for fatty acid analysis and assistance with nets deployment),
3. Sediments team – Stephen – deploying the box core and taking push cores,
4. Benthos team – Sylvie and Bruno – deploying Agassiz Trawl, 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. Sites E5 and E4 were moved further offshore compared to 2019, so the coordinates of these stations have changed. Locations of stations A2, A3, A4, and A5 were moved north compared to 2019, to align with the NTRAIN program's extension of KEBABB's line A going across Davis Strait. KEBABB sites are designed to cover a coastal – offshore gradient, and were sampled between August 17th and August 29th, 2021, a very similar timing to the 2019 sampling period (August 22nd – August 31st).

The KEBABB filtration team also sampled on most of the NTRAIN basic and full stations 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. Joannie sampled for genomics (~ 6 L of water at the surface, chl. max, 200 m and bottom) at KEBABB full stations (stations 1, 3, and 5 on each transect), KEBABS stations, and NTRAIN full stations, and did additional sampling for metagenomics at station 115 in the Northwater Polynya (NOW) transect (14 L of water at the surface = Tmax, chl. max, 200 m, 63 m = Tmin, 310 m = O_2 min, and 12 L at the bottom). Some NTRAIN nutrient stations were sampled for a limited suite of biochemical parameters.

The KEBABS program consisted of 4 full stations, 4 nutrient stations, and 2 CTD (Conductivity, Temperature, Depth) stations distributed along line S, which were sampled on September 7th and 8th 2021.

The KEBABB filtration team sampled at each KEBABB and KEBABS station as well as at NTRAIN full and basic stations. Zooplankton nets and box cores were sampled by KEBABB zooplankton and sediment teams at KEBABB stations only. Additional sampling of zooplankton for fatty acid analysis was conducted at NTRAIN 198. Benthos was sampled on KEBABB stations and some NTRAIN stations using the Agassiz Trawl and the Beam Trawl. General sampling schedule is summarized in Table 17-1.

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 17-2 for KEBABB,

Table 17-3 for KEBABS, and Table 17-4 for NTRAIN full and basic stations. Fractionated chlorophyll *a* (total and > 5 µm) concentrations were measured onboard 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. Genomics (DNA), Particulate Organic Carbon/Particulate Nitrogen POC/PN and Fatty Acid (FA) samples were filtered and kept frozen, at -80 °C until further analysis. For the other analyses, water was subsampled in different bottles and kept at 4 °C or frozen (-80C, flow cytometry).

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) according to the strategy shown in Table 17-5. 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, 750 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. 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., *Boreomysis nobilis*, *Aglantha* sp., *Thysanoessa* sp., *Ostracoda*, *Onisimus littoralis*, *Meganyctiphanes norvegica*, *Hyperia galba*, Ctenophora, Cephalopoda, Cnidaria, *Hyperoche medusarum*, *Apherusa glacialis*, *Sarsia princeps*, *Eusirus cuspidatus*, Mysidae, *Pseudosagitta maxima*, Decapoda; using a dissecting stereomicroscope, and kept frozen at -80 °C in glass cryovials. Some macrozooplankton species not found in the *Tucker* 500 µm net tows were sometimes collected opportunistically from the *Monster* 200 µm and the *Tucker* 750 µm nets, whenever these samples were not being requested by the Contaminants team (Gary Stern, CEOS, Winnipeg), and frozen at -80 °C until further processing.

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 17-6) 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.

The KEBABB benthos team sampled with an Agassiz trawl (5 mm mesh net) on most of the Quaqtaq stations (NTRAIN) as well as on the scheduled KEBABB stations. The Beam trawl was operated by Jonathan Fischer's and Maxime Geoffroy's teams and provided a lot of benthic individuals such as decapods, amphipods, echinoderms, and cnidarians. Species from the Agassiz and the beam trawl were sorted, identified, counted, weighted, and photographed. If the taxonomic identification was unsuccessful to the species level, it was frozen at -20 °C and will later be identified at Maurice Lamontagne Institute. The benthos team also provided individuals to other teams for fatty acid, trace metal and contaminant analyses.

At a few stations, Agassiz deployments and box core deployments were not successful (please see Recommendations section and details on which stations were successful for Agassiz deployments in Table 17-7 and Table 17-8 for box core deployments, respectively).

Table 17-1: General sampling schedule conducted by the KEBABB team during leg 3 of the 2021 CCGS *Amundsen* expedition.

Station name	Station ID	Latitude	Longitude	Cast	Date	Water column biochemistry[1]	Genomics	Zooplankton integrated taxonomy	Zooplankton stratified taxonomy	Zooplankton fatty acids	Sediment characterization	Benthic epifauna
Q3	NTRAIN #1	61.04826	69.66666	2	14-08-2021	X[2]					V	A
Q4		61.03033	69.68923		14-08-2021						C	A
Q6		61.05076	69.71084		14-08-2021						V	A
Q2		61.07240	69.63679		15-08-2021						V	A
356	NTRAIN #2			6	15-08-2021	X[2]						
A1 (190)	KEBABB #1	66,60468	61,20620	9	17-08-2021	X	X	X		X	V	
A2 (191)	KEBABB #2	66,66556	60,45548	10	17-08-2021	X		X			V,C,S	A
A3 (193)	KEBABB #3	66,73453	59,61436	11	18-08-2021	X	X	X	X	X	C,S,P	A
A4 (BB1)	KEBABB #4	66,80170	58,76423	12	18-08-2021	X		X			C,S	
A5 (194)	KEBABB #5	66,86712	57,95304	13	18-08-2021	X	X	X	X	X	C,S,P	A
195	NTRAIN #3	66,89200	56,91083	14	19-08-2021	X[2]						
196	NTRAIN #4	66,98333	56,06667	15	19-08-2021	X						A
197	NTRAIN #5	67,04083	55,08667	16	19-08-2021	X[2]						
198	NTRAIN #6	67.08888	54,20833	17	19-08-2021	X				X	C,S	B
B5	KEBABB #6	67,58920	59,01498	18	20-08-2021	X	X	X		X	C,S,P	
B4	KEBABB #7	67,46140	59,64978	19	20-08-2021	X		X			C,S,P	
B3	KEBABB #8	67,33110	60,27758	20	21-08-2021	X	X	X	X	X	C,S,P	
B2	KEBABB #9	67,19840	60,89830	21	21-08-2021	X		X			C,S	A
B1	KEBABB #10	67,06320	61,51200	22	22-08-2021	X	X	X		X	C,S	A,B
C1	KEBABB #11	67,34828	62,52378	25	22-08-2021	X	X	X		X	V,S	A

C2	KEBABB #12	67,55238	61,90118	26	23-08-2021	X		X			V,S	A, B
C3	KEBABB #13	67,75398	61,26760	27	23-08-2021	X	X	X	X	X	C,S,P	
C4	KEBABB #14	67,95310	60,62278	28	24-08-2021	X		X				
C5	KEBABB #15	68,14958	59,96658	29	24-08-2021	X	X	X		X	C,S,P	
D5	KEBABB #16	68,99960	61,40670	31	24-08-2021	X	X	X		X	C,S	
D4	KEBABB #17	68,62100	62,00798	32	25-08-2021	X						
D3	KEBABB #18	68,24040	62,58878	33	25-08-2021	X	X	X	X	X	C,S,P	
D2	KEBABB #19	67,85790	63,15028	34	25-08-2021	X		X				A,B
Bro-6.2	ANet Sea Project	67.72717	63.34292		26-08-2021						C,S,P	
D1	KEBABB #20	67,47360	63,69318	37	26-08-2021	X	X	X		X	C,S,P	A
E1	KEBABB #21	68,27860	65,13960	38	27-08-2021	X	X	X		X	C,S,P	A,B
E2	KEBABB #22	68,54028	64,65238	39	27-08-2021	X		X				A
E3	KEBABB #23	68,80058	64,15350	40	27-08-2021	X	X	X	X	X	C,S,P	
E4	KEBABB #24	69,21027	63,33812	41	28-08-2021	X					C,S,P	
E5	KEBABB #25	69,60455	62,54254	42	28-08-2021	X	X	X		X		
116	NTRAIN #7	76,37965	70,51880	44	31-08-2021						V	
115	NTRAIN #8	76,33220	71,19918	45/46[3]	31-08-2021	X	X[4]					
111	NTRAIN #9	76,30690	73,21527	50	31-08-2021	X						
108	NTRAIN #10	76,26395	74,59995	53	01-09-2021	X	X					B
105	NTRAIN #11	76,31757	75,75898	56	01-09-2021	X						
101	NTRAIN #12	76,38340	77,40012	62	02-09-2021	X	X					
100	NTRAIN #13	76,41150	77,95533	63	03-09-2021	X[2]						
100A	N/A	76.45926	77.82517	N/A	03-09-2021						C	A,B
322	NTRAIN #14	74,49827	80,52525	65	05-09-2021	X						
323	NTRAIN #15	74,15637	80,47415	76	05-09-2021	X						
325	NTRAIN #16	73,81722	80,49823	69	05-09-2021	X						
305D	NTRAIN #17	74,60263	93,71013		07-09-2021	X[2]						
305B	NTRAIN #18	74,35252	93,58333		07-09-2021	X[2]						
S10	KEBABB #26	74,54300	90,41100	74	07-09-2021	X	X					

S11	CTD Cast							
S10A	Box core site	74.51676	90.44272	N/A	07-09-2021			C,S
S9	Nutrients Cast							
S8	KEBABB #27	74,40200	90,62600	75	08-09-2021	X	X	
S7	CTD Cast							
S6	Nutrients Cast							
S5	KEBABB #28	74,21898	90,90500	80	08-09-2021	X	X	
S4	Nutrients Cast							
S3	KEBABB #29	74,09798	91,08700	81	08-09-2021	X	X	
S2	CTD Cast				cancelled due to ice conditions			
S1	Nutrients Cast							

[1] DIC/TA, DOC/DN, Salinity, del^{18}O, flow cytometry (FC), DAPI, chlorophyll *a* concentration, Phytoplankton taxonomy, Phytoplankton fatty acid (FA) composition, POC/PON, Frrf

[2] Limited analysis - only chl *a* tot at surface, 20m, chl. max, and 50 m; POC/PN at surface, chl. max and 100 m;, and taxonomy at 5 m and chl max. (Lugol only)

[3] Water column biochemistry done on cast 45, metagenomics for Connie was done on cast 46

[4] Metagenomics cast

A = Agassiz, B = Beam Trawl, V = Van Veen, C = Box Core, S = Bulk Surface, P = Push Core

Table 17-2: Sampling details for water column biochemistry sampled by the KEBABB filtration team during leg 3 of the 2021 CCGS *Amundsen* at KEBABB stations.

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

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

Table 17-3: Sampling details for biochemical characterization of water column sampled by the KEBABB filtration team during leg 3 of the 2021 CCGS *Amundsen* at KEBABS stations

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

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

Table 17-4: Sampling details for biochemical characterization of water column sampled by the KEBABB filtration team during leg 3 of the 2021 CCGS *Amundsen* at NTRAIN full and basic stations

Depth (m)	DIC/TA*	DOC/DN	Salinity*	^{18}O[1]	Flow cytometry		DAPI	Chlorophyll *a*		Phyto taxonomy	DNA[2]	Phyto fatty acid	POC/PN[3]	FRRF
					Bacteria	Protist		Total	>5µm					
5	1x		1x	1x	2x	2x		2x	2x	2x*	1x		1x	1x
10			1x	1x				2x	2x					
20	1x		1x	1x	2x	2x		2x	2x					
30			1x	1x				2x	2x					
Chl max	1x		1x	1x	2x	2x		2x	2x	2x*	1x		2x	1x
40	1x		1x	1x	2x	2x		2x	2x					1x
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							1x	
150			1x	1x										
200	1x		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							1x			

[1]only on the extension of KEBABB A line across Davis Strait, [2]only at NTRAIN full stations, [3]to be taken and analyzed by NTRAIN team

Table 17-5: Zooplankton stratified sampling strategy at the KEBABB stations during leg 3 of the 2021 CCGS *Amundsen* expedition. The distance between the sea floor and the tow depths for nets #1-2-3 varied depending on the station depth.

Strata/net #	Depth end (m)	Depth start (m)
9	2m	20m
8	20m	40m
7	40m	60m
6		
5	Midwater column equally divided between nets # 4, 5 and 6	
4		
3	Bot-95m	Bot-75m
2	Bot-75m	Bot-55m
1	Bot-55m	Bot-35m
Trigger depth	N/A	Bottom -30

Table 17-6: 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 17-7: General information on Agassiz and Beam Trawl deployment rationale and degree of success on KEBABB stations and some NTRAIN stations

Station	Depth (m)	Cable length and wire angle (m)	Number of taxa identified	Comments
A1	105			Not done, rocky and steep bottom.
A2	530	950[1]	83	Successful
A3	872	1500[1]	43	Net damaged, rocky bottom.
A4	911			Not done, bottom similar to A3 on the sub-bottom profiler.
A5	800	1500[1]	31	Successful, lots of muddy sediment in the net.
196	130	260[1]	?	Agassiz was lost.
198	81			Beam trawl
B1	124	175 (40°)[2]	36	Beam trawl was deployed but not the Agassiz.
B2	652	850 (45°)[2]	0	Empty net, didn't touch the bottom
B3	1093			Too deep
B4	1443			Too deep
B5	1192			Too deep
C1	191	250 (35°)[2]	53	Successful, some small rocks in the net
C2	494	580 (30°)[2]	0	Empty net, didn't touch the bottom. Beam trawl deployed successfully
C3	1565			Too deep
C4	1607			Too deep
C5	1387			Too deep
D1	673	950 (40°)[2]	17	Successful, lot of mud in the net
D2	278	300 (30°)[2]	14	Few organism in the net, barely touch the bottom. Beam trawl deployed successfully
D3	1563			Too deep
D4	1807			Too deep
D5	1387			Too deep
E1	427	520 (30°)[2]	17	Successful, net full of mud and organisms. Beam Trawl deployed successfully.
E2	499	610 (35°)[2]	3	Net barely touched the bottom.
E3	1288			Too deep
E4	1859			Too deep
E5	1976			Too deep

[1] Cable length is 2.5 times the depth.

[2] Cable length calculated using the angle of the wire and the depth.

Table 17-8: General information on Box Core sampler deployment rationale and degree of success on KEBABB/KEBABS stations and some NTRAIN/ANet stations

Station	Depth (m)	Comments / Push core recovery[1]
A1 (190)	91.38	Van Veen came up empty, sub bottom had a low sediment response.
A2 (191)	522.95	Too sandy.
A3 (193)	872.92	Successful, Push Core 23.5 cm.
A4 (BB1)	911.90	Hit a rock, deformed the box such that the surface water drained too quickly, disturbing the surface of the core. Surface
A5 (194)	816.43	Successful, Push Core 31.5 cm.
198	85.51	Too many shells/sandy to collect a push core.
B1	116.58	Too sandy and rocky.
B2	640.93	Hit a rock, surface water drained too quickly, disturbing the surface of the core.
B3	1090.69	Successful, Push Core 34 cm.
B4	1428.67	Successful, Push Core 39 cm.
B5	1175.96	Successful, Push Core 42.5 cm.
C1	138.11	Van Veen came up with sand, no box was deployed.
C2	569.19	Van Veen came up with sand, no box was deployed.
C3	1570.29	Successful, Push Core 42.5 cm.
C4	~1607	Canceled due to weather.
C5	1372.17	Successful, Push Core 44 cm.
D1	677.19	Successful, Push Core 37 cm
Bro-6.2	582.80	Successful, Push Core 29 cm
D2	~278	Skipped, sub bottom had a low sediment response.
D3	1564.18	Successful, Push Core 44.5 cm
D4	~1807	Skipped to avoid falling behind schedule.
D5	1839.59	Seal failed during recovery, the surface water drained too quickly, disturbing the surface of the core.
E1	443.64	Successful, Push Core 40 cm.
E2	~499	Skipped to avoid falling behind schedule.
E3	1296.82	Successful, Push Core 45.5 cm
E4	1858.80	Successful, Push Core 40 cm. This station is equivalent to E5 from 2019.
E5	~1976	Skipped to avoid falling behind schedule.
S10A	235.27	Many rocks, resulting in poor penetration into the sediments, rocks propped the box open and also damaged the box.

Preliminary Results

Chlorophyll *a* concentration varied from 15 to 253 mg m^{-2} along the 5 KEBABB transects, the North Water Polynya (NOW) transect and at the entrance of Lancaster Sound. Algae > 5 µm generally dominated the algal biomass, except at stations E1, D1, D3 and D4 (Figure 17-1).

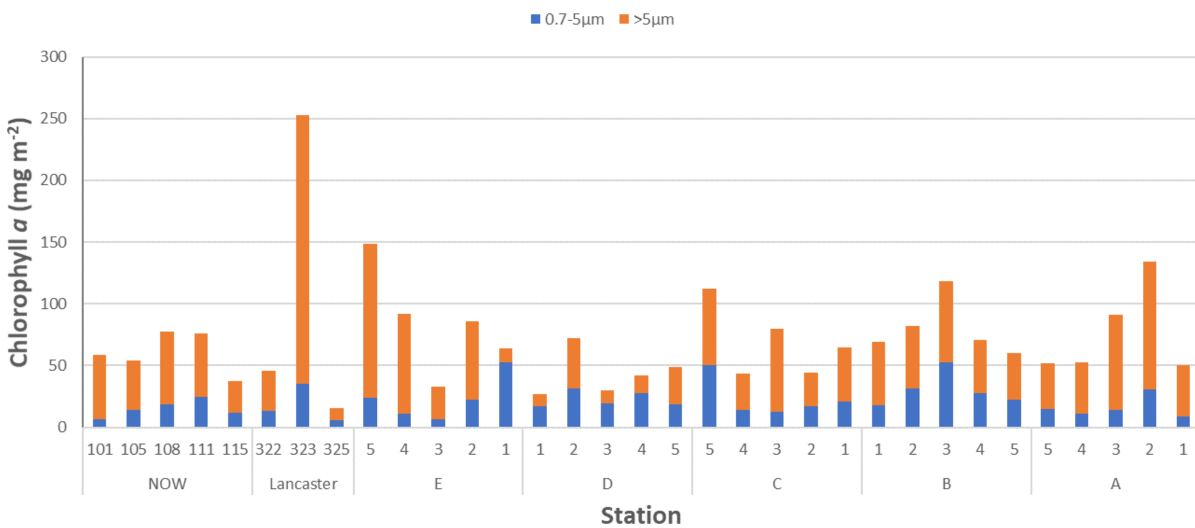

Figure 17-1: Chlorophyll a concentration across stations during Leg 3 of the 2021 Amundsen Expedition

17.3 Recommendations

- The Agassiz trawl is designed to bounce on the ocean floor; therefore it doesn't always touch the bottom while being towed. As a result, it's not an ideal trawl to use for biodiversity and biomass sampling. The Agassiz is also more fragile than the other types of trawls, so knowledge of the substrate is required prior to deployment to minimize the risk of damaging or losing the equipment.
- Information about the previous uses of the Agassiz trawl during KEBABB 2019 such as cable length deployed, success rate of the trawl sampling, problems encountered during deployment, substrates information, etc. would have helped us to make decisions about where to deploy the net. Unfortunately, this information was not provided to us and were not found in the 2019 mission report.
- The detailed mission plan and operations planned at each station were not available prior to boarding the ship.
- Box Core samplers are not ideal for sandy environments and rocks can damage the box. Researching the sub bottom in the area when planning station location would help increase the ratio of successful box core sampler deployments.

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18 Marine productivity: Carbon and nutrients fluxes

Project leaders: Jean-Éric Tremblay[1] (Jean-Eric.Tremblay@bio.ulaval.ca)

Cruise participants – Leg 3: Gabrièle Deslongchamps[1], Guillaume Cinq-Mars[1], Rémi Amiraux[1], Carlissa Salant[2]

Cruise participants – Leg 4: Jonathan Gagnon[1], Caroline Guilmette[1]

Cruise participants – Leg 5 : Gabrièle Deslongchamps[1], Jérémie Biron[1]

[1] *Department of Biology, Laval University, Quebec City, QC*
[2] *Ocean Sciences Department, Memorial University, St. John's, NL*

18.1 Introduction

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 CO2 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 CO2 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. In addition, 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.

18.2 Methodology

Samples for inorganic nutrients (ammonium, nitrite, nitrate, orthophosphate and orthosilicic acid) were taken at all stations (Table 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 during Leg 3, 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. Finally, ^{13}C and ^{15}N 24h-incubations were performed on deck-incubators with surface and SCM water to access primary productivity, nitrogen uptake (ammonium, nitrate and urea), nitrification and regeneration.

Table 18-1: List of sampling stations and measurements during leg 3 of the 2021 Amundsen Expedition

Stations	Nutrients	Nitrate isotopes	Ammonium	Stable isotopes	DOC/DON	POC/PN	BSi/POP	Fatty Acids	Total Lipids	Bio Markers	Taxonomy	13C/15N incub.
Q2	X											
Q3	X	X	X	X	X	X	X			X	X	X
Q4	X											
Q5	X											
Q6	X											
352	X	X	X	X	X	X	X	X	X	X	X	
354	X	X	X	X	X	X	X			X	X	
356	X	X	X	X	X	X	X	X	X	X	X	X
A1	X	X	X	X			X	X	X	X		X
A2	X	X	X	X			X			X		
A3	X	X	X	X			X	X	X	X		
A4	X	X	X	X			X			X		
A5	X	X	X	X			X	X	X	X		X
195	X	X	X	X	X	X	X	X	X	X	X	
196	X	X	X	X	X	X	X			X	X	
197	X	X	X	X	X	X	X			X	X	
198	X	X	X	X	X	X	X	X	X	X	X	X
B5	X	X	X	X			X			X		
B4	X	x	X	X			X			X		
B3	X		X	X			X			X		
B2	X		X	X			X	X	X	X		
B1	X		X	X			X	X	X	X		X
C1	X		X	X			X	X	X	X		X
C2	X		X	X			X	X	X	X		
C3	X		X	X			X			X		
C4	X		X	X			X			X		
C5	X		X	X			X	X	X	X		
D5	X		X	X			X			X		
D4	X		X	X			X			X		
D3	X		X	X			X			X		
D2	X		X	X			X	X	X	X		X
D1	X		X	X			X	X	X	X		
E1	X		X	X			X	X	X	X		
E2	X		X	X			X			X		X
E3	X		X	X			X	X	X	X		
E4	X		X	X			X			X		
E5	X		X	X			X	X	X	X		

Stations	Nutrients	Nitrate isotopes	Ammonium	Stable isotopes	DOC/DON	POC/PN	BSi/POP	Fatty Acids	Total Lipids	Bio Markers	Taxonomy	13C/15N incub.
116	X	X	X	X			X			X	X	
115	X	X	X	X			X	X	X	X	X	X
113	X											
111	X	X	X	X			X	X	X	X	X	
110	X											
108	X	X	X	X			X	X	X	X	X	X
107	X											
105	X	X	X	X			X	X	X	X	X	
103	X											
101	X	X	X	X			X	X	X	X	X	X
100	X	X	X	X			X			X	X	
Mit-glacier	X											
Mit-glacier SB1	X											
322	X	X	X	X			X	X	X	X	X	
300	X											
323	X											
324	X											
325	X	X	X	X			X	X	X	X	X	
305 D	X	X	X	X			X			X	X	
305 C	X							X	X			
305 B	X	X	X	X			X	X	X	X	X	X
305 A	X											

To determine NO_3^- uptake rates and primary production during Leg 5, water samples from the surface were incubated with different concentrations of nitrate and ammonium along with 15N and 13C tracers. The bottles were then incubated for 4 to 6 hours using temperature and light controlled incubators. When the incubation was completed, the water samples were filtered through a pre-combusted GF/F filters and the filters dried for 24 h at 60°C for further analyses. Isotopic ratios of nitrogen and carbon from all GF/F filters will be analyzed using mass spectrometry at the home laboratory.

Table 18-2: List of sampling stations and measurements during leg 4 2021.

Stations	Nutrients	Nitrate isotopes	Ammonium	Stable isotopes	DOC/DON	POC/PN	BSi/POP	Fatty Acids	Total Lipids	Bio BioMarkers	Taxonomy	Chlorophyll
C002	X		X	X	X							
C003	X		X		X							
C004	X		X			X		X	X	X		
310E	X		X		X	X		X	X	X		
C009	X		X									
312	X		X		X	X		X	X	X		
C010	X		X									
QMG4-Y3	X		X									
QMW	X											
314	X		X									
C011	X		X									
C012	X		X									
316	X		X			X		X	X	X		
C013	X		X									
C014	X		X									
403	X		X		X	X		X	X	X		
405	X		X		X							
407	X		X		X							
409	X	X	X	X	X	X	X	X	X	X	X	X
410	X											
412	X											
414	X	X	X	X	X	X	X	X	X	X	X	X
416	X		X		X							
418	X		X		X							
420	X	X	X	X	X	X	X	X	X	X	X	X
JET1	X		X		X							
JET5	X		X		X							X
JET6	X		X		X							
JET7	X	X	X	X	X	X	X			X	X	X
PCB05	X		X		X							
PCB07	X		X									
434	X		X		X	X		X	X	X		
432	X		X		X	X		X	X	X		
430	X											
428	X											

Stations	Nutrients	Nitrate isotopes	Ammonium	Stable isotopes	DOC/DON	POC/PN	BSi/POP	Fatty Acids	Total Lipids	Bio BioMarkers	Taxonomy	Chlorophyll
426	X											
435	X		X		X							
422	X											
421	X		X		X							
PCB21	X											
PCB22	X											
PCB23	X											
482	X		X		X							
480	X											
476	X		X		X							
478	X											
474	X											
472	X											
470	X		X		X	X				X		
PCB17A	X		X		X	X				X		
PCB11	X											
PCB13	X											
PCB12	X		X									
PCB10	X											
PCB14	X											
546	X		X									
518	X	X	X	X	X	X	X	X	X	X	X	X
516	X	X	X	X	X	X	X	X	X	X	X	X
514 (or 515)	X	X	X	X	X	X	X	X	X	X	X	X

Table 18-3: List of sampling stations and measurements during leg 5 2021.

Station	Date	Nutrients (NO3, NO2, PO4, Si)	NH4	PI	Kinetic
DE110	2021-10-12	X	X	X	X
DE120	2021-10-13	X	X	X	X
DE130	2021-10-14	X	X	X	X
DE210	2021-10-15	X			
DE310	2021-10-16	X	X	X	X
DE320	2021-10-17	X	X	X	X
DE410	2021-10-20	X	X	X	X
DE420	2021-10-21	X	X	X	X
DE430	2021-10-22	X	X	X	X
DE440	2021-10-23	X	X	X	X
DE450	2021-10-24	X			

BB2	2021-10-25	X			
DE500 (Glider)	2021-10-27	X			

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19 Benthic and Pelagic Community Characterization from eDNA Water Samples

Project leaders: Sheena Roul[1], David Cote[1], Barbara de Moura Neves[1], Ian Bradbury[1]

Cruise participants – Leg 2: Sheena Roul[1], David Cote[1]

[1]Northwest Atlantic Fisheries Centre, Fisheries and Ocean Canada, St. John's, NL

19.1 Introduction and methodology

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 non-invasive approach that is complementary to other conventional methods, particularly in the deep sea where specimens are very difficult to collect. To characterize benthic and pelagic faunal communities, sea water was collected at all stations using the CTD-Rosette water sampling system comprised of twenty-four 12L Niskin bottles. Samples were collected from the ocean surface, 500m, and bottom, where station depths allowed. These depths were selected to match other sampling activities that could be used to validate and compare results. In addition to this, 11 stations were sampled using the ROV, which will be used specifically to characterize coral fields. The same cleaning and sampling protocol was used for these deployments.

Prior to the CTD-Rosette deployment, the inside and upper and lower lids of the Niskin bottles were sprayed first 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 Whirl-pak bags. 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 1.5L of distilled water and a 4 head peristaltic pump. Once the blank was completed, the triplicate samples from each depth were filtered using sterile and/or DNA-free-single-use consumables in sealed packaging. When water samples were filtered, 2.5ml of a preservative solution (Longmires) was applied to the filter cartridge using a sterile syringe. The ends of the filter were sealed with luer lock caps, placed in individual whirl-pak bags and then stored at 4°C.

Refrigerated samples will be sent to the Centre for Environmental Genomics Applications (CEGA) for analysis. The resulting data will augment and be compared to pelagic and benthic community characterization data collected with conventional methods

Table 19-1: List of Rosette Stations for eDNA Water Sampling for Leg 2 of the 2021 Amundsen Expedition.

Station Name	Station Date (UTC)	Start , Bottom, and End Time (UTC)	Start Position	Bottom position	End position	Depth (m)	Depths sampled (m)
Site 644	2021/07/18	08:51:55 09:10:47 10:03:42	54.8226937N -53.2185825W	54.8191488N -53.2101193W	54.8087527N -53.1876673W	978	Surface (12), 500 and bottom (978)
Site 652	2021/07/18	21:21:41 22:06:18 23:51:33	55.6505687N -55.5426147W	55.6491728N -55.5360972W	55.6438432N -55.5183120W	2200	Surface (30), 500 and bottom (2200)
Makkovik	2021/07/19	23:03:43 23:18:25 00:03:08	55.5355458N -58.9516550W	55.5358990N -58.9533218W	55.5377403N -58.9609208W	690	Surface (2), 325m and bottom (690)
Kelp	2021/07/23	05:40:57 05:46:05 05:58:30	58.6686200N -62.6054933W	58.6681938N -62.6041150W	58.6665978N -62.6013818W	120	Surface (2), and bottom (120)
Sagbank	2021/07/24	22:18:57 22:33:39 22:55:31	60.5176125N -61.2738062W	60.5171090N -61.2826407W	60.5180502N -61.2947667W	602	Surface(2), 500m and bottom (602)
Hibio-C	2021/07/26	01:29:00 01:47:04 02:41:53	60.4621178N -61.1648287W	60.4623425N -61.1725207W	60.4657215N -61.1877363W	1013	Surface(2), 500m and bottom (1013)
Hatton Sill	2021/07/26	20:22:39 20:35:10 21:10:19	61.4365833N -60.6708680W	61.4351272N -60.6760807W	61.4310887N -60.6861782W	615	Surface(2.5), 500 and bottom (615)
Davis Strait	2021/07/28	16:33:50 16:58:00 18:09:18	63.3506092N -58.2726628W	63.3518825N -58.2717100W	63.3593530N -58.2703156W	1280	Surface(2.5), 500m and bottom (1280)
Southwind Fjord	2021/07/31	18:38:48 18:43:42 19:02:36	66.7608310N -62.3345085W	66.7607908N -62.3340802W	66.7602462N -62.3321295W	120	Surface(1.6) and bottom (120)
Disko Fan	2021/08/02	00:19:56 01:00:11 01:48:53	67.8808843N -59.3753093W	67.8808225N -59.3713187W	67.8775548N -59.3644630W	949	Surface(1.75), 500 and bottom (949)

Scott Inlet	2021/08/04	10:02:29 10:11:47 10:21:52	71.3792032N -70.0758108W	71.3794755N -70.0755572W	71.3799633 N -70.0759310 W	265	Surface(1.87) and bottom (265)
Scott Inlet	2021/08/05	01:13:42 01:31:06 02:08:19	71.3909877N -70.3016733W	71.3907572N -70.3014155W	71.3895138 N -70.3016597 W	700	Surface(1.7), 500m and bottom

Table 19-2: List of ROV Stations for eDNA Water Sampling for Leg 2 of the 2021 Amundsen Expedition.

Station Name	Station Date (UTC)	Time (UTC)	Latitude	Longitude	Station Depth (m)	Depths sampled (m)
R13-7	2021/07/19	20:23	55.53038	-58.96277	509	509
R14-6	2021/07/20	15:53	55.51649	-58.94509	592	592
R15-1	2021/07/21	16:31	55.51714	-58.94549	586	586
R15-4	2021/07/21	18:08	55.51728	-58.94495	562	562
R16-1	2021/07/24	15:37	60.52263	-61.24096	617	617
R17-14	2021/07/24	20:36	60.51883	-61.24657	624	624
R20-6	2021/07/27	16:02	60.43671	-61.64456	685	685
R21-5	2021/07/29	13:46	63.34639	-58.19721	1301	1301
R21-29	2021/07/29	17:18	63.34622	-58.20506	1318	1318
R23-4	2021/08/02	15:16	67.9661	-59.49065	886	886
R23-23	2021/08/02	20:06	67.97084	-59.48917	864	864

20 Shrimp analysis experiment

Investigators: Guillaume Blais

Cruise participants – Leg 2: Guillaume Blais[1]

[1] Université Laval, Quebec City, Quebec

20.1 Introduction and objectives

Since the majority of sampling methods with trawl are destructive for the environment (Depestele & al, 2015), it is essential to get the most data from them. During this trip, many shrimps were captured, and nobody had any research objective with them. Since a lot of them were already dead and were having some eggs (Figure 20-1), we decided to look at the morphology of different shrimp in the Arctic. With the variety of the trawl use in leg 2, there's even a possibility to compare eggs from benthic shrimp to more pelagic shrimp.

Figure 20-1: One beam trawl full of shrimp with eggs in Scott inlet beam trawl 3

The data collected should be on the morphological shape of the eggs and could also include eggs composition for the different species. It has been shown in the literature that aquatic invertebrates have a large variation by species and habitat (Clarke, 1993).

20.2 Methodology

The method was quite simple since we were using leftovers from the 20 to 30 minutes trawl. During this leg, we used the IKMT for pelagic organisms and the beam trawl for benthic organisms. The eggs were kept on the shrimp to protect them and fixed with formaldehyde 4%.

20.2.1 *Data quality notes/problems*

Since the project was not created before the first beam trawl, we missed one trawl and got shrimp from a few trawls from one station. The pelagic shrimp were frozen too, so there is a possibility that they will not get used, because of the conservation method utilized. A few photos of them have been taken so there is still a possibility to get some data.

20.2.2 *Samples collected*

Table 20-1: Sample collect for benthic and pelagic shrimp

Time (UTC)	Time (Local)	Station ID	Station Type	Latitude	Longitude	Activity	Comment
2021/07/25 05:59:05	2021/07/25 01:59:05	SaglekBank	ROV/Benthic	60,5089940	-61,2272323	IKMT-1	717,15
2021/07/26 05:32:00	2021/07/26 01:32:00	HiBio-C	Mooring	60,4606610	-61,1115098	IKMT-1	1085,93
2021/08/06 04:49:00	2021/08/06 00:49:00	Scott Inlet ROV1	ROV/Benthic	71,3741992	-70,0543585	Beam Trawl	265 m
2021/08/07 02:23:06	2021/08/06 22:23:06	Scott Inlet Beam Trawl 2	ROV/Benthic	71,3351073	-70,1175702	Beam Trawl 2	150 m
2021/08/07 04:28:17	2021/08/07 00:28:17	Scott Inlet Beam Trawl 3	ROV/Benthic	71,4507717	-69,7868697	Beam Trawl 3	300 m

20.3 Preliminary result

The measurement will be taken at the lab in Québec city. For now, we have 5 different species of shrimp with eggs. Those species are: *Lebbeus polaris* (i*), Spirontocaris spinus*(ii), *Sclerocrangon ferox* (iii), *Sabinea septemcarinata* (iv) and one species with no ID yet (v). All species have at least two specimens and *Lebbeus polaris* has more than one hundred specimens with eggs. Those five species were found in the first and last beam trawl on the cruise.

Figure 20-2: Shrimps collected during Leg 2. (top left) *Lebbeus polaris*, (top middle) *Spirontocaris spinus*, (top right) *Sclerocrangon ferox*, (bottom, left) *Sabinea septemcarinata* and (bottom right) one species with no ID yet. All shrimp species that we captured in the leg 2 that had some eggs

20.4 References

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21 Northern Contaminants Program: Assessing Mercury and Polycyclic Aromatic Hydrocarbons in the Canadian Arctic

Project leaders: Dr Gary Stern[1] (gary.stern@umanitoba.ca)

Cruise participant – Leg 4: Dr Cathrin Veenaas[1,2] (cathrin.veenaas@umanitoba.ca)

[1] *Centre for Earth Observation Science (CEOS), University of Manitoba, Winnipeg, MB.*
[2] *Department of Chemistry, Örebro University, Sweden*

21.1 Introduction and Objectives

Although Arctic environments are often remote and not close to industry, the Arctic is considered a sink for global pollutants (Arctic Monitoring and Assessment Programme, 2017) as the temperature gradient and prevailing winds bring POPs from emissions sources in warmer climates to northern regions. Moreover, due to remoteness, low biological diversity, and low ambient temperatures Arctic areas are especially vulnerable to contamination (Gunnarsdóttir et al., 2013). Once contaminants reach the Arctic they deposit and partition to organic matter where they can bioaccumulate and biomagnify. The assessment of contaminant enrichment, for example mercury or polycyclic aromatic hydrocarbons (PAHs) is the goal of the current project.

During Leg 4 of the Amundsen 2021 expedition, benthic invertebrates were collected for participants from the University of Manitoba while zooplankton samples were collected for the University of Manitoba, Environment and Climate Change Canada (ECCC) and the University of Minnesota. ECCC will be analyzing the samples for POPs (e.g. current use pesticides, plasticizers and flame retardants) and microplastics. The samples for the University of Minnesota will be used to study bioaccumulation and biomagnification of perfluorinated alkylated substances (PFAS) within marine organisms and, the samples at the University of Manitoba will be analyzed for organic contaminants (PAHs) and mercury to assess their bioaccumulation and biomagnification.

21.2 Methodology

In total, three types of nets were deployed: a beam trawl to sample benthic organisms and a vertically towed net (V-Tow) and obliquely towed net (O-Tow) to collect zooplankton samples. The nets were mainly deployed by the Zooplankton and Fish Ecology team on board (Cyril Aubry, Félix Tremblay-Gagnon, Jennifer Herbig).

21.2.1 *Benthic Samples*

Benthic samples were collected with a beam trawl as shown in Figure 21-1. The net opening was 3m^2 with a 32mm mesh size in the first section, followed by a 16mm mesh with a 10mm mesh liner. The length of the deployed cable was 2.5 times the depth. The trawl time was kept between 3 and 15 minutes depending on the texture of the sea floor. In some cases, for example if the sediment in the box core at the same station was very soft, the trawl was taken up after one minute to check the amount of sediment in the net. After trawling, the catch was sieved and fish was separated from the invertebrates. The samples were then rinsed and collected in a bucket covered with aluminium foil and left outside until they could be sorted and identified. After the species were identified, the specimens were rinsed with filtered seawater, collected in whirlpak bags and stored at -20°C.

Figure 21-1: Beam trawl for sampling of benthic invertebrates

21.2.2 *Zooplankton*

Zooplankton samples were collected using two different types of nets: the O-Tow (Tucker; 750µm mesh) and the V-Tow (Monster; 200µm mesh). Both nets had a 1m^2 opening and are shown in Figure 21-2. While the O-Tow was usually deployed to 100m (unless the sea was shallower in which case the net was towed at roughly 20m above sea floor), then towed at 2 knots and pulled up again right away once the desired depth was reached the V-Tow was lowered to 10 to 20m above the sea floor and pulled up after one minute while the ship was stationary. The depth of the V-Tow was assessed using the length of the cable. For the O-Tow a High Precision Acoustic Positioning (HiPAP) system was used.

The sample was kept on ice during the speciation. For this process about a quarter of it was poured into a glass dish and specimens were picked, separated and identified (setup shown in Figure 21-3). The identification was performed using a microscope where necessary. While samples for the University of Manitoba were collected at each station, the ECCC and University of Minnesota samples were collected at specific stations only. Finally, the sample was poured through a sieve (720µm for the O-Tow and 180µm for the V-Tow) and the remainder collected as a bulk sample. Speciated samples were collected in 20mL scintillation vials and bulk samples in whirlpak bags for the University of Manitoba. Samples for ECCC and the University of Minnesota were collected in pre-cleaned 40mL glass vials and 15mL Falcon tubes, respectively. All samples were stored at -20℃.

Figure 21-2: Oblique tow (Tucker; left) and vertical net (Monster; right) for sampling of zooplankton

Figure 21-3: Setup for speciating zooplankton samples

21.2.3 *Stations*

In total, samples from 21 stations were collected for this project (Table 21-1). At most sites, samples from all three nets – O-Tow, V-Tow and beam trawl – were obtained. Overall, 19 O-Tow and V-Tow samples and 13 beam trawl samples were processed.

Table 21-1: Stations and coordinates sampled using the three nets (date and coordinates are given for the first net at that station)

STATION NAME	DATE	LATITUDE	LONGITUDE	O-TOW	V-TOW	BEAM TRAWL
C004	11/09/2021	71.9551442	-95.8340945			x
310E	12/09/2021	71.2891090	-97.6748350	x	x	
312	12/09/2021	69.1683683	-100.6956085	x	x	x
C010	13/09/2021	68.2455355	-101.6533130	x	x	
QMG4-Y3	13/09/2021	68.4827042	-103.4659750	x	x	x
314	14/09/2021	68.9754735	-105.4943990	x	x	
316	15/09/2021	68.3803483	-112.1386452	x	x	x
CG13	16/09/2021	68.3838782	-113.1702745			x
403	16/09/2021	70.1096560	-120.1472140	x	x	x
405-C015	17/09/2021	70.6642915	-122.6301955	x	x	
407	18/09/2021	71.0123537	-126.0908060	x	x	
409	18/09/2021	71.8755442	-125.9172147	x	x	x
414	19/09/2021	71.4250010	-127.3913980	x	x	x
420	19/09/2021	71.0558727	-128.5372002	x	x	x
434	22/09/2021	70.1719193	-133.5364913	x	x	x
435	23/09/2021	71.0851265	-133.7543955	x	x	x
421	24/09/2021	71.4692008	-133.9031478	x	x	
482	26/09/2021	70.5228890	-139.3549637	x	x	
476	27/09/2021	69.9841128	-138.6374273	x	x	x
470	29/09/2021	69.4240468	-137.9740488	x	x	x
516	03/10/2021	74.8383300	-121.4487600	x	x	

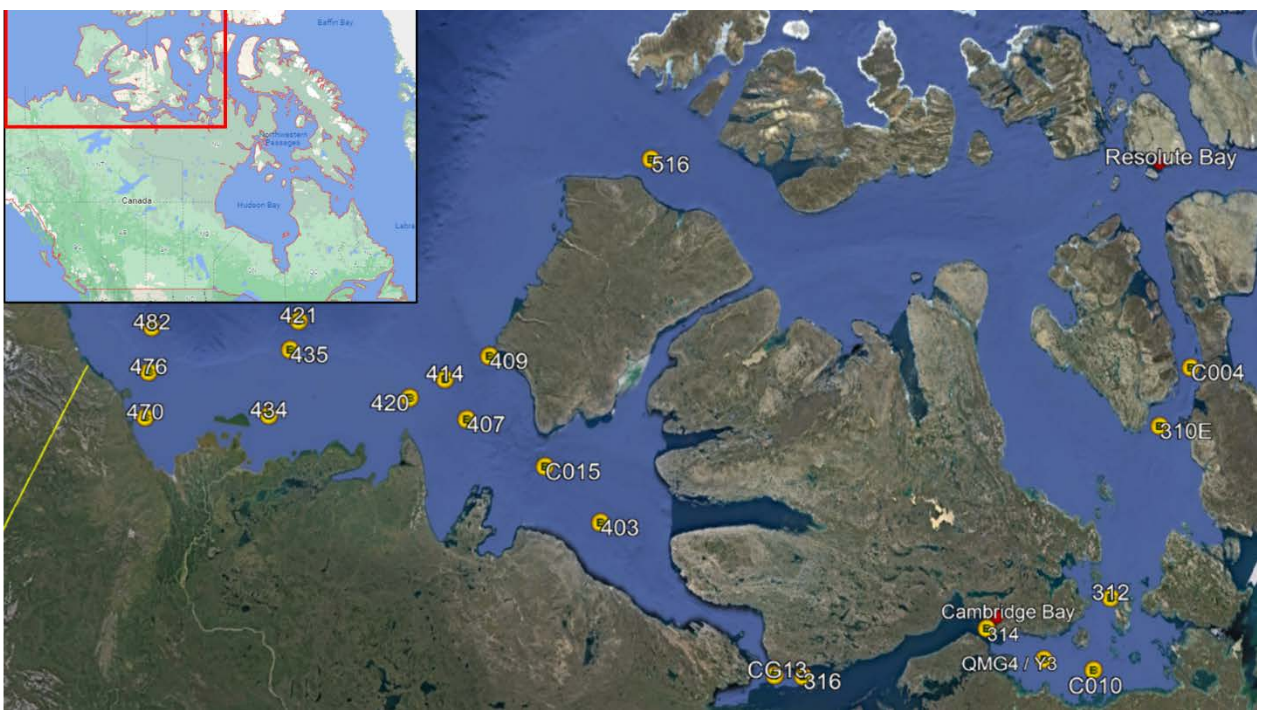

Figure 21-4: Map of sampling stations for zooplankton and benthic invertebrates

The samples were spread out geographically covering the regions Peel sound (C004), Northwest Passage (310E – CG13), Amundsen Gulf (403 – 407), Beaufort Sea (409 – 470) and M'Clure

Strait (516). Due to unfavorable ice conditions in M'Clure Strait only the zooplankton nets could be carried out.

21.3 Preliminary Results

A summary of the different species collected from the zooplankton nets is given in Table 21-2. The most common species collected was Calanus hyperboreus, a common Arctic copepod, followed by Ctenophora (Comb jelly), Limacina helicina (Sea butterfly), Chaetognata (Arrow worms) and Themisto libellula (an amphipod).

Samples collected with the beam trawl are summarized in Table 21-3. For these benthic samples, the most abundant classes were amphipods, sea stars and shrimps.

As a next step, the samples will be taken to the laboratory at the Centre for Earth Observation Science (CEOS) at the University of Manitoba and analyzed for mercury and organic contaminants such as PAHs.

Table 21-2: Zooplankton samples collected with the oblique net (O) and vertical net (V)

STATION	DATE		AMPHIPODS					JELLIES				MOLL-USCS		COPE-PODS		OTHERS					
		Tow type	Themisto libellula	Themisto abyssorum	Onisimus sp.	Hyperoche sp.	Other Amphipods	Ctenophora	Aglantha digitale	Halitholus cirratus	Other Jellyfish	Limacina helicina	Clione limacina	Calanus hyperboreus	Copepod	Chaetognata	Appendicularians	Ostracoda	Mysid	Euphausiacea	Other
310E	12/09/2021	O	x		x				x	x	3	x	x	x		x					
310E	12/09/2021	V	x		x	x		x			1	x	x		1	x	x		x		
312	12/09/2021	O							x	x		x		x		x					
312	13/09/2021	V																			
C010	13/09/2021	O	x		x	x		x				x	x	x	2	x				x	
C010	13/09/2021	V	x					x											x		
QMG4-Y3	13/09/2021	O	x		x	x		x		x	1	x	x		2	x					
QMG4-Y3	13/09/2021	V			x	x	1			x	1	x				x					
314	14/09/2021	O	x		x	x	2	x	x	x		x	x		3	x					
314	15/09/2021	V				x		x				x		x		x					
316	15/09/2021	O	x				1	x	x	x	1	x		x	1	x					
316	15/09/2021	V	x									x			1	x					
403	16/09/2021	O	x					x	x			x	x								
403	17/09/2021	V	x	x				x				x		x		x			x		
405-C015	17/09/2021	O	x	x				x			1	x	x	x		x			x	x	
405-C015	17/09/2021	V						x				x		x		x					
407	18/09/2021	O	x	x				x				x		x		x				x	1
407	18/09/2021	V		x								x		x		x					
409	18/09/2021	O	x			x		x				x	x	x		x					
409	18/09/2021	V										x		x		x					
414	19/09/2021	O	x	x		x		x	x					x		x				x	
414	19/09/2021	V	x	x				x	x					x		x					
420	19/09/2021	O	x			x		x	x	x	1	x	x	x							
420	19/09/2021	V																			
434	22/09/2021	O						x	x		1	x		x						x	
434	23/09/2021	V						x	x												
435	23/09/2021	O	x					x	x			x		x							
435	23/09/2021	V	x	x									x	x							
421	24/09/2021	O		x				x	x					x		x		x			2
421	24/09/2021	V	x	x										x		x			x		
482	26/09/2021	O						x	x	x				x							
482	27/07/2021	V						x						x			x	x	x		1
476	27/09/2021	O	x					x	x					x		x					
476	28/09/2021	V									1	x		x				x			
470	29/09/2021	O	x					x	x		1	x	x							x	
470	29/09/2021	V																			
516	03/10/2021	O	x					x	x				x	x		x	x	x			
516	03/10/2021	V	x	x								x	x	x		x	x	x	x		

Table 21-3: Benthic samples collected using the beam trawl (numbers indicate the number of different species collected within one class)

STATION	DATE	CLASSES							
		Shrimps	Sea stars	Molluscs	Amphipods	Crustaceans	Annelids	Cnidaria	Other
C004	11/09/2021	2	5	2	1		5		4
312	13/09/2021	5	1	3	4	1	2		3
QMG4-Y3	13/09/2021	2	3	2	1		1		2
316	16/09/2021	4	5	1	4		1	2	
CG13	16/09/2021	4	5	1	6	1	1	1	2
403	17/09/2021	1	1	1	1		1		3
409	18/09/2021	3	1	3	5		2		
414	19/09/2021	3	6		3		2		1
420	19/09/2021	4	2		5				1
434	23/09/2021	1	2	3	1	1	1	1	
435	23/09/2021	3	4	3	3	1	2		2
476	28/09/2021	4	5	1	4	1	2		1
470	29/09/2021	4	3	2	7	1	2	1	3

21.4 Reference

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R. Gunnarsdóttir, P.D. Jenssen, P. Erland Jensen, A. Villumsen, R. Kallenborn, A review of wastewater handling in the Arctic with special reference to pharmaceuticals and personal care products (PPCPs) and microbial pollution, Ecol. Eng. 50 (2013) 76–85.

22 ArcticFish: Zooplankton and Fish Ecology/Acoustics

Project leaders: Maxime Geoffroy[1] (maxime.geoffroy@mi.mun.ca), Jonathan Fisher[1], Dominique Robert[2]

Cruise participants – Leg 2: Eugenie Jacobsen[1], Jordan Sutton[1], Maxime Geoffroy[1]

Cruise participants – Leg 3: Cyril Aubry[3], Jonathan Fisher[1], Jennifer Herbig[1]

Cruise participants – Leg 4: Cyril Aubry[3], Félix Tremblay-Gagnon[2], Jennifer Herbig[1]

[1] *Fisheries and Marine Institute of Memorial University, Saint-John's, NL*
[2] *Institut des sciences de la mer, Université du Québec à Rimouski, Rimouski, QC*
[3]*Département de Biologie, Université Laval, Quebec City, QC*

22.1 Introduction

The Canadian Arctic Ocean is rapidly changing, as waters warm and sea ice declines. In addition, a relaxation of harsh environmental conditions has 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 remain unclear, and the successful management of the region will require robust biological data (Niemi et al. 2019). However, for many Arctic species, information about life history characteristics, abundance, and distribution remains unknown (Hollowed et al. 2013). While the demersal ecosystem has received increased attention, there are still critical knowledge gaps about the marine pelagic ecosystem and how it will respond to climate change. Therefore, the overarching objective of this project is to fill in these knowledge gaps, which will facilitate better forecasting of how ongoing climatic changes will affect the region.

Additionnaly, 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, which could shift energetic pathways as competitive and predatory pressures increase for native species. The effects of these changes on commercial fisheries remain unclear and the successful management of these fisheries will require robust biological data. Furthermore, 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, for many Arctic species, information about life history characteristics, abundance, and distribution remain unknown. 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. Therefore, 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 shed light on the distribution and ecology of key pelagic species in Arctic marine food webs. Aboard the CCGS *Amundsen* during Leg 2, 3 and 4 in 2021, 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; and (3) coordinate the collection and sharing of fish and invertebrate samples with other research groups to complement and extend their sampling and (4) refine the ecological importance of the North Water for fisheries resources, marine mammals and seabirds (Leg 3).

22.2 **Methodology**

22.2.1 *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 22-1A). This net was made up of two 1m^2 frames attached together and rigged with two 4.5m long, conical-square plankton nets with 200µm mesh, and an external 10cm diameter, 50µm mesh net. Each of the 200µm 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, 10-20m off the bottom to the surface. In the lab, the 50µm mesh nets were preserved in a 4% formaldehyde solution for taxonomy and abundance measurements. The 200µm mesh net was given to Fisheries and Oceans Canada (DFO) team (PI: Christine Michel) for the KEBABB project or was given at some stations to the Environment Canada team for contaminant analysis.

22.2.2 *O-Tow (Tucker) (1 × 500µm, 1 × 750µm, 1 × 50µm):*

Icythyoplankton and zooplankton were sampled using an obliquely towed net (O-Tow or Tucker net) (Figure 22-1B). This net consisted of a rectangular frame rigged with two 4.5m long, 1m^2 mouth aperture, square-conical nets (mesh size 500 and 750µm) and an external 10cm diameter, 50µm mesh net (to collect the microzooplanktonic prey of the fish larvae). The O-Tow was equipped with three KC® flowmeters; one for the 750µm net, one for the 500µm net and a control flowmeter between the two nets. It was towed obliquely from the side of the ship at a speed of ~2 knots to a maximum depth of 100m (depth estimated with Hipap sensor). All fish larvae were identified, measured and preserved individually in 95% ethanol + 1% glycerol. Zooplankton samples from the 500µm mesh and the 50µm mesh nets were preserved in 4% formaldehyde solution for further taxonomic identification. For the KEBABB stations, the 500µm mesh net's sample was given to the Fisheries and Oceans Canada team (PI: Christine Michel) for fatty acid analysis. After retrieval of fish larvae, the 750 µm mesh net was given at some stations to the Environment Canada team for contaminant analysis.

22.2.3 *Hydrobios (9× 200µm):*

The plankton community was sampled with a Hydrobios multi-net plankton sampler (Figure 22-1C). The net was equipped with nine 200µm mesh nets (opening 0.5m^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, allowing for depth specific sampling of the water column. It is deployed vertically from 10-20m off the bottom to the surface. The nets open and close one by one as the pressure decreases while the net is going up in the water column. The depth at which the different nets open and close is programmed before deployment. For KEBABB stations, the samples were given to the DFO team for preservation, otherwise the samples were preserved in 4% formaldehyde solution for further taxonomic identification.

22.2.4 *Isaac-Kidd Midwater Trawl (IKMT):*

The mesopelagic fish and macro-zooplankton communities were sampled using the Isaac-Kidd Midwater trawl (IKMT) (Figure 22-1D). The rectangular net had a 9m^2 mouth aperture and mesh size of 11mm in the first section and 5mm in the last section. The net was lowered to a target depth, determined by the echosounder (Ek-80) signal and towed at that depth for 15-30 minutes at a speed of 3 knots. In the laboratory, fish were identified to the level of family or species, counted, and measured. Adult Arctic cod (*Boregadus saida*) were stored at -80C while all other adult fish were stored at -20C. Larvae were preserved in 95% ethanol + 1% glycerol. Macro-zooplankton were identified to the level of family or species, counted, measured, and frozen at -20C.

22.2.5 *Benthic Beam Trawl:*

The demersal fish community was sampled using the benthic beam trawl (Figure 22-1E). The rectangular net had a 3m^2 mouth aperture, 32mm mesh size in the first section, and 16mm in the last section, with a 10mm mesh liner. This net was lowered to the seafloor and towed for 15-30 minutes at a speed of 3 knots. Adult Arctic cod were stored at -80C while all other adult fish were stored at -20C. If larvae were caught, they were preserved in 95% ethanol + 1% glycerol. At some stations, the invertebrate samples were shared with the KEBAB benthic team to complement their samples.

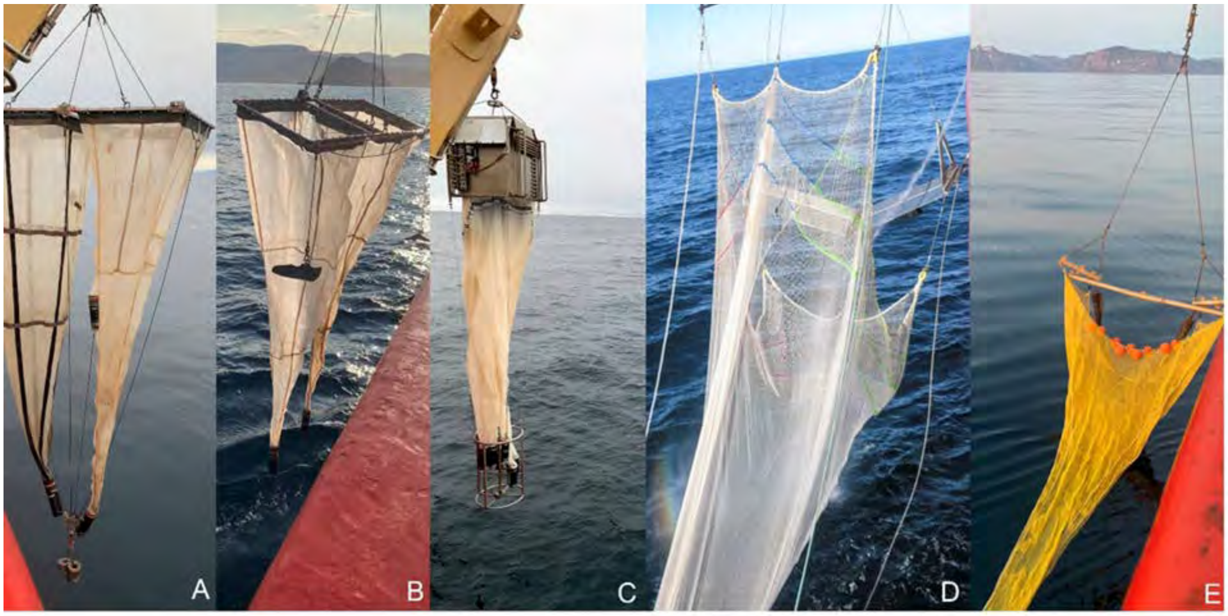


Figure 22-1: The V-Tow net(A), the O-Tow net (B), the hydrobios net (C), the IKMT net (D), and the beam trawl net (E) which were used to sample the fish and zooplankton communities.

A summary of all net sampling that took place during Leg 2, Leg 3 and Leg 4 is presented respectively in Table 22-1, Table 22-2 and Table 22-3

Table 22-1: List of samples stations from the CCGS *Amundsen* during Leg 2. 'X' indicates whether the sampling took place at that station.

Station ID	Date UTC	Latitude	Longitude	Hydro	IKMT	Beam	Tucker
Makkovik Bank	2021/07/20	55.5390953	-58.9511307	X	X		X
Kelp 2021	2021/07/23	58.6670368	-62.6034482	X		X	X
Saglek Bank	2021/07/25	60.5175720	-61.2501757	X	X		
HiBio-C	2021/07/26	60.4664712	-61.1626750		X		X
Hatton Sill	2021/07/26	61.4346973	-60.6541210	X	X		X
Davis Strait	2021/07/28	63.3506907	-58.2683660	X	X		X
Disko Fan	2021/08/02	67.8840613	-59.3865777	X	X		X
Scott Inlet Deep	2021/08/04	71.3913687	-70.3086288	X	X		X
Scott Inlet ROV1	2021/08/05	71.3777585	-70.0690478			X	X
Scott Inlet Piston Core 3	2021/08/06	71.3950922	-70.3504722		X		
Scott Inlet Beam Trawl 2	2021/08/06	71.3310473	-70.1244147			X	
Scott Inlet Beam Trawl 3	2021/08/07	71.4507717	-69.7868697			X	X

Table 22-2: Net deployment summary from 2021-08-14 to 2021-09-06 (Leg 3)

Station	Sampling Date	Latitude (N)	Longitude (W)	2x1m2 O-Tow	Hydrobios	2x1m2 V-Tow	Beamtrawl	IKMT
Q3	2021-08-14	61.0482	-69.6664	1				
A1	2021-08-17	66.6019	-61.2013	1		1		
A2	2021-08-17	66.6655	-60.4602			1		
A2	2021-08-18	66.6632	-60.4601				1	
A3	2021-08-18	66.7359	-59.6201	1	1	1		
A4	2021-08-18	66.7995	-58.7729			1		1
A5	2021-08-19	66.8668	-57.9590	1	1	1		
195	2021-08-19	66.8948	-56.9175					1
198	2021-08-20	67.0842	-54.2295	1			1	
B5	2021-08-20	67.5870	-59.0166	1	1	1		
B4	2021-08-21	67.4613	-59.6426			1		
B3	2021-08-21	67.3300	-60.2779	1	1	1		
B2	2021-08-21	67.1966	-60.8961			1		1
B1	2021-08-22	67.0625	-61.5117	1		1	1	
C1	2021-08-23	67.3498	-62.5215	1		1		
C2	2021-08-23	67.5526	-61.9032			1	1	
C3	2021-08-23	67.7537	-61.2689	1	1	1		
C4	2021-08-24	67.9537	-60.6317			1		
C5	2021-08-24	68.1504	-59.9695	1		1		1
D5	2021-08-24	68.9997	-61.4073	1				
D5	2021-08-25	69.0017	-61.4121			1		
D3	2021-08-25	68.2420	-62.5958	1	1	1		
D2	2021-08-25	67.8571	-63.1505			1		
D2	2021-08-26	67.8596	-63.1544				1	
D1	2021-08-26	67.4726	-63.6974	1		1		
D1	2021-08-27	67.4727	-63.6988					1
E1	2021-08-27	68.2797	-65.1350	1		1	1	
E2	2021-08-27	68.5404	-64.6535			1		
E3	2021-08-28	68.8000	-64.1544	1	1	1		1
E5	2021-08-28	69.6055	-62.5299	1				
E5	2021-08-29	69.6043	-62.5349			1		1
115	2021-08-31	76.3338	-71.2045	1	1			1
105	2021-09-01	76.3176	-75.7399					1
108	2021-09-01	76.2657	-74.6069	1	1		1	
101	2021-09-02	76.3830	-77.4052	1	1			
101	2021-09-03	76.3890	-77.4186				1	
			Totals	20	10	23	8	9

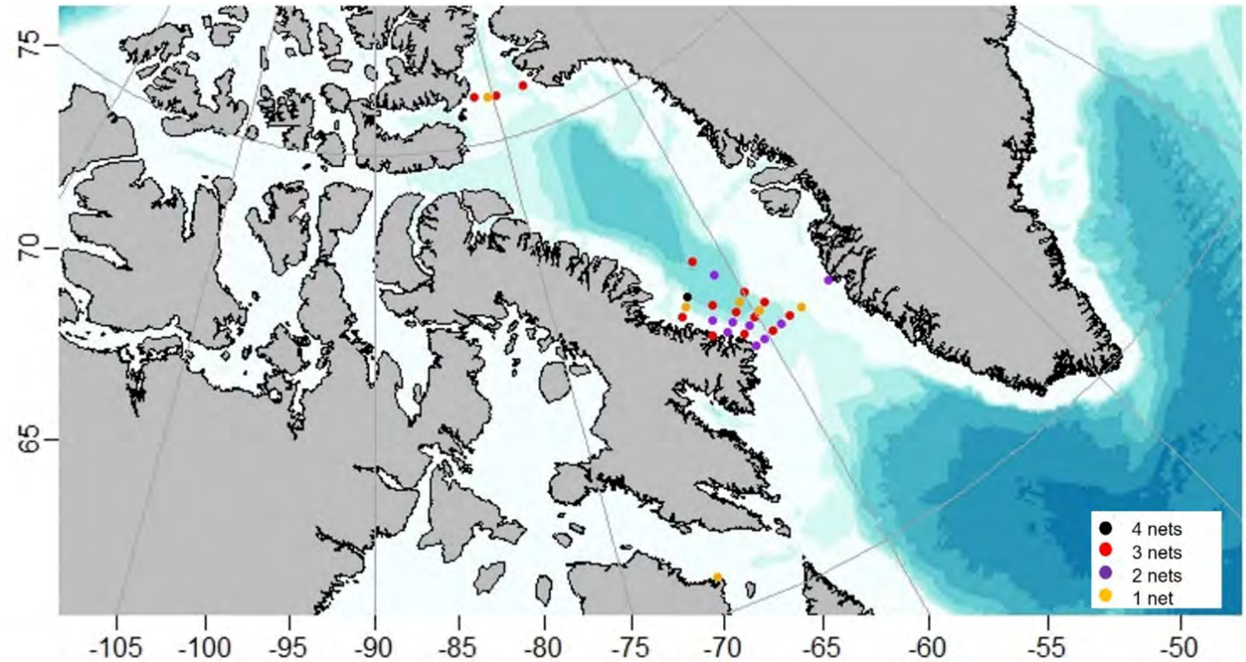


Figure 22-2: The average location of the 70 nets deployments of Leg 3 as of 6 September 2021. Colors of circles represent the number of nets deployed at each station.

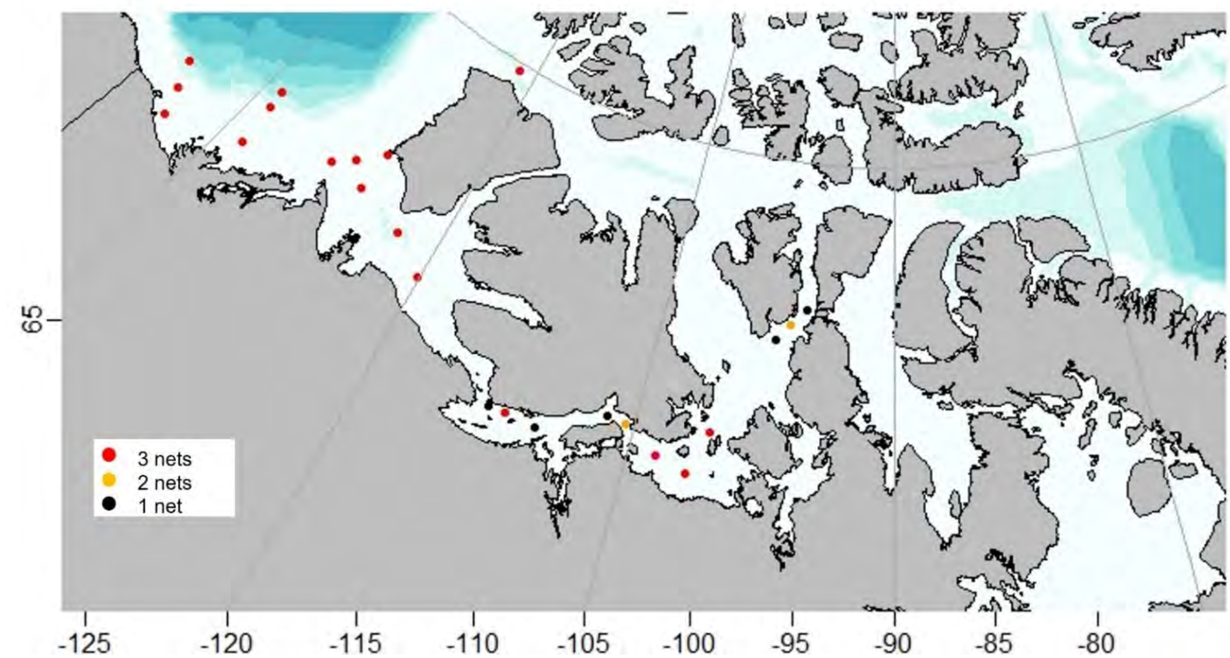


Figure 22-3: The average location of the 60 nets deployments for Leg 4. The colors of the circles represent the number of nets deployed at each station.

Table 22-3: Net deployment summary from 2021-09-09 to 2021-10-04 (Leg 4)

Station	Sampling Date	Latitude (N)	Longitude (W)	2x1m2 O-Tow	2x1m2 V-Tow	Beamtrawl	IKMT
C004	2021-09-11	71.9551	-95.8381		1	1	
310E	2021-09-12	71.2891	-97.6908	1	1		
312	2021-09-12	69.1713	-100.6902	1			
312	2021-09-13	69.1684	-100.7037		1	1	
C010	2021-09-13	68.2474	-101.6439	1	1	1	
QMG4-Y3	2021-09-13	68.4839	-103.4427	1	1	1	
314	2021-09-14	68.9749	-105.4794	1			
314	2021-09-15	68.9705	-105.4781		1		
316	2021-09-15	68.3870	-112.1251	1	1		
C011	2021-09-15	69.0130	-106.6235			1	
C012	2021-09-15	68.3239	-110.2740			1	
316	2021-09-16	68.3894	-112.1195			1	
403	2021-09-16	70.1077	-120.1246	1			
CG13	2021-09-16	68.3856	-113.1604			1	
403	2021-09-17	70.1005	-120.1078		1	1	
405	2021-09-17	70.6661	-122.6292	1	1		1
407	2021-09-18	71.0059	-126.0775	1	1		1
409	2021-09-18	71.8710	-125.8781	1	1	1	
414	2021-09-19	71.4229	-127.3676	1	1	1	
420	2021-09-19	71.0526	-128.5161	1	1	1	
434	2021-09-22	70.1726	-133.5400	1			
434	2021-09-23	70.1784	-133.5577		1	1	
435	2021-09-23	71.0807	-133.7704	1	1	1	
421	2021-09-24	71.4700	-133.8995	1	1		1
482	2021-09-26	70.5208	-139.3708	1			
476	2021-09-27	69.9832	-138.6561	1			
482	2021-09-27	70.5241	-139.3559		1		1
476	2021-09-28	69.9908	-138.6400		1	1	
470	2021-09-29	69.4288	-138.0034	1	1	1	
516	2021-10-03	74.8461	-121.4266	1	1		1
			Totals	19	20	16	5

22.2.6 *Continuous Plankton Recorder (CPR):*

The plankton community and microplastics in the upper water column (~5m) were sampled with the continuous plankton recorder (CPR) (Figure 22-4). The torpedo-shaped steel body (85 kg) with a 1.6cm^2 aperture that 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.

Figure 22-4: The continuous plankton recorder was used to sample the plankton community and microplastics in the upper water column (~5m) during leg 3. The photo also shows the internal sampling cassette being removed.

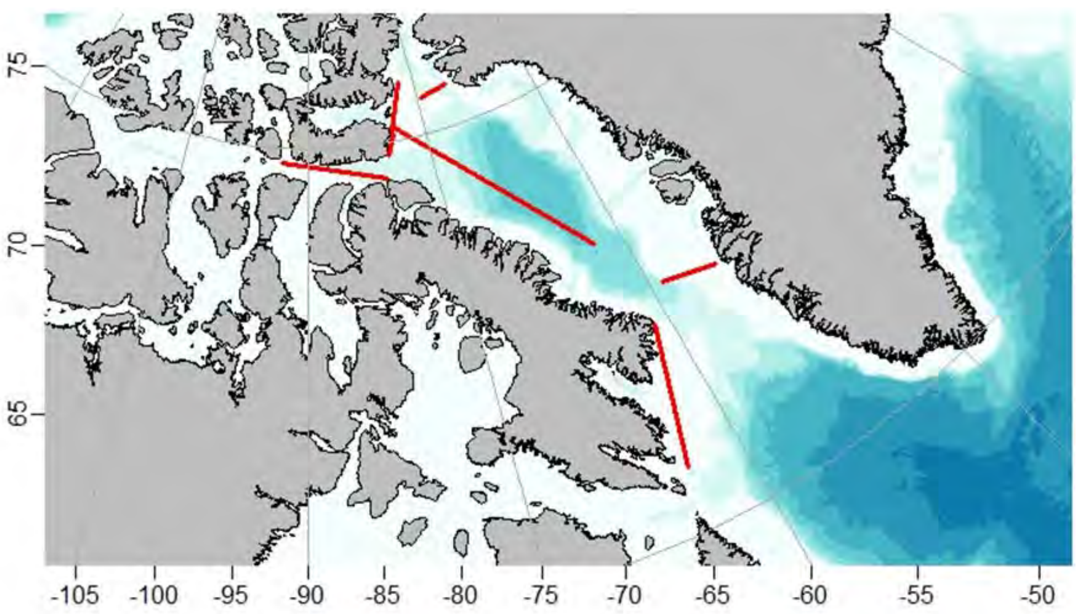


Figure 22-5: The continuous plankton recorder (CPR) transects, represented by the red lines.

22.2.7 *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 22-7). 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.

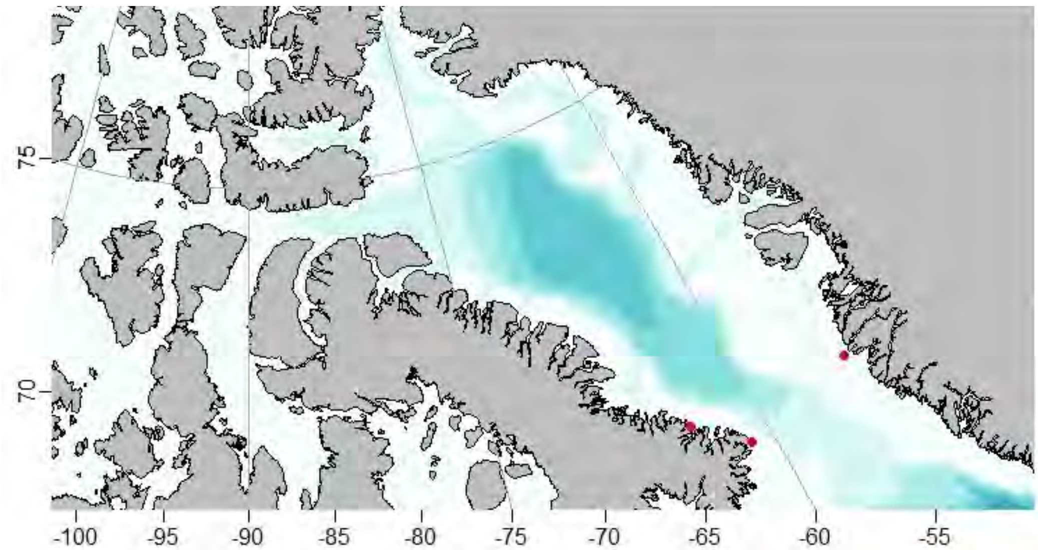


Figure 22-6: The location of the baited camera deployments for Leg 3 represented by red circles.

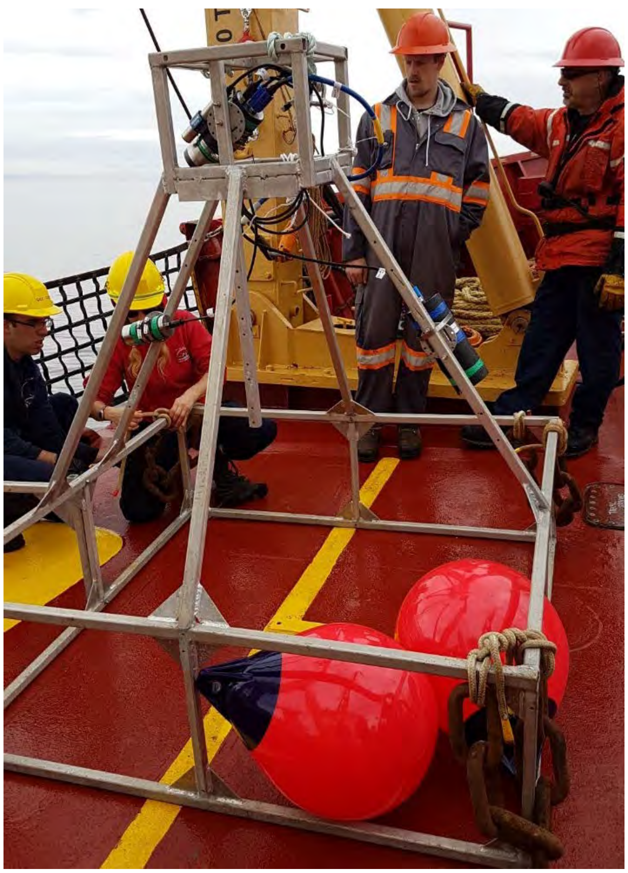


Figure 22-7: The baited remote underwater video camera system (camera, LED light, parallel lasers, lithium battery, bait arm, squid bait), which was used to characterize the benthic fish and invertebrate communities at three sampling locations during Leg 3.

Table 22-4: Baited remote underwater video camera deployment summary from Leg 3

Station	Sampling Date	Latitude (N)	Longitude (W)	Depth (m)	Bottom Temp (C)	Dominant benthic habitat and fauna
A1	2021-08-17	66.55	61.24	99	-1.0	Wavy sand and cobble, basket stars and amphipods, sculpins
198	2021-08-19	67.08	54.33	85	5.5	Scallop shell shingle, Snow crabs and sculpins
D1_177	2021-08-26	67.47	63.82	497	0.5	Fine silt, Brittlestars, northern shrimp, Greenland shark

22.2.8 *Acoustic monitoring:*

The *CCGS Amundsen* was equipped with a hull-mounted EK80 broadband echosounder operating at 38, 120 and 200 kHz. The EK80 operated continuously during the leg in narrowband mode, which allowed our group to monitor the spatial and vertical distribution of zooplankton and fish, thus providing an extensive mapping of where the fishes and zooplankton are along the ship track. The calibration of the EK80 echosounder was done prior to departure. In addition to the hull-mounted echosounder, an Acoustic Zooplankton and Fish Profiler (AZFP) was moored at station HiBio-C-20 in 2019 (serviced in 2020) and in 2020. It was successfully recovered on July 24th 2021 and redeployed at Hi-BioA on July 25th 2021. The upward-looking AZFP was deployed at 599 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.

22.3 Preliminary Results

22.3.1 *Leg 2*

On August 8th 2021 at 265m in Scott Inlet, a large aggregation of fish was identified with the EK80 broadband echosounder at 38kHz (Figure 22-9). This coincided with the deployment of the baited camera (Cote) where the fish aggregations were identified as Arctic cod (Figure 22-10). This will require further investigating into the role of troughs as potential hot spots for these fish.

The most frequent species caught in the IKMT and the Beam Trawl were in the family Myctophidae, Gadidae, Cottidae, Zoarchidae, and Liparidae (Figure 22-8). It is important to mention that the frequency of each did differ from station to station. An example of this variation (Figure 22-11) shows the catches from Hatton Sill (310-390 m) July 26, 2021 where Mycotphidae dominated and in Scott Inlet Deep (300-350 m) Aug 5, 2021 where Gadidae dominated. This shows an observable change in species composition of the two mesopelagic fish given a change in latitude. An example of other noteworthy species caught in the IKMT (and some Beam Trawl) can be seen in Figure 22-12. In the tucker trawl, the most frequently caught families were Gadidae, Liparidae, and Pleuronectidae (*R. hippoglossoides*).

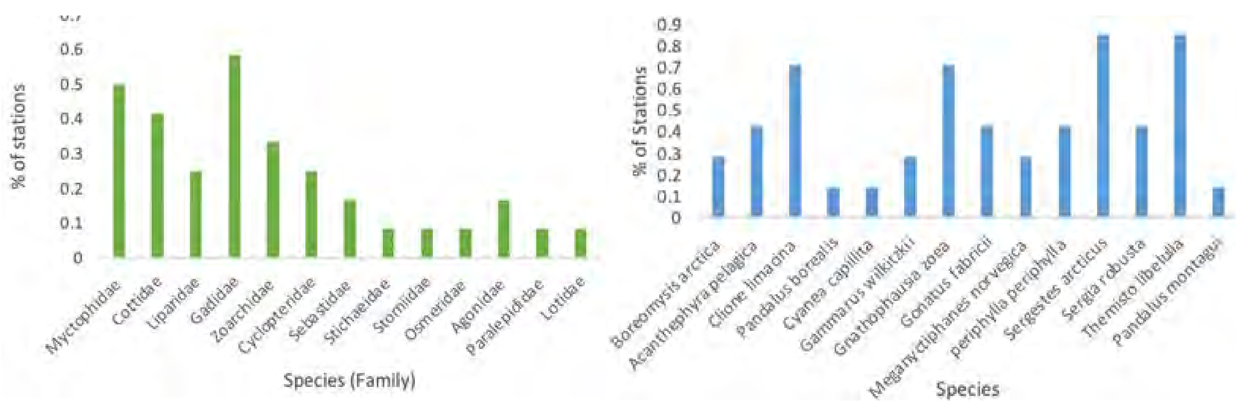


Figure 22-8: Frequency of occurrence of fish (left) and zooplankton (right) species caught with the IKMT (and Beam Trawl for fish) during leg 2 of the Amundsen 2021 expedition

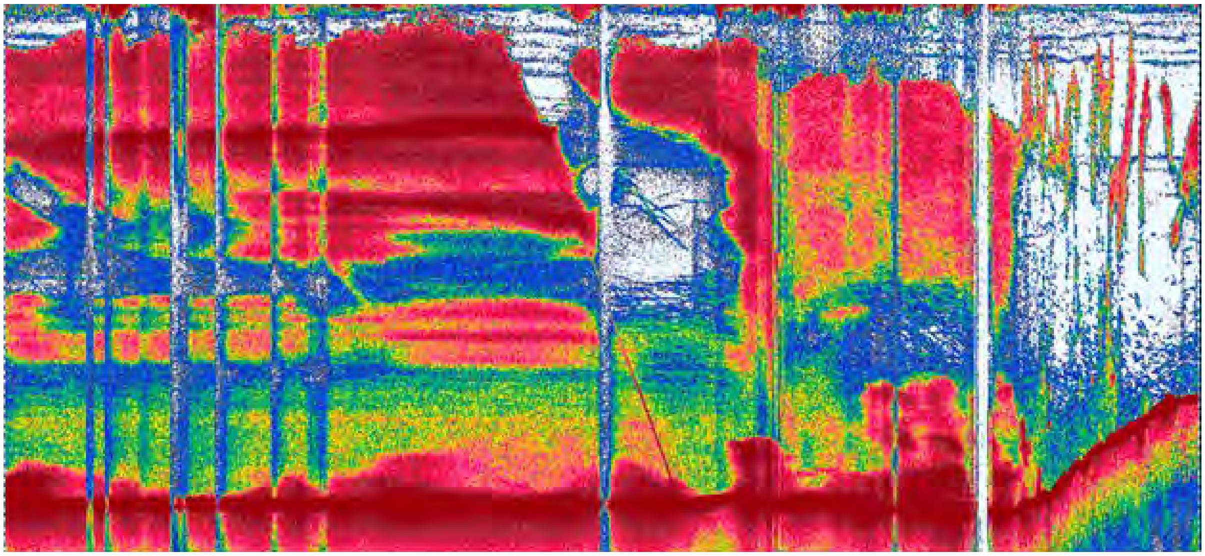


Figure 22-9: Example of echogram taken at Scott Inlet (265 m 18:40 UTC 04/08/2021) using the EK80 broadband echosounder at 38kHz highlighting two aspects (1) the light avoidance of the mesopelagic fish from the baited camera as it lowers diagonally to the bottom and (2) the thick aggregations of fish in the trough.

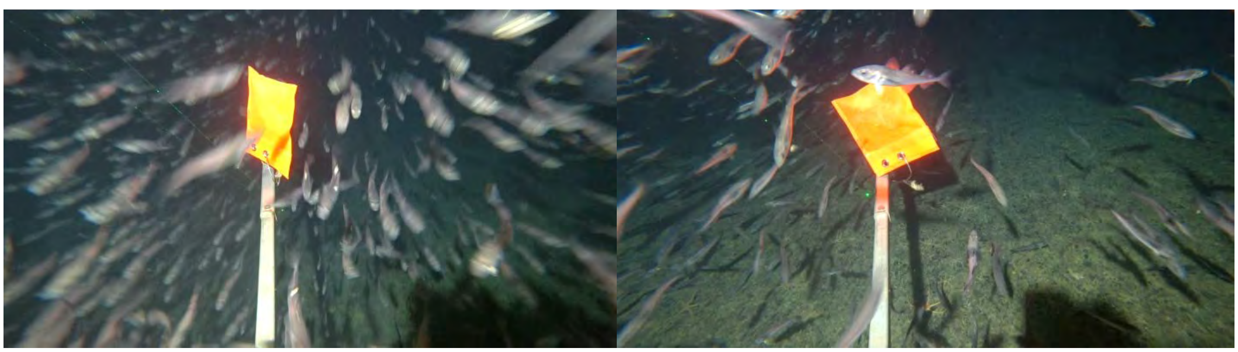


Figure 22-10: Arctic cod footage from the baited camera deployment at Scott Inlet at 265m at 18:40 UTC August 4, 2021.

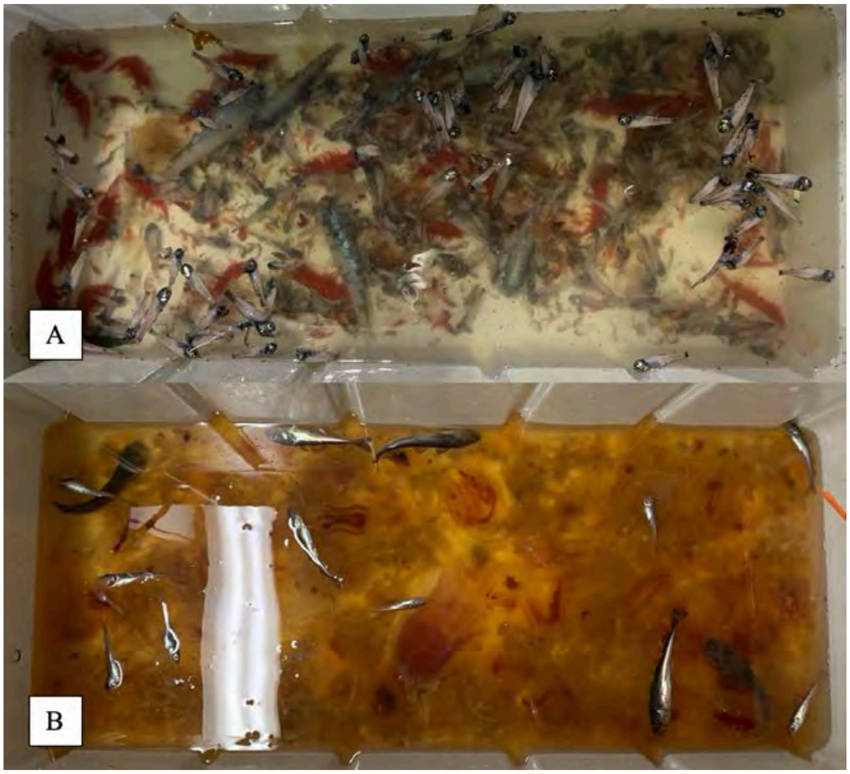


Figure 22-11: Comparison between the IKMT catches (A) Hatton Sill (310-390 m) July 26, 2021 (B) Scott Inlet Deep (300-350 m) Aug 5, 2021

Figure 22-12: Examples of species caught from the IKMT and Beam Trawl including (A) juvenile Anarhichas sp (wolfish).; (B) Cottidae (sculpins); (C) Gonatus fabricii (squid); (D) Myctophidae (lanternfish); (E) Careproctus reinhardti (sea tadpole); (F) Boreogadus saida (Arctic Cod).

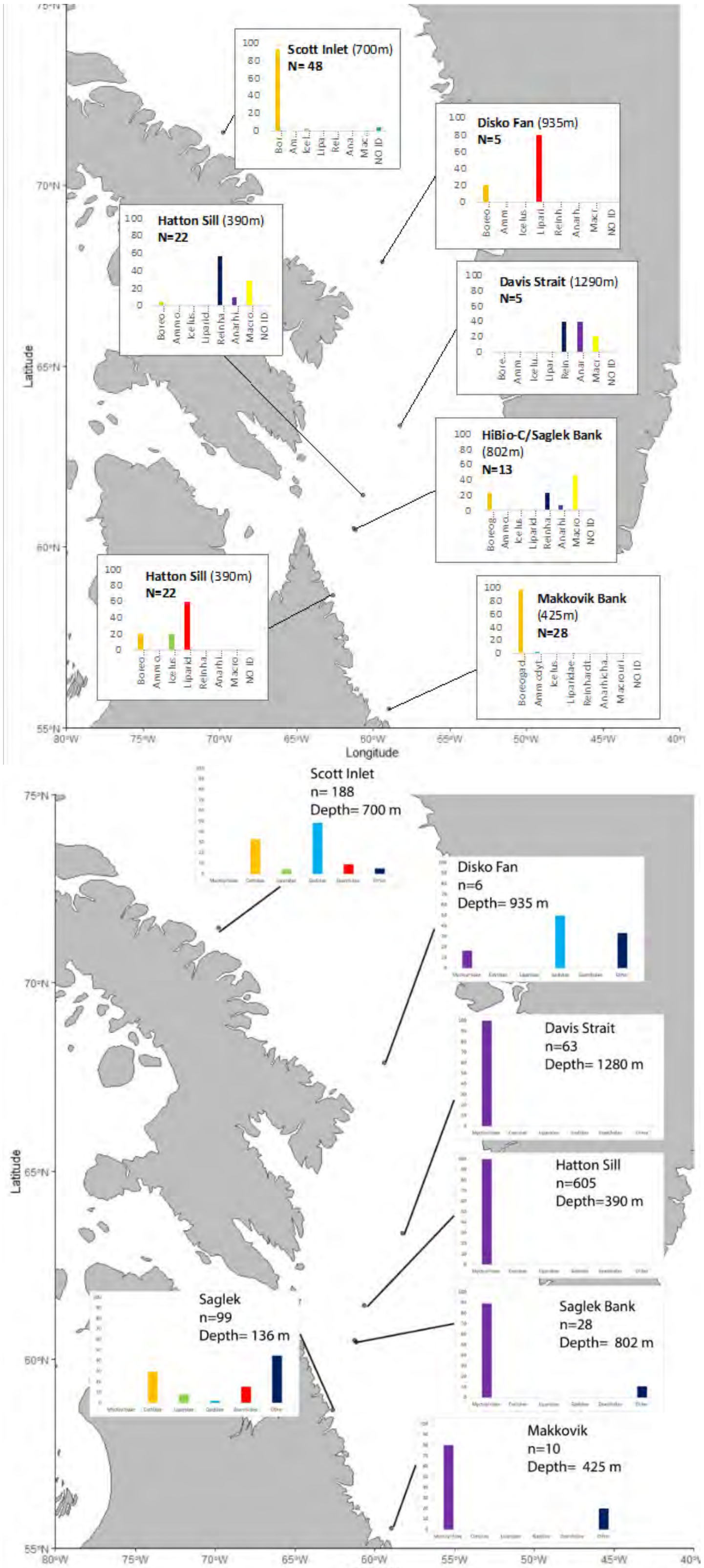


Figure 22-13: Frequency of (top) larval and (bottom) fish species caught at each station (HiBio-C and Saglek Bank combined).

22.3.2 *Leg 3*

As of 6 September 2021, 70 net deployments were conducted to sample the fish and zooplankton communities (Table 22-2, Figure 22-2). There were 1,004 larval fish from seven different families identified, counted, and preserved. The most frequently occurring species were Arctic cod, followed by species from the Liparidae and Cottidae families (Figure 22-14). Ninety-three percent (n=939) of the larval fish captured were Arctic cod. Of the 939 Arctic cod collected, a sub-sample of 305 were measured. The average standard length of these larval Arctic cod was 21.5mm (SD=6.2mm), while the median size was 19.5mm (Figure 22-15).

There were 611 fish from 14 families caught in the IKMT and Beamtrawl nets. The most frequently caught species were in the families: Liparidae, Gadidae, and Zoarcidae (Figure 22-16, top). One-hundred and seven Arctic cod were collected and measured. In general, the length frequency had a bimodal distribution, which could be due to the two different gear types, age cohorts, or locations sampled (Figure 22-17, top). The average standard length was 111mm (SD=34.9mm), while the median was 114mm (Figure 22-17, top).

There were 6,635 zooplankton from 13 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. Chaetognatha, Clionidae, Cnidaria, Hyperiidae, and Mysidae were the most frequently occurring zooplankton groups (Figure 22-18). Mysidae, Euphausidae, Hyperridae, and Chaetognatha typically had the highest relative abundance by station (Figure 22-19).

Three additional nets (two beam trawls and one O-Tow) were conducted in Lancaster Sound on September 7th and 8th. However, data from these nets have not been analyzed for this report.

Deployment of the baited remote underwater video camera occurred at two shallow and one relatively deep stations (Table 22-4, Figure 22-6). The shallow stations had similar depths but recorded within very different water masses on the eastern (cold) and western (warm) extents of KEBABB transect A. Differences in benthic habitats, invertebrate and fish faunas were evident. Deployments at A1 and Station 198 recorded for 340 minutes each, while D1_177 recording lasted 430 minutes, of which 380 minutes recorded with bait. The presence of multiple Greenland sharks (*Somniosus microcephalus*) at D1_177 is similar to our results at this site in 2019 and further comparisons of video data between years are in progress.

Our goals for the deployment of the Continuous Plankton Recorder were met during this leg. In total, 1200 nautical miles of Continuous Plankton Recorder samples were obtained within seven transects (Figure 22-5) spanning from north of Hudson Strait (62 N) to east of Ellesmere Island (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.

22.3.3 *Leg 4*

Sixty net deployments were conducted to sample the fish and zooplankton communities (Table 22-3, Figure 22-14). The PETRL team was provided with samples from 52 of these 60 nets and the Environment Canada team was provided with samples from 16 nets. There were 271 larval fish from seven different families identified, counted, and preserved. The most frequently occurring species were Arctic cod, followed by species from the Liparidae and Stichaeidae families (Figure 22-14, bottom). Fifty-seven percent (n=156) of the larval fish captured were Arctic cod. Of the 156 Arctic cod collected, a sub-sample of 147 were measured. The average standard length of these larval Arctic cod was 37.6mm (SD=11.7mm), while the median size was 40mm (Figure 22-15, bottom).

There were 391 fish from eight families caught in the IKMT and Beamtrawl nets. The most frequently caught species were in the families: Cottidae, Gadidae, Stichaeidae, and Zoarcidae (Figure 22-16, bottom). One-hundred and seventy-six Arctic cod were collected, and a subsample of 129 were measured. The average standard length was 98.9mm (SD=33mm), while the median was 93mm (Figure 22-17, bottom).

There were 1,829 zooplankton from 11 groups identified 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. Chaetognatha, Clionidae, Cnidaria, Hyperiidae, and Mysida were the most frequently occurring zooplankton groups (Figure 22-18, bottom). Acanthephyridae, Chaetognatha, Hyperiidae, and Mysida typically had the highest relative abundance by station (Figure 22-19, bottom).

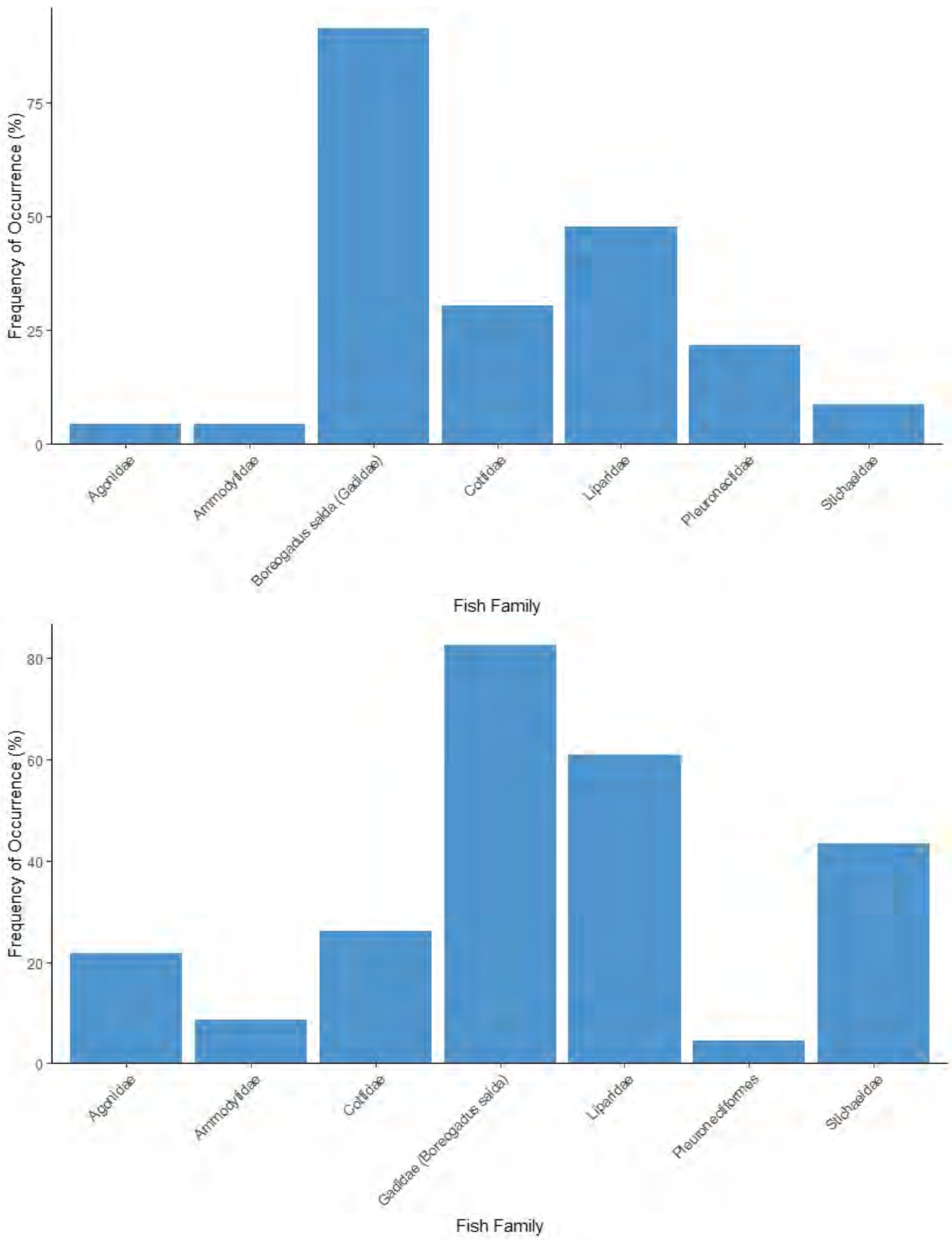


Figure 22-14: The frequency of occurrence (# of nets a species was captured in/total number of nets) of larval fish for Leg 3 (top) and Leg 4 (bottom).

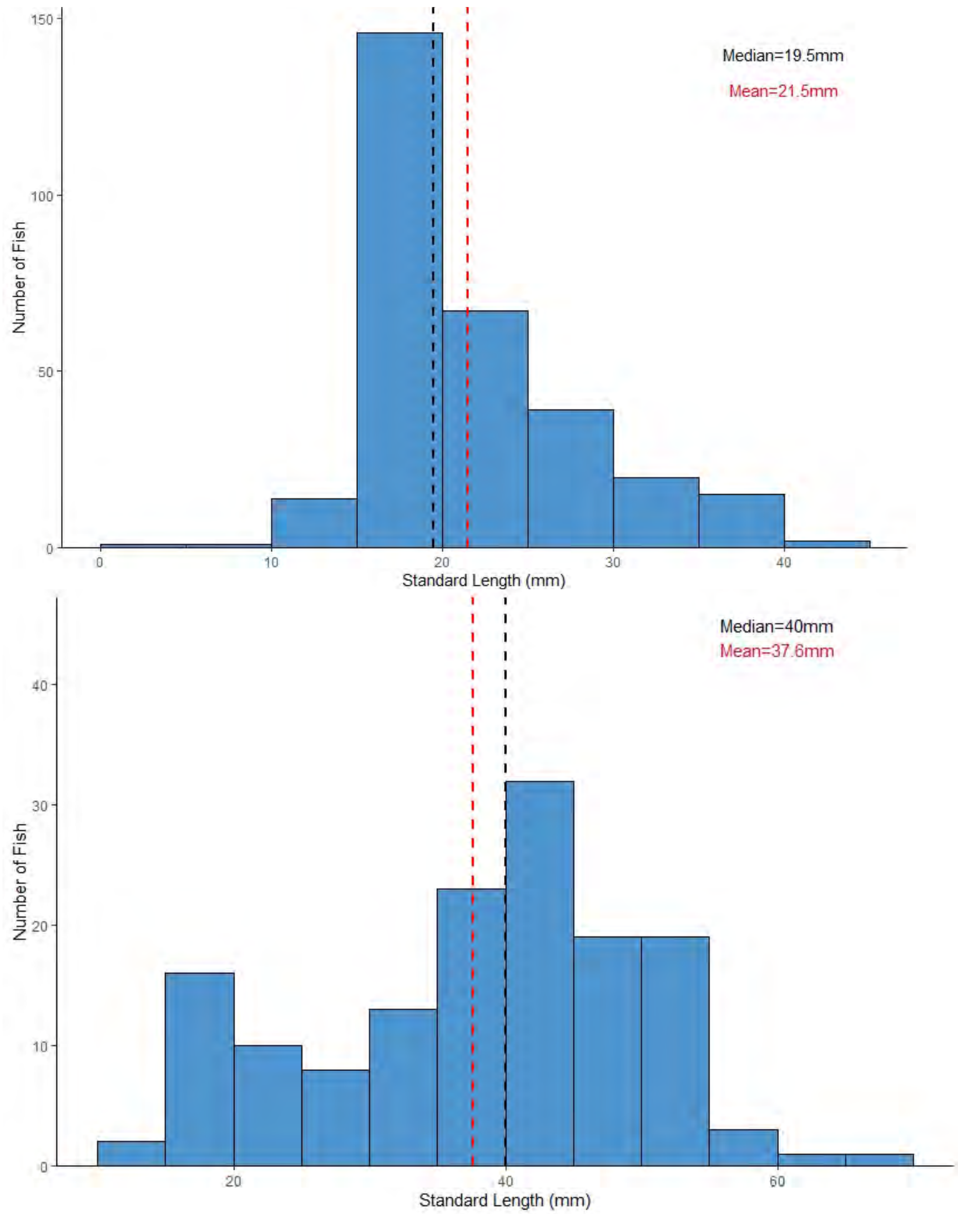
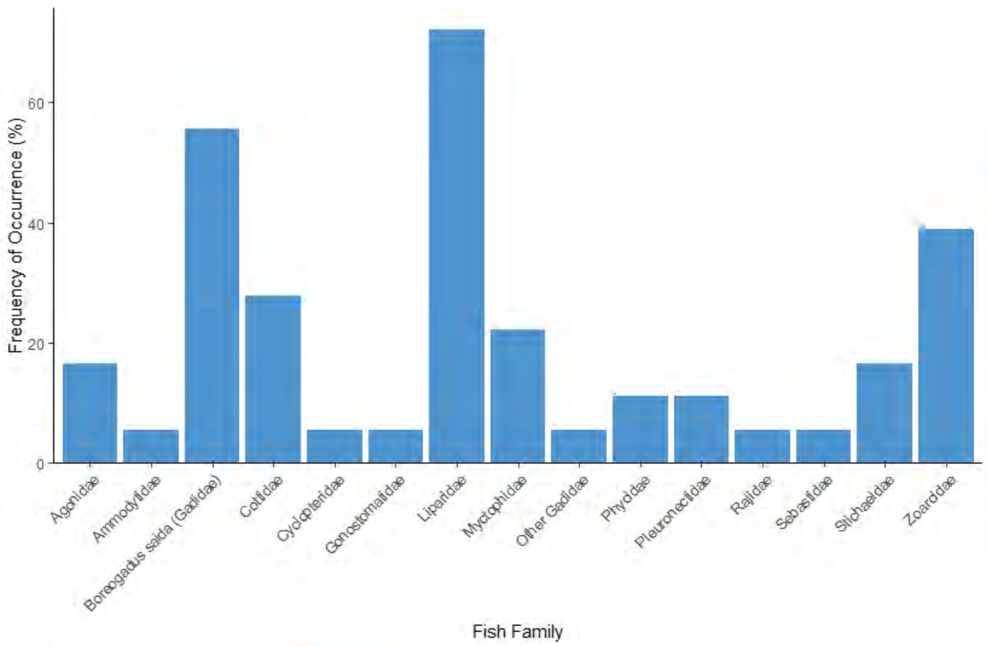


Figure 22-15: Length frequency of larval Arctic cod for Leg 3 (top, n=305) and Leg 4 (bottom, n=147). The mean is represented by the vertical red line and the median by the black vertical line.



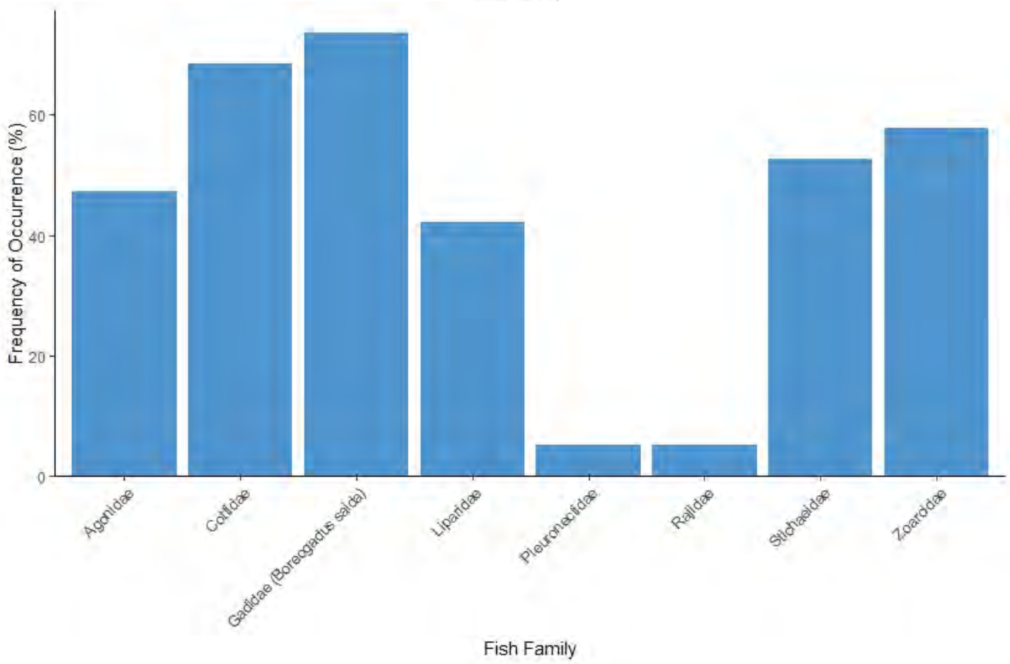


Figure 22-16: The frequency of occurrence (# of nets a species was captured in/total number of nets) of adult fish caught in the IKMT and Beam trawls fro Leg 3 (top) and Leg 4 (bottom).

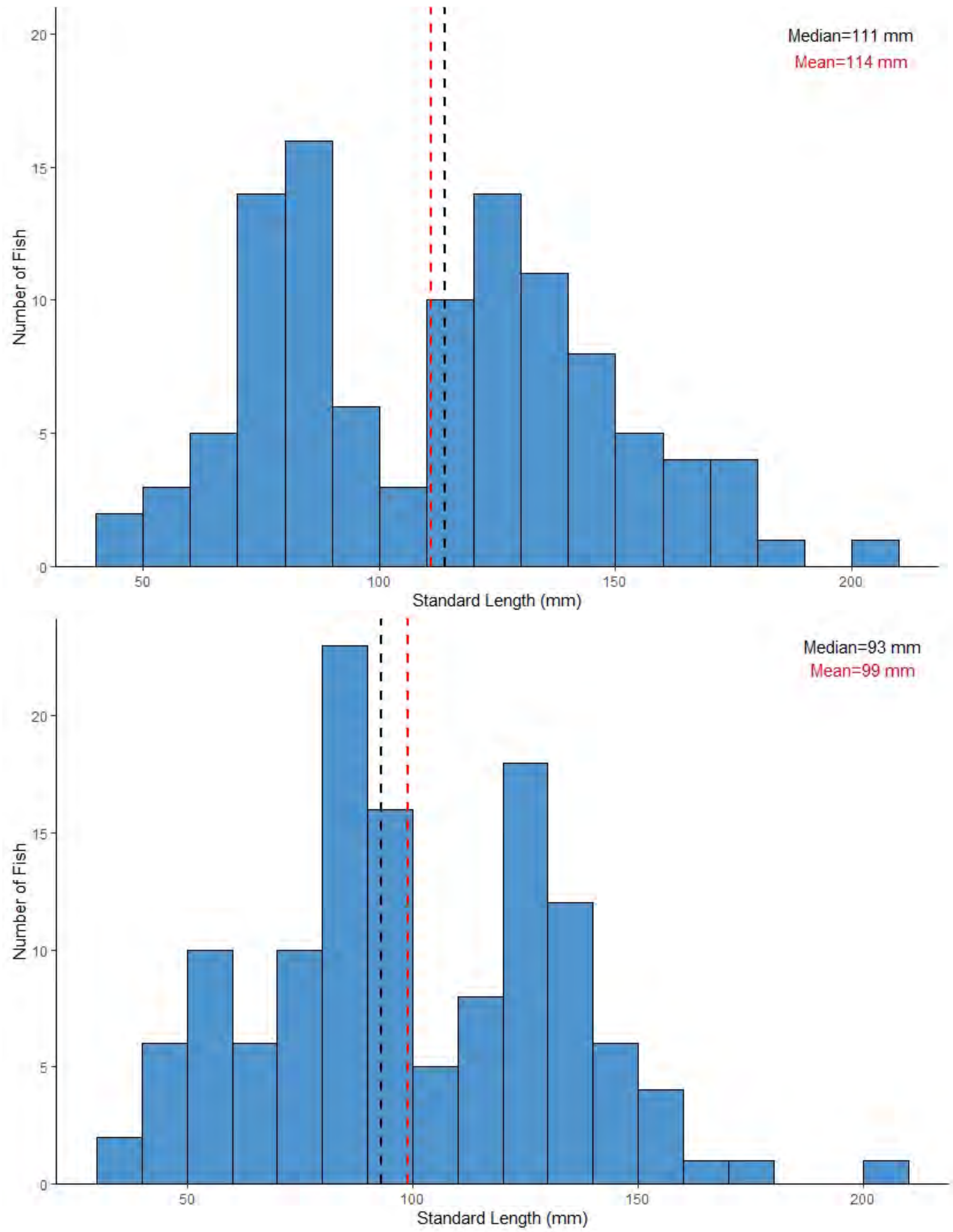


Figure 22-17: Length frequency of adult Arctic cod from the IKMT and Beam Trawl for Leg 3 (top, n=107) and Leg 4 (bottom, n=129). The mean is represented by the vertical red line and the median by the black vertical line.

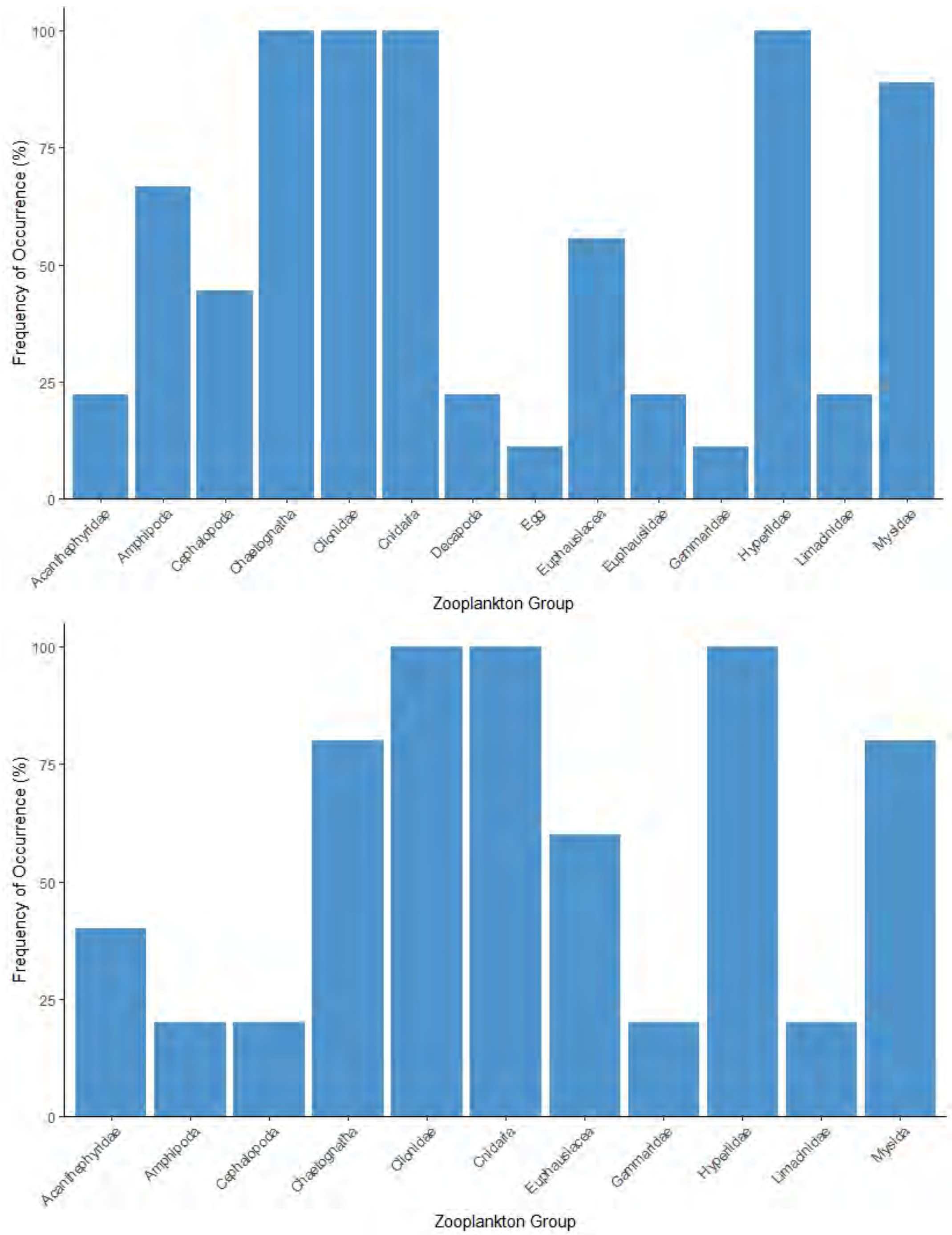
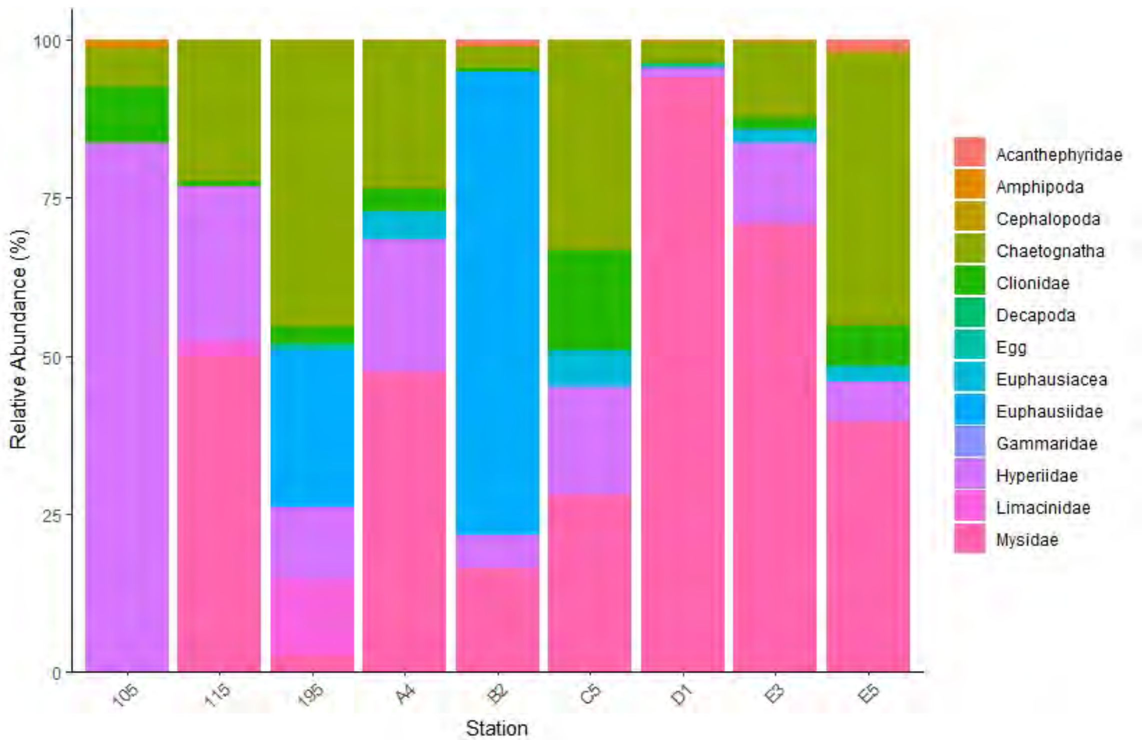


Figure 22-18: The frequency of occurrence (# of nets a species was captured in/total number of nets) of zooplankton caught in the IKMT nets fro Leg 3 (top) and Leg 4 (bottom).



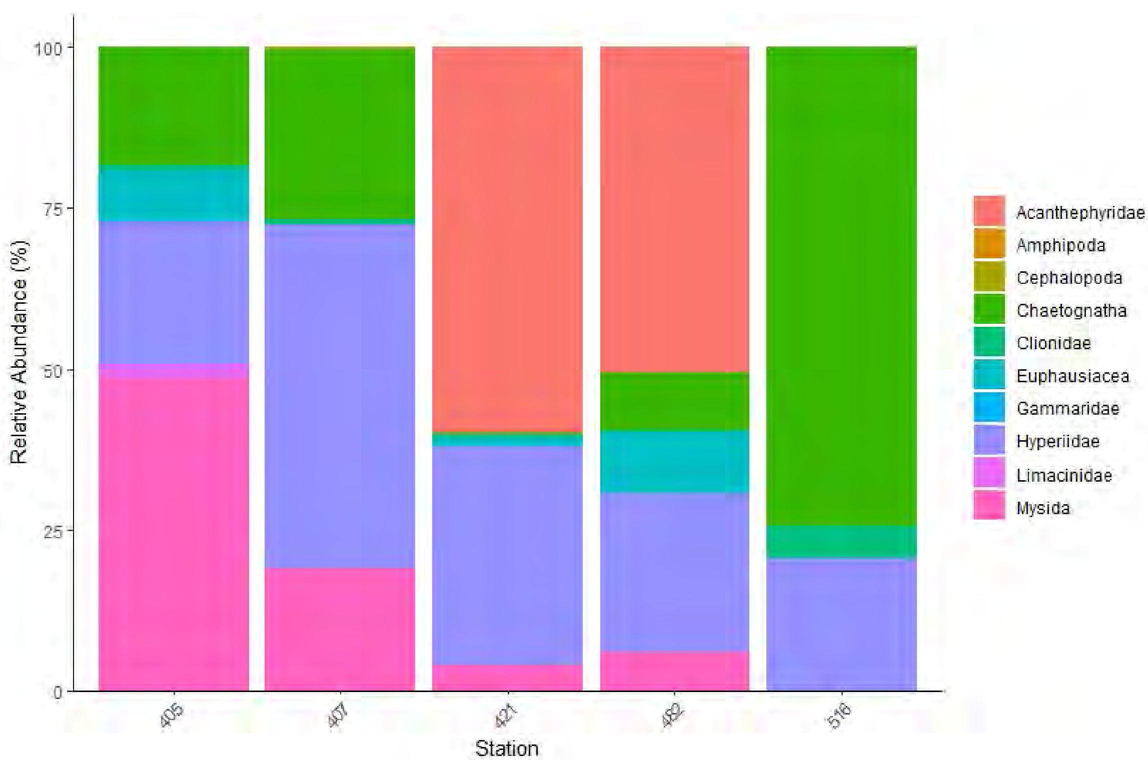


Figure 22-19: Relative abundance of zooplankton groups in the IKMT nets by station for Leg 3 (top) and Leg 4 (bottom)

22.4 Reference

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23 CalAct: Zooplankton and fish

Project leaders: Malin Daase[1] (malin.daase@uit.no), Gérald Darnis[2] (Gerald.Darnis@qo.ulaval.ca), Maxime Geoffroy[1,2] (maxime.geoffroy@mi.mun.ca)

Cruise participants – Leg 5: Estelle Coguiec[1], Malin Daase[1], Maxime Geoffroy[1,2], Maja Hatlebakk[3], Pierre Priou[2]

[1] Department of Arctic and Marine Biology, The Arctic University of Norway, Tromsø, Norway
[2] Centre for Ecosystems Research, Fisheries and Marine Institute of Memorial University, St. John's, NL, Canada, A1C 5R3
[3] NTNU University, Trondheim, Norway

23.1 Introduction and Objectives:

The pelagic fish and zooplankton community of the eastern Canadian Arctic is poorly described. For instance, mesopelagic organisms are forming dense mid-water aggregations across the global oceans known as deep sound scattering layers (DSLs) and are hypothesized to be responsible for the largest biomass aggregations of animal life on the planet deep ocean (Proud et al 2017). Yet, their spatial variations and diel vertical migration (DVM) patterns remain largely undocumented in the eastern Canadian Arctic, particularly in autumn, at the onset of the winter polar night. In the region, Arctic cod (*Boreogadus saida*) and invertebrate zooplanktivores feed predominantly on calanoid copepods, but their vertical overlap with and predation on surface grazing zooplankton is still unclear. In the European Arctic, the diel behavior of mesopelagic organisms was associated with scattering layers originating from the Atlantic water masses (Gjøsæter et al 2017), but the importance of water masses as well as the effect of ice and light remain largely undocumented for the eastern Canadian Arctic. This work package aims to better describe the seasonal, diel, and spatial variation as well as biodiversity and trophic niche of pelagic fishes, meso- and macro-zooplankton of the eastern Canadian Arctic in relation to light and hydrography. Special effort was placed during this cruise in describing the condition of *Calanus* populations in Baffin Bay at the start of the winter in terms of stage composition, vertical distribution, lipid content, activity patterns, and respiration rates. Copepods of the genus *Calanus* are key species in the Arctic ecosystem. They conduct seasonal vertical migration, descending to greater depth at the end of the productive season where they remain in a state of diapause during winter. During summer they accumulate energy stored in form of lipids that are critical to determine timing of descent, winter survival and reproduction the following spring. Within the framework of *CalAct*, a Sentinel Nord collaboration project between UiT and ULaval, we aim to describe life history strategies of Arctic and boreal *Calanus* along latitudinal gradients across the Arctic, and data collected during the DarkEdge cruise will be compared with similar dataset from the Norwegian Arctic to improve our understanding of *Calanus* life history adaptions.

23.2 Methodology:

Our understanding of the biodiversity of pelagic organisms 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 mesozooplankton avoid capture and thus may be underestimated. Therefore, in this study we combine high-resolution acoustic imaging (hull mounted EK80 and rosette mounted Wideband Autonomous Transceiver–WBAT), with traditional midwater trawls (Isaac-Kidd Midwater Trawl–IKMT), depth-stratified plankton net sampling (Hydrobios plankton net), and ichthyoplankton nets (DSN Tucker trawl) to better understand the biodiversity and distribution of pelagic organisms in the eastern Canadian Arctic. We will further combine our results with those from the Underwater Vision Profilers (UVP5 and UVP6) installed on the rosette. A total of 5 stations were sampled for zooplankton and fish (Table 23-1).

Table 23-1: Details of sampling conducted by the zooplankton and fish group

Station	Date (yyyy/mm/dd)	Hydrobios	IKMT	DNS (Tucker)	WBAT
DE110	2021/10/12 – 2021/10/13	1	1	1	3
DE120	2021/10/13 – 2021/10/14	2	0	0	3
DE130	2021/10/14	1	0	0	1
DE210	2021/10/15	0	0	0	1
DE310	2021/10/16 – 2021/10/17	2	2	1	3
DE320	2021/10/17 – 2021/10/18	0	0	0	4
DE400	2021/10/17	0	0	0	1
DE410	2021/10/20 – 2021/10/21	2	1	0	6
DE420	2021/10/21	0	0	1	6
DE430	2021/10/22	0	0	0	5
DE440	2021/10/22 – 2021/10/24	1	0	0	5
BB2	2021/10/25	0	0	0	1
DE500	2021/10/27	2	0	0	0
TOTAL		11	4	3	39

23.2.1 *Hydroacoustics*

The *Amundsen* is equipped with a new state-of-the-art hull-mounted EK80 broadband echosounder operating at 38 and 120 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 for one hour on stations to obtain the frequency-response curve of single targets. In addition to the hull-mounted echosounder, a Wideband Autonomous Transceiver (WBAT) was mounted as an acoustic probe on the CTD rosette (Figure 23-1B). The sideward-looking WBAT was operated for the full depth at all stations <1500 m to provide a fine scale profile of the acoustic backscatter of fish (35-45 kHz) and zooplankton (283-383 kHz) and document their DVM.

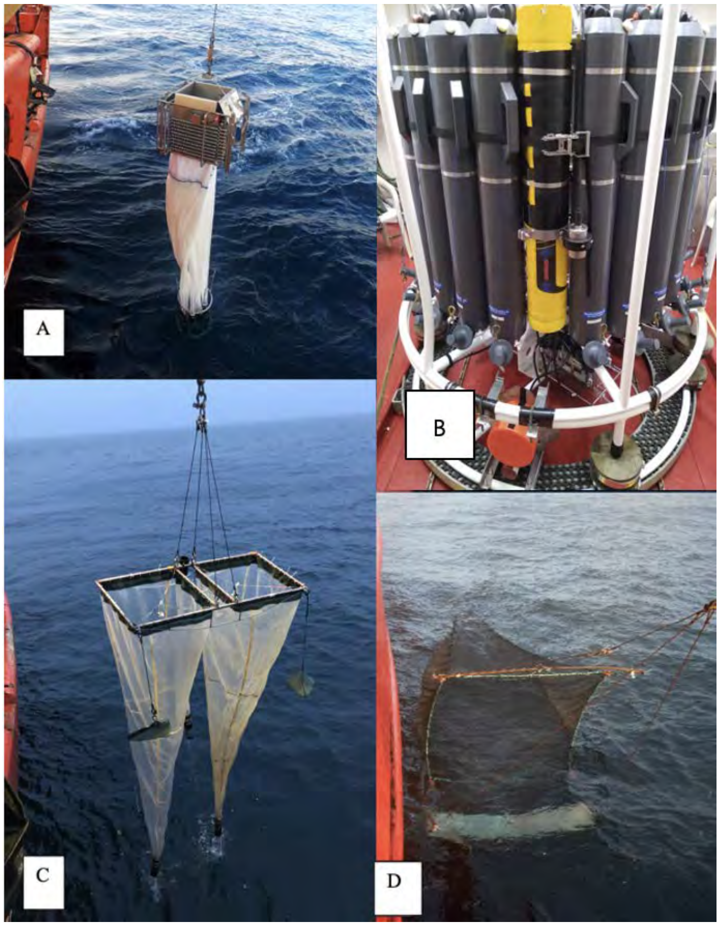

Figure 23-1: A) Hydriobios, B) sideward-looking WBAT mounted on the CTD rosette, C) double-square net (Tucker), and D) IKMT deployed from the CCGS *Amundsen*

23.2.2 *Multi-net plankton sampler (Hydrobios)*

Meso-zooplankton was sampled with a Hydrobios multi-net plankton sampler (Figure 23-1A). The net is 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 Hydrobios is deployed vertically from 10-20 m off the bottom to the surface. The nets open and close one by one while the net is going up in the water column. The depth at which the different nets open and close is programmed before deployment. Once retrieved, the zooplankton samples are preserved in 4% formalin solution and stored for further taxonomic identification at Laval University and UiT The Arctic University of Norway.

The Hydrobios net was also used to catch live organisms for activity and respiration measurements (see below). Live copepods were picked from these samples, the remaining samples were fixed in ethanol for genetic analysis (Gérald Darnis, ULaval). Sample depth and fate of different copepods sampled from each deployment can be found in Table 23-2.

Table 23-2: Sample depth and overview of samples taken with Hydrobios

Date Time (UTC)	Station ID	Latitude	Longitude	Sample depth (from)	Sample depth (to)	Sample used for	Preservation
2021/10/12 23:07:16	DE110	76.03	-77.26	270	200	lipid pics, respiration, LAM	rest of samples pooled and fixed in ethanol, nbot quantitative
				200	150		rest of samples pooled and fixed in ethanol for genetics
				150	100	respiration	rest of samples pooled and fixed in ethanol for genetics
				100	80		rest of samples pooled and fixed in ethanol for genetics
				80	20	lipid pics, respiration, LAM	rest of samples pooled and fixed in ethanol for genetics
				20	0	Grazing	rest of samples pooled and fixed in ethanol for genetics
2021/10/14 01:56:11	DE120	76.41	-78.70	175	150	Community analysis	formalin
				150	125	Community analysis	formalin
				125	100	Community analysis	formalin
				100	50	Community analysis	formalin
				50	40	Community analysis	formalin
				40	30	Community analysis	formalin
				30	20	Community analysis	formalin
				20	10	Community analysis	formalin
				10	0	Community analysis	formalin
2021/10/14 17:35:12	DE130	76.35	-78.33	115	100	Community analysis	formalin
				100	80	Community analysis	formalin
				80	65	Community analysis	formalin
				65	50	Community analysis	formalin
				50	40	Community analysis	formalin
				40	30	Community analysis	formalin
				30	20	Community analysis	formalin
				20	10	Community analysis	formalin
				10	0	Community analysis	formalin

2021/10/16 12:51:03	DE310	78.24	-74.05	580	500	lipid pics, respiration, LAM	rest of samples pooled and fixed in ethanol, not quantitative
				500	450		rest of samples pooled and fixed in ethanol, not quantitative
				450	350		rest of samples pooled and fixed in ethanol, not quantitative
				350	250	lipid pictures	rest of samples pooled and fixed in ethanol, not quantitative
				250	150		rest of samples pooled and fixed in ethanol, not quantitative
				150	100		rest of samples pooled and fixed in ethanol, not quantitative
				100	50	lipid pics, respiration, LAM	rest of samples pooled and fixed in ethanol, not quantitative
				50	20	lipid pics, respiration, LAM	rest of samples pooled and fixed in ethanol, not quantitative
				20	0	lipid pics, respiration, LAM	rest of samples pooled and fixed in ethanol, not quantitative
2021/10/17 00:14:15	DE310	78.16	-74.34	645	600	Community analysis	formalin
				600	500	Community analysis	formalin
				500	400	Community analysis	formalin
				400	300	Community analysis	formalin
				300	200	Community analysis	formalin
				200	100	Community analysis	formalin
				100	50	Community analysis	formalin
				50	20	Community analysis	formalin
				20	0	Community analysis	formalin
2021/10/20 17:50:24	DE410	75.97	-85.60	595	500	lipid pics, respiration, LAM	rest in ethanol, not quantitative
				500	450		in ethanol
				450	350		in ethanol
				350	300		in ethanol 350-200
				300	200		pooled with above
				200	100		in ethanol
				100	50	lipid pics, respiration, LAM	rest in ethanol, not quantitative
				50	20	lipid pics, respiration, LAM	50-0 pooled in ethanol, not quantitative

				20	0	lipid pics, respiration, LAM	50-0 pooled in ethanol, not quantitative
2021/10/20 23:48:34	DE410	75.96	-85.59	590	500	Community analysis	formalin
				500	450	Community analysis	formalin
				450	350	Community analysis	formalin
				350	300	Community analysis	formalin
				300	200	Community analysis	formalin
				200	100	Community analysis	formalin
				100	50	Community analysis	formalin
				50	20	Community analysis	formalin
				20	0	Community analysis	formalin
2021/10/24 00:59:17	DE440	76.18	-81.84	212	200	sample split in two: one for lipid pics, respiration, LAM; one half for community analysis	rest of that fixed in ethanol, 212-175 pooled for experiments and ethanol samples
				200	175	sample split in two: one for lipid pics, respiration, LAM; one half for community analysis	rest of that fixed in ethanol
				175	150	Community analysis	split in two, one in ethanol, one in formalin
				150	125	Community analysis	all in formalin
				125	100	Community analysis	all in formalin
				100	75	Community analysis	all in formalin
				75	50	sample split in two: one for lipid pics, respiration, LAM; one half for community analysis	one in ethanol, one in formalin
				50	20	sample split in two: one for lipid pics, respiration, LAM; one half for community analysis	rest of that fixed in ethanol, 50-0 pooled for experiments and ethanol samples
				20	0	sample split in two: one for lipid pics, respiration, LAM; one half for community analysis	rest of that fixed in ethanol, 50-0 pooled for experiments and ethanol samples
2021/10/27 11:14:07	DE510 /D5 Glider	68.08	-58.77	250	200	Community analysis	formalin

				200	175	Community analysis	formalin
				175	150	Community analysis	formalin
				150	125	Community analysis	formalin
				125	100	Community analysis	formalin
				100	75	Community analysis	formalin
				75	50	Community analysis	formalin
				50	20	Community analysis	formalin
				20	0	Community analysis	formalin
2021/10/27 12:02:49	DE510/D5 Glider	68.08	-58.76	250	200	lipid pics, respiration, LAM	
				200	175		all depth pooled, fixed in ethanol, quantitative
				175	150		all depth pooled, fixed in ethanol, quantitative
				150	125		all depth pooled, fixed in ethanol, quantitative
				125	100		all depth pooled, fixed in ethanol, quantitative
				100	75		all depth pooled, fixed in ethanol, quantitative
				75	50		all depth pooled, fixed in ethanol, quantitative
				50	20	lipid pics, respiration,	
				20	0	lipid pics, respiration, LAM	

23.2.3 *Double Square Net (DSN or Tucker)*

Ichthyoplankton were sampled using a double square net (DSN or Tucker net) carrying two 1 m^2 aperture nets (mesh size 500 and 750 µm; Figure 23-1C). The nets were deployed obliquely at maximum sampling depths of 100 m with a ship speed of two knots. The duration of the Tucker vertical tow averaged 25 min from surface to surface. Fish larvae were sorted out and individually preserved in 95% ethanol while the rest of the contents in the net was preserved in 10% formalin.

23.2.4 *Isaac-Kidd Midwater Trawl (IKMT)*

The IKMT (Figure 23-1D) sampled pelagic fish and macrozooplankton. The rectangular net has a 13.5 m^2 (4.5m x 3m) mouth aperture and mesh size of 11 mm in the first section and 5 mm in the last section. The net was lowered in a sound scattering layer at a target depth, which was determined by the echosounder EK80 signal and towed at that depth for 30 minutes at a speed of 3 knots. All samples were sorted down to the lowest taxonomic level possible, counted, and weighed before being frozen at -80 °C for further analyses.

23.2.5 *Artificial light experiments*

To test the impacts of artificial light from the vessel on fish and zooplankton distribution, four artificial light experiments were conducted. The ship was drifting with the ice pack at night while all lights were turned off for 1 hour and then turned on for 30 minutes, which was repeated 3 times during each experiment. Fish and zooplankton reactions were recorded on the EK80. In addition, to test potential light avoidance of the UVPs, we conducted tests where all lights on the rosette were masked and the rosette deployed 3 times in a sound scattering layer, and then where the lights of the UVP5 and UVP6 were turned on before deploying the rosette another three times at a target depth in the sound scattering layer. The reaction of the fish and zooplankton was recorded with the WBAT.

23.2.6 *Calanus lipid content, activity and respiration rates*

At station DE130, DE310, DE410, DE440 and DE500 we conducted the following measurements on copepods of the genus *Calanus* collected at depth and in surface layers:

Individual lipid content: Samples from the deepest layer and the surface layer taken with the Hydrobios were used to estimate lipid content of *Calanus*. Samples split in two, one half was used to pick out live animals for the activity and respiration incubation, the other half was used to estimate lipid content of *Calanus*. The sample was concentrated up to a specific volume, subsamples were taken with a pipette and each *Calanus* present in the subsampled was photographed, and the stage was noted along with morphological traits. Number of subsamples was chosen to take at least 100 live individuals of *Calanus* in depth layer. Prosome length, lipid sac area and prosome area will be measure of each picture. Lipid content will be determined from lipid sac area measured in each picture as described in Vogedes et al. (2010). Furthermore, a subset of individual *Calanus* (different life stages and species) were placed in pre-weighted tin cups and dried at 50ºC for 24 h. These samples will be used to determine dry weight and conduct CHN analysis.

Activity patterns: To compare the activity in Calanus at surface with those at depth and between different life stages and species, we measures activity patterns using Trikinetics Locomotor Activity Chambers (LAM). Activity measurements using the LAMs yield activity as a proxy for swimming, quantified as the number of beam breaks across the experimental chamber per specified unit of time. Activity screens were carried out with various life stages of Calanus caught at depth and at the surface (Table 23-3). Samples were sorted in the cold room under dim light. Individual Calanus were transferred into modified Trikenetics Locomotive Activity Monitors and placed in the cold room at an ambient temperature 2ºC. All experiments were run in darkness. The activity was monitored for ca. 50 h.

Oxygen consumption rates: To measure oxygen consumption rates of individual Calanus, we used a 24-well Loligo microrespiratory system. Respiration measurements were conducted in darkness in the incubator in the zooplankton lab at 2ºC on different species and life stages of

Calanus (Table 4). The temperature in the incubator was overall relative stable (between 1-2 C), but at the last station (DE500) it increased to 14°C while experiments were running and we did not manage to achieve cold, stable temperatures for the remainder of the cruise.

After both the activity and respiration experiments, a digital image was taken of each individual, and the individual was placed in multi-well plates and frozen at -20°C. The images will be used to measure prosome length, lipid sac area and prosome area. Prosome length will be used to convert to dry weight for calculation of mass-specific respiration rate. The frozen samples will be stored in ULaval and will be used to identify all individuals to species using molecular tools.

Table 23-3: Overview of Activity experiments conducted during Leg 5 of the 2021 Amundsen Expedition

Station	LAM	Start date	Stop date	Species	Stage	Depth
DE110	LAM1	13.10.2021 02:39:(	15.10.2021 12:29:(	Calanus hyperboreus	CIV	270-200
DE110	LAM2	13.10.2021 02:39:(	15.10.2021 12:29:(	Calanus glacialis	CIV/CV	270-200
DE110	LAM5	13.10.2021 02:39:(	15.10.2021 12:29:(	Calanus glacialis	CIII	80-20
DE110	LAM6	13.10.2021 02:39:(	15.10.2021 12:29:(	Calanus glacialis	CIII	80-20
DE110	LAM17	13.10.2021 02:39:(	15.10.2021 12:29:(	Calanus hyperboreus	CV	270-200
DE110	LAM18	13.10.2021 02:39:(	15.10.2021 12:29:(	Calanus hyperboreus	CIV/CV	270-200
DE310	LAM1	16.10.2021 18:28	19.10.2021 16:26	Calanus glacialis	CIV/CV	580-500
DE310	LAM2	16.10.2021 18:28	19.10.2021 16:26	Calanus glacialis	CII-CV	50-20
DE310	LAM5	16.10.2021 18:28	19.10.2021 16:26	Calanus glacialis	CII-CIV	50-20
DE310	LAM6	16.10.2021 18:28	19.10.2021 16:26	Calanus glacialis	CIII/CIV	580-500
DE310	LAM17	16.10.2021 18:28	19.10.2021 16:26	Calanus hyperboreus	CIV	580-500
DE310	LAM18	16.10.2021 18:28	19.10.2021 16:26	Calanus hyperboreus	CIV	580-500
DE410	LAM1	20.10.2021 23:21:(	23.10.2021 12:30:(	Calanus glacialis	CII-CV	50-20
DE410	LAM2	20.10.2021 23:21:(	23.10.2021 12:30:(	Calanus glacialis	CIV/CV	500-450
DE410	LAM5	20.10.2021 23:21:(	23.10.2021 12:30:(	Calanus glacialis	CIV/CV	20-0
DE410	LAM6	20.10.2021 23:21:(	23.10.2021 12:30:(	Calanus glacialis	CIII	20-0
DE410	LAM17	20.10.2021 23:21:(	23.10.2021 12:30:(	Calanus hyperboreus	CIV	500-450
DE410	LAM18	20.10.2021 23:21:(	23.10.2021 12:30:(	Calanus hyperboreus	CIV	500-450
DE440	LAM1	24.10.21 2:30	26.10.21 12:33	Calanus glacialis	CIV/CV	212-175
DE440	LAM2	24.10.21 2:30	26.10.21 12:33	Calanus glacialis	CII/CIII	50-0
DE440	LAM5	24.10.21 2:30	26.10.21 12:33	Calanus glacialis	CIII/CIV	50-0
DE440	LAM6	24.10.21 2:30	26.10.21 12:33	Calanus glacialis	CIII	50-0
DE440	LAM17	24.10.21 2:30	26.10.21 12:33	Calanus hyperboreus	CIV	212-175
DE440	LAM18	24.10.21 2:30	26.10.21 12:33	Calanus hyperboreus	CIV	212-175
DE510	LAM1	29.10.2021 15:18	31.10.2021 12:52	Calanus finmarchicus	CIV/CV	20-0
DE510	LAM2	29.10.2021 15:18	31.10.2021 12:52	Calanus finmarchcicus	CIV/CV	20-0
DE510	LAM5	29.10.2021 15:18	31.10.2021 12:52	Calanus finmarchicus	CV	250-200
DE510	LAM6	29.10.2021 15:18	31.10.2021 12:52	Calanus finmarchcicus	CV	250-200
DE510	LAM17	29.10.2021 15:18	31.10.2021 12:52	Calanus hyperboreus	CIV	250-200
DE510	LAM18	29.10.2021 15:18	31.10.2021 12:52	Calanus hyperboreus	CIV	250-200

Table 23-4: Overview of respiration measurements conducted during the cruise

Experiment	Station	Date	Depth	Stage	Species
S1_R_deep1_817	DE110	13.10.2021	270-200	CIV	Chyp
S1_R_surf1_810	DE110	13.10.2021	80-20	CIII, CIV	Cgla
S1_R_surf2_810	DE110	13.10.2021	80-20	CIII, CIV	Cgla
S1_R_deep2_817	DE110	13.10.2021	270-200	CV, CIV	Cgla
S1__R_surf3_817	DE110	13.10.2021	80-20	CIII, CIV	Cgla
S1_R_mid1_810	DE110	14.10.2021	150-100	CV, CIV	Cgla
S1_r_mid1_817	DE110	14.10.2021	150-100	CV, CIV	Cgla
S2_R_surf1_817	DE310	16.10.2021	50-20	CIII, CIV	Cgla
S2_R_deep1_810	DE310	16.10.2021	50-20	CIV	Chyp
S2_R_surf2_810	DE310	17.10.2021	100-50	CIII, CIV	Cgla
S2_R_surf2_817	DE310	17.10.2021	100-50	CIII, CIV	Cgla
S2_R_deep_2_810	DE310	17.10.2021	580-500	CV, CIV	Cgla
S2_R_deep2_817	DE310	17.10.2021	580-500	CIV	Chyp
S2_R_surf3_817	de310	18.10.2021	100-50	CV, CIV	Cgla
S2_r_deep3_810	de310	18.10.2021	580-500	CV, CIV	Cgla
S3_R_deep1_810	DE410	20.10.2021	595-500	CIV	Chyp
S3_R_deep1_817	DE410	20.10.2021	595-500	CIV	Chyp
S3_R_surf1_810	DE410	21.10.2021	100-50	CIII	Cgla
S3_R_surf1_817	DE410	21.10.2021	100-50	CIV	Cgla
S3_R_deep2_817	DE410	22.10.2021	595-500	CIV	Cgla
S3_R_surf2_810	DE410	22.10.2021	100-50	CIII, CIV	Cgla
S3_R_deep3_810	DE410	23.10.2021	595-500	CV, CIV	Cgla
S3_R_deep3_817	DE410	23.10.2021	595-500	CV, AF	Chyp
S4_R_deep1_810	DE440	24.10.2021	212-175	CIII, CIV	Cgla
S4_R_deep1_817	DE440	24.10.2021	212-175	CV	Cgla
S4_R_surf1_810	DE440	24.10.2021	50-0	CIII, CIV	Cgla
S4_R_surf1_817	DE440	24.10.2021	50-0	CIII, CIV	Cgla
S4_R_deep2_810	DE440	25.10.2021	212-175	CIV	Chyp
S4_R_deep2_817	DE440	25.10.2021	212-175	CIV	Chyp
S4_R_deep3_810	DE440	25.10.2021	212-175	CIII, CIV	Cgla
S4_R_deep3_817	DE440	25.10.2021	212-175	CIII, CIV	Cgla
S4_R_deep4_817	DE440	26.10.2021	212-175	CIII, CIV,CV	Cgla
S4_R_surf2_810	DE440	26.10.2021	50-0	CII, CIII	Cgla
*S5_R_surf1_810	DE510	27.10.2021	20-0	CV	Cfin
*S5_R_surf1_817	DE510	27.10.2021	20-0	CIV	Cfin

Experiment	Station	Date	Depth	Stage	Species
***S5_R_deep1_810**	DE510	28.10.2021	250-200	CV	Cfin
***S5_R_deep1_817**	DE510	28.10.2021	250-200	CV	Cfin
***S5_R_deep2_810**	DE510	28.10.2021	250-200	CV	Cfin
***S5_R_deep2_817**	DE510	28.10.2021	250-200	CIV	Chyp
***S5_R_surf2_810**	DE510	29.10.2021	50-20	CV	Cfin
***S5_R_deep3_817**	DE510	29.10.2021	50-20	CV	Cfin

23.2.7 *Dilution and grazing experiments*

Three dilution and grazing experiments were conducted during the cruise: at station DE110, DE310 and DE410. The aim of the experiments is to estimate growth rate of phytoplankton and microzooplankton, and the grazing rate of microzooplankton and copepods (*Calanus* spp.) to study the dynamics in the planktonic food web. Water was collected from deep Chlorophyll a maximum and copepods were collected with a multiple opening and closing plankton sampler (MPS, 200 µm mesh size) from the upper 100 m of the water column. The water was screened through a 180 µm mesh to eliminate larger grazers. From the screened water, four treatments were prepared in triplicates for incubation: one treatment diluted with 0.2 µm filtered sea water to 20% concentration, one treatment with 100% sea water and no manipulation, one treatment with 100% sea water and added *Calanus* spp. and one treatment with 100% sea water with added f/2 medium. The incubation lasted for 48-52 hours and was done in the incubators on deck to expose the incubated bottles to the natural light cycle. Samples were collected at the start and the end of the incubation for the following parameters: Phytoplankton taxonomy, microzooplankton taxonomy, Flow cytometry, Chlorophyll a, HPLC, nutrients, ammonium and POC/PON.

23.3 Preliminary results

Arctic cod (*Boreogadus saida*) and *Liparis* spp. dominated the fish assemblage, while *Themisto libellula* and mysids dominated the macrozooplankton assemblage. DVM patterns were detected on both the hull-mounted EK80 and the WBAT (Figure 23-2).

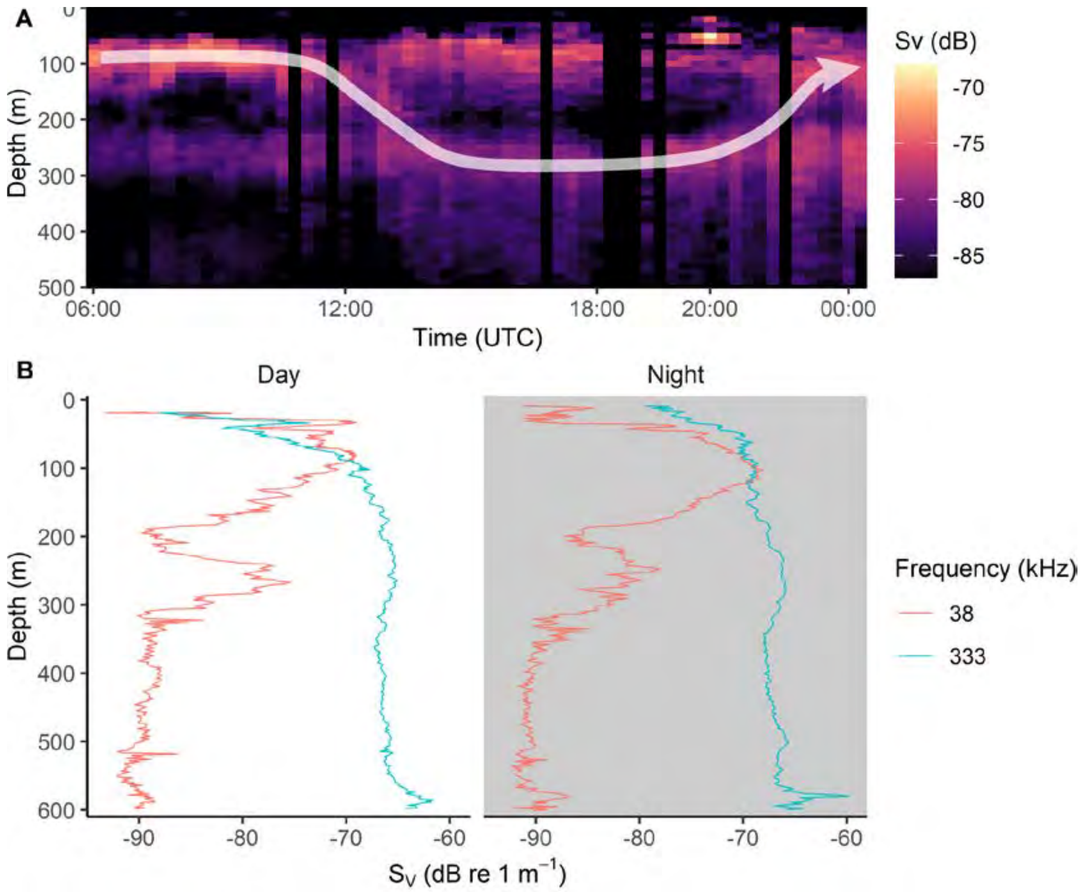

Figure 23-2: A) Echogram showing the mean volume backscatter coefficient (SV) at 38 kHz from the shipborne echosounder on October 20, 2021, at station DE410. The white arrow shows the diel vertical migration pattern. B) Vertical profiles of SV from the rosette mounted acoustic probe WBAT at station DE410 during day (left) and night (right) at 38 and 333 kHz.

The EK80 detected a clear avoidance behaviour from the artificial lights from the ship (Figure 23-3), but no avoidance behaviour from the UVP5 nor UVP6 were detected (Figure 23-4).

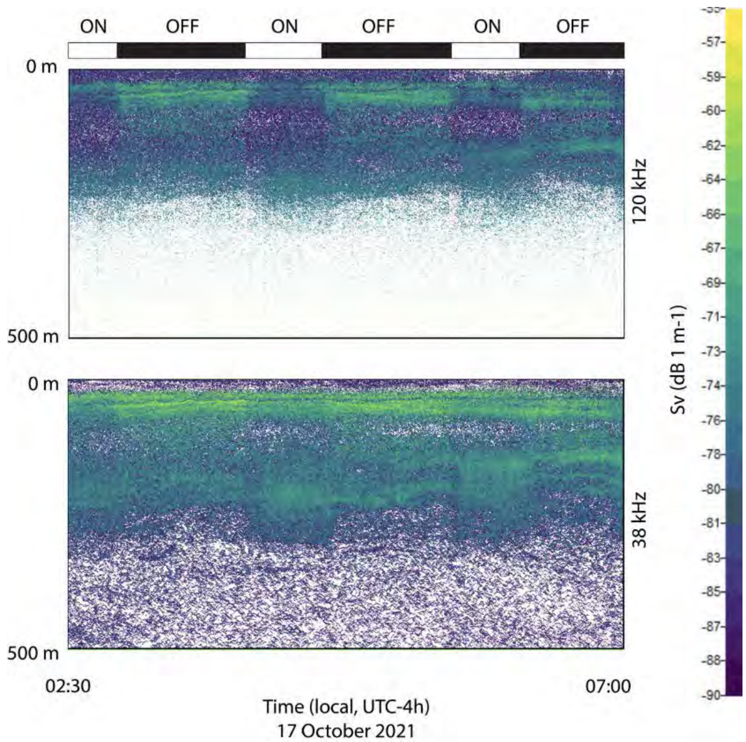

Figure 23-3: Example of avoidance reactions detected by the EK80 when the lights of the Amundsen were turned on.

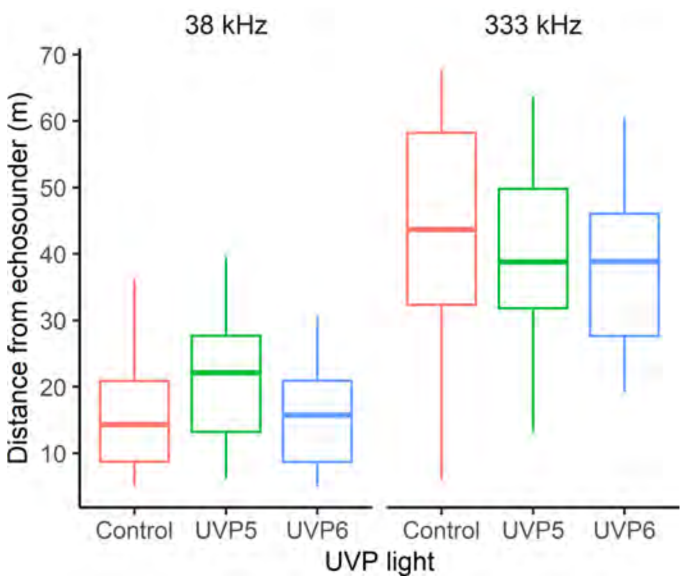

Figure 23-4: Boxplot of the distance of animals from the echosounder when lights of the UVP5 and UVP6 were turned off (red), UVP5 lights on (green), and UVP6 lights on (blue). The threshold to define the distance from the echosounder was 90 dB.

23.3.1 *Calanus species and stage composition*

Northern Baffin Bay (DE1-DE4): *Calanus glacialis* and *C. hyperboreus*, both species of Arctic origin, dominated the *Calanus* community in northern Baffin Bay. The Atlantic species *C. finmarchicus* was detected but in low numbers (Figure 23-5). The *C. glacialis* population in surface waters (upper 50 m) was dominated by young copepodites stages (CI-CIII) (Figure 23-6). These were actively feeding (observed in live microscopy). In addition to the dominance of young copepodites, the zooplankton community in the surface layer was also characterized by the presences of benthic larvae (bivalves, echinoderms, polychaets), juveniles of *Clione limacina* and we even observed large diatoms and dinoflagellates in the Multinet samples (200 µm mesh size). At depth, overwintering stages of *C. glacialis* (CIV, CV) and *C. hyperboreus* (mainly CIV, some CV and females) dominated.

At the southern station (DE5), CV and females of *C. finmarchicus* dominated in surface waters, at depth CIVs of *C. hyperboreus* were abundant.

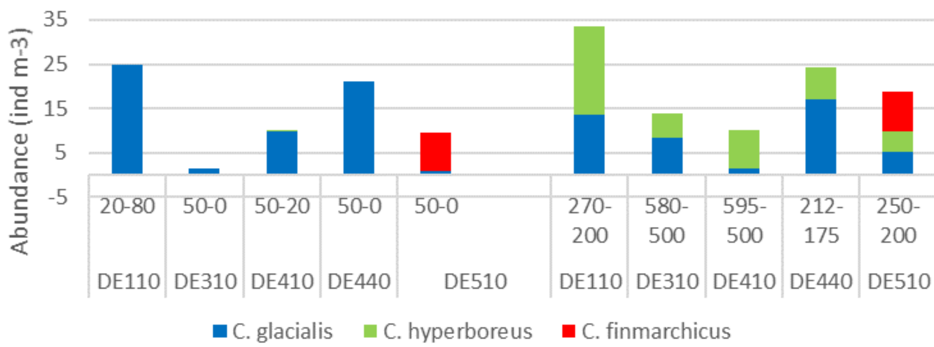

Figure 23-5: Preliminary abundance estimates of different *Calanus* species in surface and deepest layer at each station

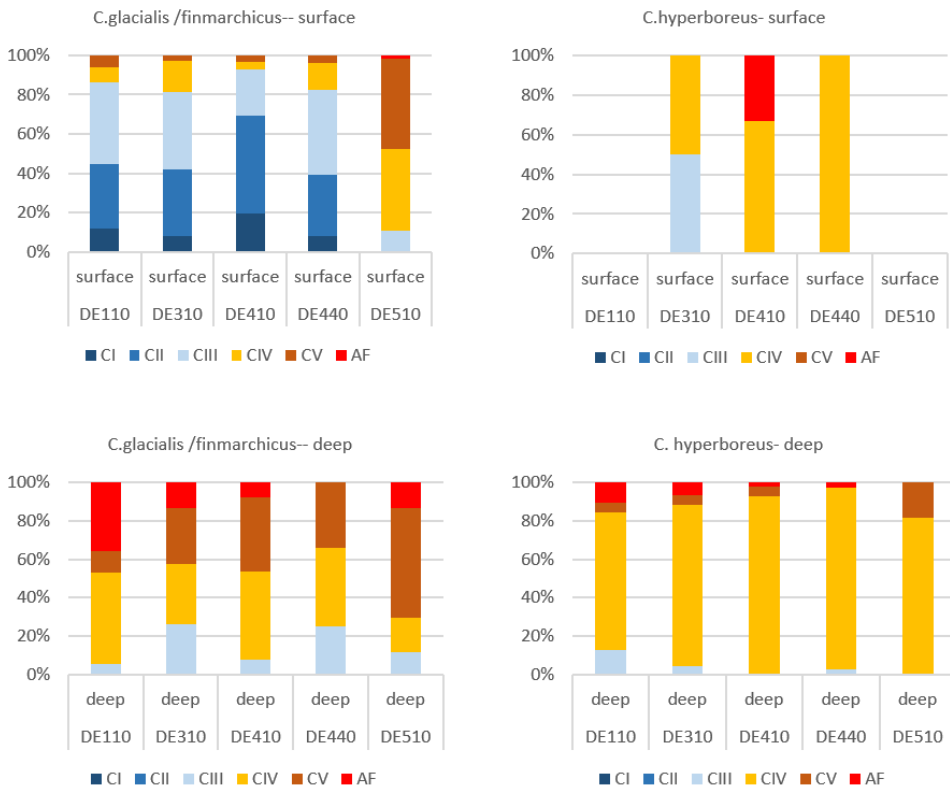

Figure 23-6: Stage composition of C. glacialis/finmarchicus (left) and C. hyperboreus (right) in surface waters (upper panel) and deep waters (lower panel) at each station

23.3.2 *Activity*

At DE130 over 50% of individuals showed rhythmic activity patterns (Figure 23-7) over the 50h incubation time. Rhythmicity was particular high in *C. hyperboreus* at depth (Table 23-5). The decrease in the proportion of rhythmic individuals at the following stations is likely reflecting changes in light climate during the sampling period and not due to differences between stations.

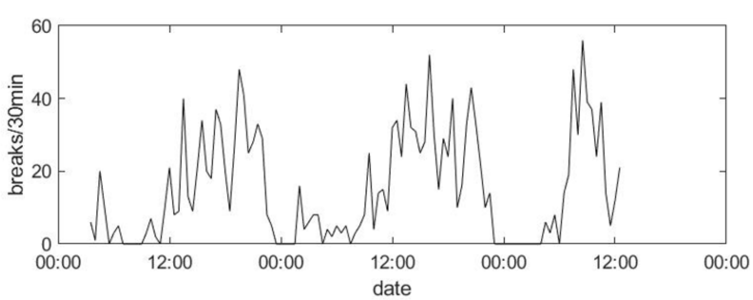

Figure 23-7: Example of an activity pattern of a rhythmic individual *Calanus*

Table 23-5: Proportion of rhythmic individuals in the different LAM experiments

	DE130		DE310		DE410		DE440	
	deep	surface	deep	surface	deep	surface	deep	surface
C. glacialis								
CIII	0.5	0.51	0.1	0.09	0.03	NA	0	0.16
CIV	0.5	0.25	0.047	0.03	0	0	0.4	0.3
CV	0.46	0.33	0.24	0.66	0.3	0.05	0.14	0.2
C. hyperboreus								
CIV	0.82	NA	0.12	0.4	0.22	0.75	0.48	NA
CV	0.92	NA	0.33	NA	0.5	NA	NA	NA

23.4 Recommendations

In general, we were really pleased with the equipment and support from the coast guard crew and Amundsen Science. We identified some items that could be improved, listed below:

- The safety lock of the Hydrobios should be maintained and probably lubricated. It was very difficult to use.
- In cold conditions the cod ends of the Hydrobios were frozen and it was very hard to unscrew them.
- A second set of Cod ends would be useful to increase turn-over time if Hydrobios is deployed twice in a row.
- We recommend designing a better chariot to move the IKMT on deck.
- When possible, minimum light should be used while sampling zooplankton and fish at night.
- The incubator in the zooplankton lab has an unstable temperature. A complete maintenance needs to be conducted.

23.5 References

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24 Phytoplankton and photosynthesis project

Project leader: Chris Bowler[1] (cbowler@biologie.ens.fr)

Cruise participant – Leg 5: Chris Bowler[1], Angela Falciatore[1], Benjamin Bailleul[1], Richard Dorrell[1], Nathalie Joli[1], Carole Duchène[1]

[1]IBPC Paris

24.1 Introduction and objective

Our overall objective was to understand how marine phytoplankton prepare for the polar night. The Dark Edge campaign provided an opportunity to address this question because we were to go up to Smith Sound in the North Water at a late time of the year. We were equipped to study phytoplankton communities by microscopy and omics, and to measure photosynthetic activity in plankton communities using a Mini **F**luorescence **I**nduction and **Re**laxation (FIRe) system built by Dr. Maxim Gorbunov in the laboratory of Dr. Paul Falkowski in Rutgers University. We aimed to sample phytoplankton communities in open water, at the ice edge, and within newly formed sea ice.

24.2 Methodology

We conducted successful operations at three different sites. At each site omics sampling was performed by filtering seawater collected by the rosette at surface and surface chlorophyll maximum (SCM; typically around 20-30 m) sequentially 20 micron, 3 micron and 0.2 micron filters in order to size fraction plankton communities (a 200 micron net was used first to remove debris and zooplankton). These samples were frozen and will be shipped back to Paris for analysis by metabarcoding, metatranscriptomics, and metaproteomics, aiming to characterize the entire community of plankton between 200 microns and 0.2 microns in size. From these studies we aim to learn about community structure and what functions they are performing. Samples from the same water were also fixed for microscopy and will be analysed in Paris to further investigate cell morphology. A 20 micron phytoplankton net was also deployed at each station with the aim of concentrating more biomass (above 20 micron) for future microscopy analysis. At each station, we also collected ice samples, representative of ice of different ages including very young slushy and pancake ice. These were melted in a way that optimized cell viability and samples were collected for omics analysis by filtration. The photophysiology of all samples was additionally measured. In Jones Sound we completed a 36 hour diurnal study, with sampling performed from 6am every 3 hours (except at 3am), with the aim of addressing possible different activities of the phytoplankton community exposed to short photoperiods (around 6 hs light and 18 h dark). Moreover, we performed the same analysis (microscopy, -omics, photophysiology, cell isolation) at the two stations in Baffin Bay, where we aim to understand how the influence of the Atlantic water shapes the phytoplankton community. We also attempted to isolate phytoplankton strains by culturing. Cultures were grown in liquid f/2 enriched sea water media during the expedition (4 °C, 5-10 uE white light) and will be sent to France either in liquid media or cryopreserved.

24.3 Preliminary results

The onboard light microscope was used as a preliminary screen to determine which planktonic organisms were present in the different samples, in particular from 20 micron phytoplankton net samples. These observations revealed the predominance of diatoms (*Pseudo-nitzschia, Chaetoceros, Fragilariopsis*, *Rhizosolenia*) and dinoflagellates (*Ceratium*), as well as a single-celled species characterized by an ovoid cell with two protruding setae-like appendages. It may be *Chaetoceros minimus*, but identification will require further elctron microscopy observations. The predominance of diatoms (*Pseudo-nitzschia, Chaetoceros, Fragilariopsis*, *Rhizosolenia*) was also noted in sea ice samples, alongside specific sea ice algae from other groups of the tree of life (*Phaeocystis*- haptophyte*, Dinobryon* and *Dictyocha*- ochrophytes*, Karenia* and *Ceratium*- dinoflagellates). These were also observed in sea ice cytometric observation from the GreenEdge campaign. The potential presence of chlorophytes such as *Pyramimonas* in some samples was also noted, as was the presence of small chlorophytes (too small to be correctly visualized with the on board microscope).Of note, station 430 sea ice was highly enriched in euglenids (*Eutreptiella* sp.), reflecting the widespread occurrence of euglenids in the continental Arctic inferred from the *Tara* Oceans expedition, but with no such strains currently isolated or in culture.

Analysis of photosynthetic activity revealed contrasted photophysiologies between Baffin Bay stations and the three Arctic stations: the later displayed a lower activity of photosystem II under saturating light, lower maximal quantum yields and lower absorption cross-section, probably reflecting the stronger limitation in nitrogen/light.

Photophysiology was also used to optimize the treatment of sea ice before further analysis: the protocol consisted on melting small amounts of the sea ice with varying amounts of filtered sea water from the surrounding sea ice and measure the photophysiology of the final melted samples. The treatment allowing the higher biomass and the higher Fv/FM was then applied to the whole piece of sea ice, which was then left to melt at 2 degrees in darkness for ~24h. Overall, sea ice displayed between two and twenty times more photosynthetic activity than its surrounding seawater.

25 Bamboo coral collection for δ11B analysis

Project leader: Thomas Williams[1]

Cruise participants – Leg 2: Thomas Williams[1]

[1] *University of Southampton, Southampton, England*

25.1 Introduction

The deep sea plays a critical role in global climate regulation through uptake and storage of heat and carbon dioxide. However, this regulating service causes warming, acidification and deoxygenation. Instrumental records of these processes, especially the change in pH, are scarce and only go back a few decades. One way to reconstruct environmental parameters further back in time is to use indirect measurement of pH using, for example, the boron isotope (δ11B) ratio pH proxy in corals. This method has been used to capture existing records of surface pH change [Goodkin et al., 2015] and to extend the historical pH record (e.g. Liu et al., 2014; Fowel et al., 2018) but often at limited spatial and temporal resolution. Long-lived bamboo corals (Family Isididae) from cold-water environments (such as the Eastern Canadian Arctic) are attractive prospects for deep-sea palaeoceanographic reconstruction with potential sub-decadal resolution over multi-century timescales. Two bamboo coral species (*Acanella arbuscula, Keratoisis flexibilus*) were collected during ROV dives and their skeletal structures are to be analysed using a Laser Ablation Inductively Coupled Plasma Mass Spectrometry (LA-ICP-MS) technique at the National Oceanography Centre, Southampton. By analysing the skeletons of the bamboo coral from sites of different environmental baselines and histories of climate-driven change (Davis Strait, Disko Fan), it will open investigations into the spatial variability of long-term pH dynamics in cold-water environments.

25.2 Methodology

Two species of bamboo coral (*Acanella arbuscula* and *Keratosis flexibilus*) were sampled at two stations (Davis Strait and Disko Fan) using a remotely operated vehicle (ROV). The skeletons are to be transported back the University of Southampton and analysed for isotope ratios of Boron (δ11B) through use of a laser ablation method.

25.2.1 *Sampling strategy*

The two bamboo coral species (*Acanella arbuscula, Keratoisis flexibilus*) were collected live at two stations (Davis Strait, Disko Fan) using the Sub-Atlantic® Comanche (Forum Energy Technologies™, USA) remotely operated submersible. Individual colonies were collected opportunistically along the planned dive transects at each station (see section "Samples collected" for exact geo- and timestamps). Where possible, the corals were sampled at or close to the basal internode (near the base of the specimen at the sediment surface). Once onboard, any external debris and residing fauna were carefully removed from the colonies using tweezers before each coral was sealed in a plastic Ziploc bag and frozen at -20 °C. After 72 hours, the colonies were removed from the freezer and carefully cleaned with jets of re-circulated 0.45 µm membrane-filtered seawater (FSW) at 4 °C using a WaterPik™ [Johannes & Wiebe 1970] before being placed back in -20 °C.

25.2.2 *Laser ablation ICP-MS*

Boron (δ11B) isotope analysis will be undertaken using a Laser Ablation Inductively Coupled Plasma Mass Spectrometry (LA-ICP-MS) technique [de la Vega, 2020] once the bamboo coral samples are transported to the National Oceanography Centre, Southampton.

25.2.3 *Data quality notes/problems*

Although the ROV dive at Davis Strait was successful in terms of numbers of *Acanella* colonies collected (five for this project alone), they are some considerations in terms of how viable this species is for LA-ICP-MS. Despite that all the colonies were collected intact and from the base internode, they are very small (145 – 90 mm in height) and the diameter of the internodes at the widest point are extremely thin (2.19 – 1.47 mm). The *Keratoisis* (900 – 220 cm in height; 6.65 – 3.44 mm internode diameter) that were collected from Disko Fan were more difficult to obtain intact and required re-assembling when retrieved from the ROV. Furthermore, the dive transect at Disko Fan was intermittently stopped and repositioned due to an increasing risk from the accumulating sea ice. Despite this, four different *Keratoisis* colonies were able to be collected for this project alone.

After the ROV dive at Davis Strait, *Acanella* specimens were brought to the temperature-controlled room for processing. After removing all external fauna and sediment, it became quickly apparent that cleaning the colonies to remove tissue was to be extremely difficult due to the production of a protective mucus. As such, corals were instead quickly rinsed in pre-filtered seawater and placed in -20 °C. This was then made the standard procedure for all coral samples, and the cleaning was pushed back to 72 hours post-freezing.

25.2.4 *Samples collected*

Table 25-1: Sampling details for the collection of corals (ROV) for the LA-ICP-MS of boron isotopes (δ11B).

Time (UTC)	Time (Local)	Station	Station Type	Activity	Latitude	Longitude	Depth (m)	Dive #	Sample #	Species	Colony #
29/07/2021 15:38	29/07/2021 11:38	Davis Strait	ROV/Benthic	ROV	63.34704	-58.20793	1297.2	R21	21-12	Acanella	4
29/07/2021 15:43	29/07/2021 11:43	Davis Strait	ROV/Benthic	ROV	63.34694	-58.20783	1297.6	R21	21-13	Acanella	5
29/07/2021 15:50	29/07/2021 11:50	Davis Strait	ROV/Benthic	ROV	63.3467	-58.20756	1299.6	R21	21-14	Acanella	6
29/07/2021 16:14	29/07/2021 12:14	Davis Strait	ROV/Benthic	ROV	63.34668	-58.20788	1298.1	R21	21-18	Acanella	10
29/07/2021 16:36	29/07/2021 12:36	Davis Strait	ROV/Benthic	ROV	63.34668	-58.20812	1296.9	R21	21-22	Acanella	13
02/08/2021 15:06	02/08/2021 11:06	Disko Fan	ROV/Benthic	ROV	67.96629	-59.49069	885	R23	23-1	Keratoisis	1
02/08/2021 15:54	02/08/2021 11:54	Disko Fan	ROV/Benthic	ROV	67.96631	-59.4899	883	R23	23-6	Keratoisis	2
02/08/2021 16:21	02/08/2021 12:21	Disko Fan	ROV/Benthic	ROV	67.96631	-59.48892	879.9	R23	23-10	Keratoisis	3
02/08/2021 17:02	02/08/2021 13:02	Disko Fan	ROV/Benthic	ROV	67.9663	-59.48768	876.2	R23	23-16	Keratoisis	7

25.3 Preliminary results

As the main component of the analysis will be taking place post-cruise, it is therefore not possible to present preliminary data for this section other than initial photos of an *Acanella* specimen from Davis Strait and a *Keratoisis* specimen from Disko Fan.

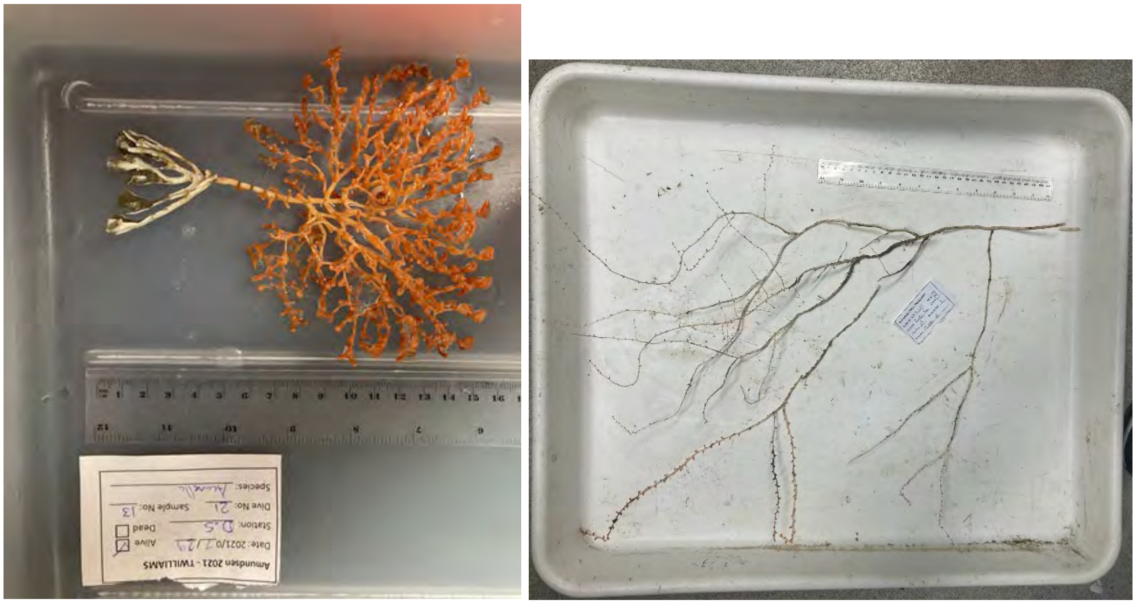

Figure 25-1: Photos of (Left) an *Acanella* specimen from Davis Strait and (Right) a *Keratoisis* specimen from Disko Fan

25.4 References

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26 Faunal bioturbation experiments

Investigators: Thomas Williams[1], Guillaume Blais[2],

Cruise participants – Leg 2: Thomas Williams[1], Guillaume Blais[2]

[1] University of Southampton, Southampton, England
[2] Université Laval, Quebec City, Quebec

26.1 Introduction

Epi- and infauna play a critical role in benthic biogeochemical cycling and carbon sequestration. The biological reworking of surface sediments (bioturbation) and burrow ventilation (bioirrigation) mediate fluxes of oxygen and nutrients at the sediment-water interface and thus exert a strong influence on remineralization processes and organic matter degradation at the seafloor. Despite significant scientific attention devoted to studying benthic biodiversity in the Eastern Canadian Arctic, quantitative studies of bioturbation and bioirrgation activity within this region are scarce [Solan et al., 2019] and global knowledge of bioturbation rates below 1000m is extremely fragmentary [Smith and Demopoulos, 2003]. Therefore, the objectives during this expedition were to;

- Quantify rates of deep-water bioturbation and bioirrigation activity within the Eastern Canadian Arctic
- Explore the spatial variability in benthic activity along a gradient in sea ice and temperature

26.2 Methodology

To quantify *in situ* rates of functionally significant faunal activity (bioturbation and bioirrigation), intact benthic communities were subsampled from the 0.25m^2 box corer (McGregor Precision Enterprises) at the Davis Strait and Disko Fan stations. Optically distinct particulate tracers (luminophores) were added to the surface of each core and incubated for 8 days at 4 ± 0.5 °C and the redistribution of these particles were quantified using fluorescent sediment profile imagery (f-SPI). This choice of 8 days for the duration of the experiment was a compromise between the response that we were expecting from the benthic communities and the available time on board to process the experiments.

26.2.1 *Sampling Strategy*

At each of the two stations (Davis Strait, Disko Fan; see section "Samples collected"), 3 replicate sediment cores were collected from three separate 0.25 m^2 Precision box cores. Prior to removing subsample from box core, three 50 ml syringe corers were pushed into the sediment to a depth of approximately 8 cm. The sediment from these 3 x 50 ml cores were pooled and stored in -20 °C for granulometry and organic carbon analysis. Each box core was subsampled using a (LWH) 20 x 20 x 10 cm insert (Figure 26-1) and placed in transparent aquaria (internal LWH: 20 x 20 x 34 cm, wall thickness 0.5 cm) before being overlaid with uncontaminated surface seawater (~6 L) and left to settle for 24 hours. After 24 hours, 80% of the overlying water was replaced with uncontaminated surface seawater. All aquaria were maintained in a temperature-controlled laboratory at 4 ± 0.5 °C and continuously aerated throughout the incubation (Figure 26-1).

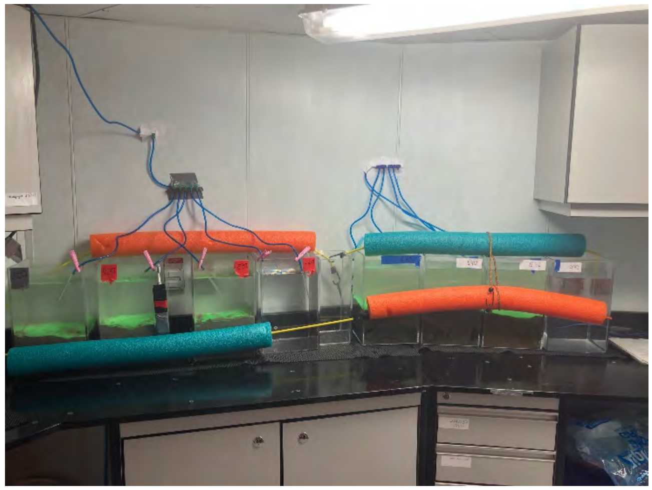


Figure 26-1: (Left) Photo of Perspex insert used to subsample from box core, (Right) Photo of experimental set-up. Pool noodles and bungee-cords were used to fasten down the aquaria.

26.2.2 *Bioturbation, bioirrigation and ecosystem functioning*

To carry out initial nutrient analysis (NH4-N, NOx-N (i.e. NO3-N + NO2-N) and PO4-P), 14 ml of water (0.45 µm NALGENE filtered) was removed from the centre of each aquarium at approx. 5 cm depth before the addition of luminophores (215 g $aquaria^{-1}$, fluorescent green, less than 200 µm silica sand, density 2.35 kg dm^{-3}; Glass Pebbles Ltd., UK) to the sediment surface. The cores were incubated for 8 days after which an additional 14 ml of water was removed for nutrient analysis and 2.831 g of sodium bromide was added. The net change in nutrient concentrations over the 10-day incubation period was used to quantify the level of biogeochemical cycling, whether there is an overall release into the water column (positive difference) or drawdown into the sediment (negative difference). The net change in bromide [Br^-] concentration over an 8-hour period was used to quantify the rate of burrow ventilation of the benthic infauna (= bioirrigation). The rate of bioturbation in each replicate core was analysed using fluorescent sediment profile imaging (f-SPI). This involved photographing the four sides of each replicated core under UV light (Figure 26-2) and processing the images using standard f-SPI analysis techniques [Solan et al., 2004, Schiffers et al., 2011].

Figure 26-2: Photo of f-SPI set up underneath the lab bench. Black out fabric was used to reduce any reflections onto the core and maintain total darkness under the UV light.

26.2.3 *Identification of fauna*

To quantify what macrofaunal species were dominant in the cores, the sediment was sieved through a 500 µm mesh sieve, all collected fauna was fixed in 10% phosphate-buffered formalin (4% formaldehyde) and stored in sealed plastic buckets (5L) for a minimum of three months [Rumohr, 1990]. These will be processed back at the University of Southampton, where all individuals will be identified to the lowest possible taxon and quantified by abundance and biomass per taxon. Biomass will be measured as blotted wet weight (± 0.0001 g). Mobility and feeding [WoRMS Editorial Board, 2021], and particle reworking behaviour (classified into five bioturbation functional groups based on the type of the sediment mixing) will also be attributed to each taxon.

26.2.4 *Data quality notes/problems*

A trial box core was sampled at station 644 (982 m depth) and incubated for 5 days, to test whether the fauna can survive the maximum box core ascent speed of 50 m/min^{-1}. The inspection of the core after five days found no evidence of mortalities (e.g. patches of anoxic sediment). However, when this core was sieved, we only found one polychaete, so this was discarded and not deemed a true trial run. Additionally, as both the Davis Strait and Disko Fan box core were sampled below 1000 m, the ascent rate of the box cores was limited to 30 m/min^{-1} regardless to reduce any risk of rapid decompression effects.

Due to sea ice conditions, the original sites for Disko Fan box cores were adjusted. However, we had no issues with sample collection at either station.

During the expedition, we noticed that warm air was being pumped through the ventilation of the temperature-controlled room at odd intervals, causing the air conditioning system to kick in and rechill the air. After notifying the technicians, two temperature probes were placed at different locations inside the room for 72 hours to gauge the impact this had on the conditions inside the lab. We found that every 6 hours the temperature would quickly rise by near 2 °C, before coming back to ambient temperatures in 15-25 minutes. Despite these events, the standard deviation of temperatures within that 72-hour period was ± 0.36 °C.

It was quickly apparent that the UV light controller that was brought from the UK only works at 220-240 V. As such, a custom adaptor was created by the vessel's senior electrician to use the 220 V plug in the laboratory. No other issues were found during the data collection.

26.2.5 *Samples collected*

Sampling details for the collection of cores (Precision corer), bottom water and surface water (CTD-Rosette) for the bioturbation incubations.

Time (UTC)	Time (Local)	Station ID	Station Type	Activity	Event	Latitude	Longitude	Depth (m)
28/07/2021 21:58	28/07/2021 17:58	Davis Strait	ROV/Benthic	Box Core 1	Deployment	63.3468	-58.2513	1265
28/07/2021 22:19	28/07/2021 18:19	Davis Strait	ROV/Benthic	Box Core 1	Bottom	63.4016	-58.5377	1081
28/07/2021 22:54	28/07/2021 18:54	Davis Strait	ROV/Benthic	Box Core 1	Recovery	63.4017	-58.5371	1082
28/07/2021 23:13	28/07/2021 19:13	Davis Strait	ROV/Benthic	Box Core 2	Deployment	63.4019	-58.5334	1087

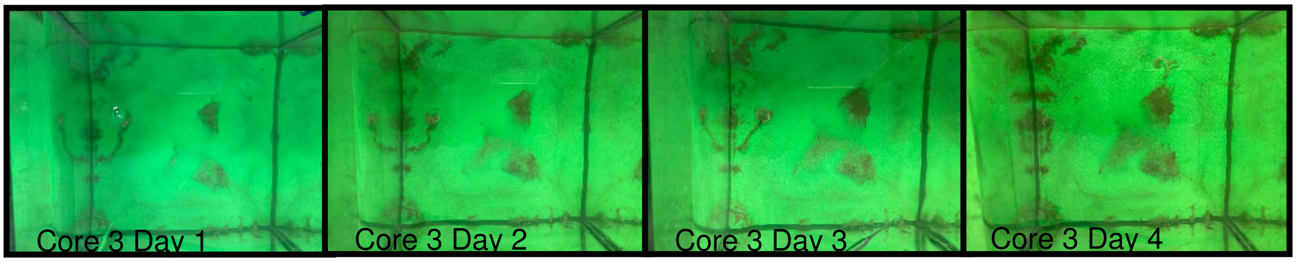
28/07/2021 23:35	28/07/2021 19:35	Davis Strait	ROV/Benthic	Box Core 2	Bottom	63.4017	-58.5347	1085
29/07/2021 00:09	28/07/2021 20:09	Davis Strait	ROV/Benthic	Box Core 2	Recovery	63.4021	-58.5334	1087
29/07/2021 00:25	28/07/2021 20:25	Davis Strait	ROV/Benthic	Box Core 3	Deployment	63.4022	-58.5350	1084
29/07/2021 00:46	28/07/2021 20:46	Davis Strait	ROV/Benthic	Box Core 3	Bottom	63.4022	-58.5350	1084
29/07/2021 01:21	28/07/2021 21:21	Davis Strait	ROV/Benthic	Box Core 3	Recovery	63.3999	-58.5303	1093
29/07/2021 01:57	28/07/2021 21:57	Davis Strait	ROV/Benthic	CTD-Rosette 2	Deployment	63.4007	-58.5334	1089
29/07/2021 02:17	28/07/2021 22:17	Davis Strait	ROV/Benthic	CTD-Rosette 2	Bottom	63.3977	-58.5276	1100
29/07/2021 02:39	28/07/2021 22:39	Davis Strait	ROV/Benthic	CTD-Rosette 2	Recovery	63.3966	-58.5306	1094
02/08/2021 00:19	01/08/2021 20:19	Disko Fan	ROV/Benthic	CTD Rosette	Deployment	67.88088	-59.37531	942.68
02/08/2021 01:00	01/08/2021 21:00	Disko Fan	ROV/Benthic	CTD Rosette	Bottom	67.88082	-59.37132	931.34
02/08/2021 01:48	01/08/2021 21:48	Disko Fan	ROV/Benthic	CTD Rosette	Recovery	67.87755	-59.36446	925.2
02/08/2021 02:06	01/08/2021 22:06	Disko Fan	ROV/Benthic	Box Core 1	Deployment	67.8832	-59.38406	952.38
02/08/2021 02:20	01/08/2021 22:20	Disko Fan	ROV/Benthic	Box Core 1	Bottom	67.88232	-59.38227	950.17
02/08/2021 02:37	01/08/2021 22:37	Disko Fan	ROV/Benthic	Box Core 1	Recovery	67.88041	-59.38218	954.81
02/08/2021 02:55	01/08/2021 22:55	Disko Fan	ROV/Benthic	Box Core 2	Deployment	67.88246	-59.38484	957.59
02/08/2021 03:11	01/08/2021 23:11	Disko Fan	ROV/Benthic	Box Core 2	Bottom	67.88149	-59.38699	962.06
02/08/2021 03:42	01/08/2021 23:42	Disko Fan	ROV/Benthic	Box Core 2	Recovery	67.87837	-59.38657	983.02
02/08/2021 04:30	02/08/2021 00:30	Disko Fan	ROV/Benthic	Box Core 3	Deployment	67.8833	-59.38452	951.89
02/08/2021 04:44	02/08/2021 00:44	Disko Fan	ROV/Benthic	Box Core 3	Bottom	67.88255	-59.38345	
02/08/2021 05:15	02/08/2021 01:15	Disko Fan	ROV/Benthic	Box Core 3	Recovery	67.88095	-59.37949	949.18

26.3 Preliminary results

Due to the delayed arrival at Disko Fan than scheduled because of sea ice, bioturbation incubations were reduced to 8 days and cores from the Disko Fan station were still outstanding until the penultimate day of the expedition. Consequently, the f-SPI analysis and identification of dominant macrofauna from the sieved cores will be carried out after return to the UK.

Preliminary data for this project is presented in Figure 26-3.

(i)



(ii)

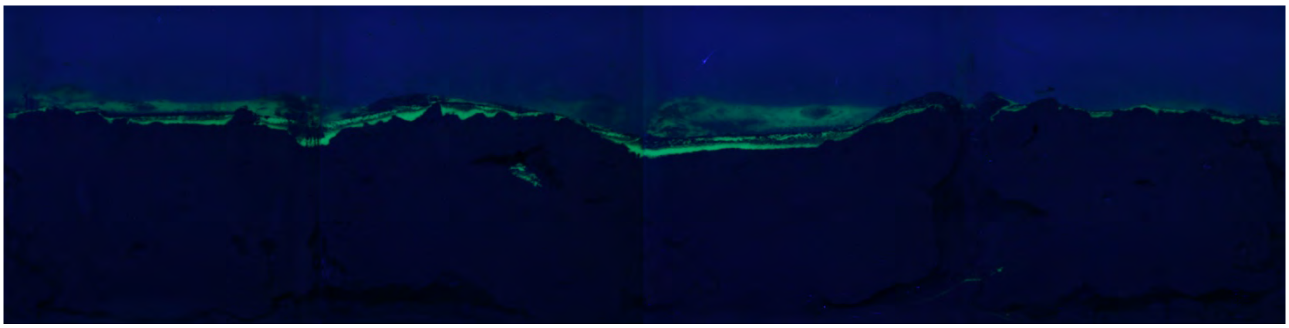


Figure 26-3: (i) sediment surface turnover of cores from Disko Fan and (ii) sediment profile images of cores from Davis Strait

26.4 References

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27 Epifaunal Colonization Analysys from Dropstones

Investigators: Annie Mercier[1] (amercier@mun.ca)

Cruise participants – Leg 2: Wolvin, Sophie[1] and Murray, Kathryn[1]

[1] *Memorial University of Newfoundland, St. John's, NL*

27.1 Introduction and Methodology

Dropstones and other rocks were collected to investigate epifaunal colonization and settlement patterns. This was accomplished using the ROV at various sites and depths from July 24 to August 6, 2021, as well as opportunistic collections from box cores. Rocks were selectively chosen based on size (~5-15cm) and evidence of colonization, both with and without large biogenic structures. Photographs of the rocks were taken *in situ,* as well as after collection. The rocks were collected using the ROV arm attachment and placed into bio-boxes aboard the ROV, separated as much as possible to preserve isolation of any motile fauna associated with the rock. Upon recovery at surface, the rocks and associated fauna were preserved in appropriate concentrations of either ethanol (70-100%) or formalin (10%), or were frozen. Any visible organisms within the same bio-box that could be associated with the rocks were collected and preserved in 70-100% ethanol for later confirmation. In total, 43 rock samples were collected over four sites (Saglek Bank, Hatton Sill, Davis Strait, Scott Inlet). The rocks and associated fauna will be transported back to the Mercier Lab at Memorial University of Newfoundland, and the epifaunal communities will be characterized by MSc candidate Sophie Wolvin. Details regarding the collections can be found in Table 27-1.

Table 27-1: Summary of dropstone and rock collections made on the Amundsen 2021 expedition by the Mercier Lab between July 24th and August 5th, 2021.

Site	Date	Collection Method	Dive Number	Number Collected
Saglek Bank	July 24th, 2021	ROV	17	7
Saglek Bank	July 25th, 2021	ROV	18	6
Saglek Bank	July 25th, 2021	ROV	19	5
Hatton Sill	July 27th, 2021	Box Cores		2
Hatton Sill	July 27th, 2021	ROV	20	2
Davis Strait	July 29th, 2021	ROV	21	5
Scott Inlet	August 4th, 2021	ROV	24	5
Scott Inlet	August 6th, 2021	ROV	26	5
Scott Inlet	August 6th, 2021	ROV	27	6

27.1.1 *Colour chart*

A pilot project to accurately compare colour patterns of dominant benthic taxa by standardizing ROV image-taking was performed at various dive sites in 2021. To do this, raw images were to be taken of organisms next to a colour chart held by the ROV (Image 1), with the camera settings standardized across all photographs. The colour chart was attached to a metal rod, which was then held out beside an organism of interest by the ROV arm, perpendicular to the camera view and within the lasers of the ROV to be able to accurately measure distance. This was repeated with three different organisms at each site included in this project, with additional sets of three organisms done when multiple dives were performed at a site (Makkovik, Saglek Bank, Hatton Sill, and Scott Inlet). Organisms selected were preferentially echinoderms, but chosen based on size, colour intensity, and substrate variety. Limitations of camera setting manipulation of the ROV required that the footage be recorded on the "miniZeus" hi-resolution video camera as opposed to raw images. Image stills will be taken from the footage and used instead for image post-processing to recreate the light and colour of the image and organism as it would be *in situ*. The video camera was set to manual settings for each section of video footage including the colour card, to exclude automatic white balancing, as well as gamma, contrast, and brightness adjustments as much as possible. Measurements of the ROV were also taken after the video footage, to be able to make adjustments for haze due to the thickness of the water column between camera and subject. The video footage will be brought back to the Mercier Lab at Memorial University of Newfoundland for image post-processing.

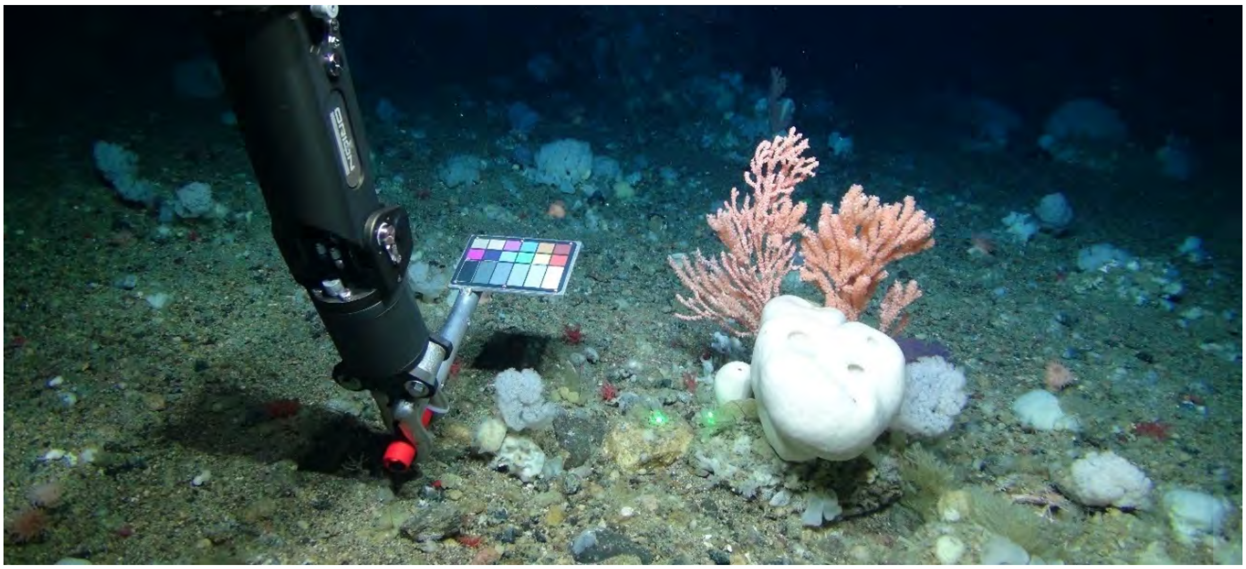

Figure 27-1: Colour chart being positioned by ROV arm next to large benthic fauna during the Amundsen 2021 expedition (ROV Dive #16, Makkovik site).

27.1.2 *Organism collection*

Echinoderms, nudibranchs, pycnogonids, and unknown egg masses were collected from various sites and depths to continue eDNA identification and reproductive studies of the Canadian Arctic benthic fauna. Organisms of interest collections occurred during ROV dives and opportunistically from other sampling methods such as box cores or beam trawls. Other taxa were collected opportunistically as well. Upon collection, organisms were labeled, described, photographed, and preserved in appropriate concentrations of ethanol (70-100%) or formalin (10%), or frozen. A summary of collections can be found in Table 27-2, as well as a full description of samples in Appendix. Organisms will be transported to the Mercier Lab at Memorial University for identification and analysis.

Table 27-2: Summary of organism collections made on the Amundsen 2021 expedition by the Mercier Lab between July 18th and August 7th, 2021.

SITE	COLLECTION METHOD	DATE	MAIN ORGANISMS COLLECTED	TOTAL ORGANISMS COLLECTED	PRESERVATION
Station 644	Box core	July 18th, 2021	Pycnogonid, Coral	2	70% ethanol
Makkovik	Baited Camera bycatch	July 19th, 2021	Anthozoa, bivalves	3	100% ethanol
Makkovik	ROV	July 20th, 2021	Ophiuroids, pycnogonid, annelids, anthozoans	58	100% ethanol
Makkovik	ROV	July 21st, 2021	Sea stars, crinoids, annelids	20	100% ethanol
Nain	Box core	July 22nd, 2021	Ophiuroids, sea stars, egg case	35	95-100% ethanol
Kelp2021	Beam Trawl	July 23rd, 2021	Ophiuroids, sea cucumbers, sea anemones, crinoids, sea urchins, gastropods, bivalves, annelids	175	100% ethanol or frozen
Kelp2021	Box core	July 23rd, 2021	Sea urchin, ophiuroids, crustacean	4	100% ethanol
Saglek Bank	Mooring bycatch	July 24th, 2021	Nudibranchs, sea anemone	3	100% ethanol
Saglek Bank	ROV	July 24th, 2021	Ophiuroids, crinoids	13	70-100% ethanol
Saglek Bank	ROV	July 25th, 2021	Ophiuroids, bryozoans, anthozoans, annelids, egg mass	39	100% ethanol
Hatton Sill	Box core	July 27th, 2021	Ophiuroids, pycnogonid, sea star	9	100% ethanol
Hatton Sill	ROV	July 27th, 2021	Sponge, bryozoans, ophiuroids	10	70-100% ethanol or 10% formalin
Davis Strait	ROV	July 29th, 2021	Ophiuroid, bryozoan, sponge	4	70-100% ethanol
C22 Southwind Fjord	ROV	July 31st, 2021	Gastropod	1	100% ethanol
Southwind Fjord	Box cores	July 31st, 2021	Sea cucumbers	9	100% ethanol or 10% formalin
Disko Fan	Box core	August 1st, 2021	Ophiuroid	1	70% ethanol
Disko Fan	ROV	August 2nd, 2021	Sea stars	3	100% ethanol
Scott Inlet	ROV	August 4th, 2021	Ophiuroids, amphipods, sea urchins	23	100% ethanol or 10% formalin
Scott Inlet	ROV	August 5th, 2021	Gastropod	1	100% ethanol

Scott Inlet	Beam Trawl	August 6th, 2021	Crinoids, pycnogonid, ophiuroids, sea urchins, possible ascidians	46	70-100% ethanol or 10% formalin
Scott Inlet	ROV	August 6th, 2021	Pycnogonid, sponge, ophiuroid	10	100% ethanol
Scott Inlet	Beam Trawls	August 7th, 2021	Ophiuroids, sea stars, sea urchins, pycnogonids	115	100% ethanol or 10% formalin
CLA-3.1	Box Core	August 7th, 2021	Ophiuroid, annelid	2	100% ethanol
CLA-3.2	Box Core	August 7th, 2021	Ophiuroids	3	70-100% ethanol

28 Solenoneine analysis experiment

Investigators: Guillaume Blais[1], Arianne Barrette[1]

Cruise participants – Leg 2: Guillaume Blais[1]

Cruise participants – Leg 3: Arianne Barrette[1]

[1] *Université Laval, Quebec City, QC*

28.1 Introduction and objectives

As discuss in the precedent research, methylmercury is a huge problem in the north, especially for people who eat organisms from there (Achouba, 2019). A recent study had shown that solenoneine could help populations that confront a lot of bioaccumulations by demethylate the molecule (Yamashita, 2013 and Achouba, 2019). To get a better understanding of this important protein in the north, this study will get data from the leg 2 and 3 on the presence of solenoneine in the environment (only data from Leg 2 presented in this report).

28.2 Methodology

To analyze the presence of solenoneine, it's important to quantify other variables like the pigment sediment, the organic carbon, the sediment size and stable isotope and HBI analysis. To get that information a boxcore was dropped at 12 stations during the leg 2. The organic carbon and the sediment size were taken, from a 60ml syringes, at 1 centimeter and 5 centimeters deep respectively and kept at -20 degrees Celsius. The pigments and selenoneine was taken, from a 10ml syringe, 1 centimeter deep and kept at -80 degrees Celsius. The syringes were washed in between every station with cytranox. The selenoneine was the important part so samples were taken from 12 different stations. The rest of the analyzes was taken when there was enough sediment so at 4 stations. Samples will be analyzed in Quebec City.

28.2.1 *Data quality notes/problems*

A few collect of organic carbon, pigment and sediment size from stations were skipped because of missing space in the boxcore due at a lot of water leaking on the side draining surface sediment too.

28.2.2 *Samples collected*

Table 28-1: All boxcore that were taken to analyse the solenoneine

Time (UTC)	Time (Local)	Station	Latitude	Longitude	Activity	Depth (m)	Comment
2021/07/20 06:59:57	2021/07/20 02:59:57	Makkovik	55,5401402	-58,9506460	Box Core	759,29	690 m
2021/07/18 11:16:10	2021/07/18 07:16:10	644	54,8197778	-53,2237060	Box Core 1	947	Depth=982 m
2021/07/18 12:19:47	2021/07/18 08:19:47	644	54,8208152	-53,2250925	Box Core 2	951	2e box core stn 644
2021/07/19 01:04:18	2021/07/18 21:04:18	652	55,6554813	-55,5536193	Box Core	2438,69	Depth = 2400 m
2021/07/20 06:59:57	2021/07/20 02:59:57	Makkovik	55,5401402	-58,9506460	Box Core	759,29	690 m
2021/07/22 09:24:36	2021/07/22 05:24:36	NAI-8.5A	56,5985642	-60,8115817	Box Core	133,49	71 m
2021/07/22 14:44:21	2021/07/22 10:44:21	NAI-8.5B	56,6932163	-60,2846948	Box Core	473,14	492 m
2021/07/23 13:22:50	2021/07/23 09:22:50	Kelp2021	58,7005587	-62,5303540	Box Core	149,67	120 m
2021/07/27 07:43:41	2021/07/27 03:43:41	Hatton Sill	61,4461515	-60,5768608	Box Core	900,86	900 m
2021/07/31 17:08:33	2021/07/31 13:08:33	SF-6.2a	66,7512722	-62,3123452	Box Core 1	-	38 m
2021/07/31 17:26:48	2021/07/31 13:26:48	SF-6.2b	66,7525707	-62,3114907	Box Core 2	-	38 m
2021/08/05 23:34:09	2021/08/05 19:34:09	Scott Inlet-Deep	71,3961172	-70,3125178	Box Core 1	699,05	700 m
2021/08/07 21:17:46	2021/08/07 17:17:46	Cla-3.1	70,8849162	-72,2969520	Box Core	260,79	-
2021/08/09 22:15:30	2021/08/09 18:15:30	Cum-8.2	64,9733522	-64,8467463	Box Core	798,25	801 m

28.3 Reference

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29 Deep-water coral and seep habitats of the Northern Labrador Sea and Baffin Bay: biodiversity, microbiology, paleoceanography, and conservation

Project leaders and collaborators:
Dr. Owen Sherwood, Dalhousie University
Dr. Philippe Archambault, Université Laval
Dr. Chris Algar, Dalhousie University
Dr. David Coté, Fisheries and Oceans Canada, DFO-NL
Dr. Barbara de Moura Neves, Fisheries and Oceans Canada DFO-NL
Dr. Evan Edinger, Memorial University of Newfoundland
Dr. Maxime Geoffroy, Marine Institute, Memorial University of Newfoundland
Dr. Casey Hubert, University of Calgary
Mr. Rodd Laing, Nunatsiavut Government
Dr. Annie Mercier, Memorial University of Newfoundland
Dr. Paul Snelgrove, Memorial University of Newfoundland
Ms. Vonda Wareham-Hayes, Fisheries and Oceans Canada, DFO-NL
Dr. Len Zedel, Memorial University of Newfoundland

Researchers on board CCGS *Amundsen* and affiliations
Dr. Maxime Geoffroy, Marine Institute, Memorial University of Newfoundland (chief scientist)
Dr. Chris Algar, Dalhousie University
Dr. David Coté, Fisheries and Oceans Canada, DFO-NL
Dr. Barbara de Moura Neves, Fisheries and Oceans Canada, DFO-NL
Dr. Evan Edinger, Memorial University of Newfoundland
Dr. Alexandre Normandeau, Geological Survey of Canada-Atlantic

Students and Post-doctoral Fellows on board CCGS *Amundsen* and affiliations
Ms. Bianca Barrett, M.Sc. student, Marine Institute, Memorial University of Newfoundland
Mr. Guillaume Blais, M.Sc. student, Université Laval
Dr. Simone Booker, Post-doctoral fellow, Dalhousie University
Ms. Shaomin Chen, Ph.D. student, Dalhousie University
Ms. Haley Geizer, M.Sc. Dalhousie University
Ms. Eugenie Jacobsen, M.Sc. student, Marine Institute, Memorial University of Newfoundland
Ms. Meng Ji, M.Sc. student, University of Calgary
Ms. Kathryn Murray, M.Sc. student, Memorial University
Ms. Josiane Ostiguy, Ph.D. student, Memorial University of Newfoundland
Ms. Laura Piccirillo, M.Sc. student, Memorial University of Newfoundland
Mr. Jordan Sutton, M.Sc. student, Marine Institute, Memorial University of Newfoundland
Ms. Judith Vogt, Ph.D. student, St. Francis Xavier University / Memorial University of Newfoundland
Mr. Tom Williams, Ph.D. student, University of Southampton, UK
Ms. Sophie Wolvin, M.Sc. student, Memorial University

ROV and other Professionals
Mr. Keith Tamburri – Canadian Scientific Submersible Facility
Mr. Peter Lockhart – Canadian Scientific Submersible Facility
Mr. Barry Brake – Canadian Scientific Submersible Facility
Ms. Chris Morrissey, Amundsen Science
Ms. Sheena Roul, Fisheries & Oceans Canada, DFO-NL
Mr. Shawn Meredyk, Amundsen Science
Mr. Reilly MacKay, Amundsen Science / Marine Institute, Memorial University of Newfoundland
Mr. Tom Carson, Geological Survey of Canada-Atlantic
Mr. Rick Ludkin, Environment and Climate Change Canada

29.1 Introduction and Objectives

The new Comanche 38 ROV aboard CCGS *Amundsen* forms an integral part of the ArcticNet, NSERC STAC, and DFO funded programs. Associated research used instrumental data and water sampling from the CTD & rosette, invertebrate and ichthyoplankton sampling using the IKMT and Hydrobios nets, video sampling with a drop camera and baited camera, piston and gravity coring, and benthic sampling using the box corer to sample the same environments through the water column, while seafloor mapping with multibeam sonar and sub-bottom profiler characterizes the seafloor underlying these benthic environments. Our integrated geological, biological, and oceanographic sampling addresses these understudied environments in a holistic fashion.

Most sites were chosen based on previously identified coral and/or sponge diversity and abundance hotspots from scientific trawl survey or commercial fisheries bycatch data. These included the various sites around, NE Saglek Bank, Hatton Basin & Davis Strait). Similarly, the bamboo coral forest at the Disko Fan (Neves et al. 2015) has been studied extensively in our previous cruises. Finally, an important operational goal was to carry out the first scientific use of the new Comanche 38 ROV aboard Amundsen, the replacement for the SuperMohawk (SuMo) ROV that was used from 2003-2018.

This mission was an interdisciplinary effort to understand Vulnerable Marine Ecosystems of the northern Labrador Sea, as well as in southern and western Baffin Bay. The mission included many inter-related components, using the Comanche 38 ROV, a drop-video camera, baited camera, water sampling using the CTD/rosette, plankton and fish sampling, box-coring to study benthic fauna, marine habitat mapping using multibeam sonar and sub-bottom profiling, and piston & gravity coring to study the accretion rates of the large and small bamboo coral forests in Davis Strait and Disko Fan. The variety of activities are reflected in the broad range of objectives listed below. This report focuses on the results of the ROV dives. Related activities, including water sampling for dissolved nutrients, stable isotope analysis of dissolved nutrients, and carbonate chemistry, are covered in separate reports submitted by those students.

The scientific objectives as presented in the NSERC STAC proposal for this cruise are numbers 1-9 in the list below. Additional scientific objectives related to DFO Science activities in Labrador, the ArcticNet seafloor geology project (Normandeau), Geological Survey of Canada activities, and the ArcticNet Labrador coastal marine science & conservation project (Coté, Edinger) are indicated below.

1) Extend knowledge on the abundance, distribution, and diversity of cold-water corals and associated biodiversity in relation to depth and substrate in previously unexplored areas.
2) Assess environmental drivers of life-history strategies (distribution patterns, size, sex, fecundity, reproductive mode), trophic ecology and pigmentation diversity in benthic invertebrates and associated epibionts across depth and latitudinal gradients.
3) Investigate age-frequency distributions and corresponding carbonate production rates of cold-water coral populations in the context of ocean acidification in a rapidly changing environment.
4) Determine annual growth rates of bamboo corals (*Acanella arbuscula* and Keratoisis cf. *flexibilis*) using an *in-situ* coral staining chamber.
5) Develop novel biomarkers of ice-associated (sympagic) vs pelagic primary productivity and use these biomarkers to reconstruct paleoceanographic variability in export productivity recorded in sediments and coral skeletons.
6) Evaluate infaunal biodiversity and its influence on nutrient efflux and respiration in northern upper slope 3D biogenic habitats.
7) Quantify benthic carbon mineralization in relation to microbial communities and benthicpelagic coupling.
8) Characterize the microbiology of permanently cold marine seabed hydrocarbon seep ecosystems and isolate psychrophilic hydrocarbon-degrading bacteria.

9) Assess benthic biodiversity and ecological patterns in conservation-priority regions.
10) Characterize variability in the mesopelagic sound scattering layer (SSL) over an annual cycle and ground-truth the signal with mesopelagic nets, hull-mounted acoustics, and ROV videography.
11) Characterize bottom types and fauna in the Makkovik Trough area identified by Inuit knowledge and fishermen's reports, and initially explored without the benefit of an ROV during the Amundsen 2020 cruise (DFO; ArcticNet coastal Labrador)
12) Characterize sediment movement associated with iceberg-induced slope failures and other slope instabilities in Southwind Fjord and Scott Inlet (GSC, ArcticNet Seafloor geology).
13) Recover a CTD/Rosette lost during operations in Scott Inlet in 2019 (Amundsen Science).

29.2 Methodology

A total of seven locations in the northern Labrador Sea and southeastern Baffin Bay were surveyed using the Comanche 38 ROV during the *Amundsen* 2021 expedition: the inner shelf coral and sponge hotspot at Makkovik, the NE Saglek Bank coral hotspot, the NE Hatton outer sill site at two depths, Davis Strait small gorgonian coral concentration deep on the SE Baffin Shelf, the iceberg-induced submarine landslide at Southwind Fjord (Normandeau et al. 2021) the large bamboo coral forest at Disko Fan, and the persistent hydrocarbon seeps at Scott Inlet, Baffin Bay. We focused a lot of our attention on detailed sample collection with the ROV, which was limited or impossible in the last few years of the SuperMohawk ROV operations leading up to its decommissioning after the 2018 cruise.

Furthermore, we targeted gravity coring in the *Acanella* small bamboo coral habitat, and in the bamboo coral forest at the Disko Fan site studied in 2016 and 2018, in order to provide replicate measurements of the age of this biogenic habitat, and the rates of sediment accumulation in the coral patches vs. the spaces between the coral patches. Results of these coring efforts are summarized in the GSC report on coring during this cruise leg.

At each station, the intended sampling methodology consisted of: multibeam sonar and 3.5 kHz sub-bottom profile survey, one or more ROV dives, water column profile sampling with CTD and rosette, plankton sampling using vertical tows, (monster or hydrobios nets), mesopelagic fish assessment using the IKMT trawl, and benthos characterization using box core, drop camera, and baited camera where the bottom was suitable for these samplers. The box core was were cancelled in locations that appeared to contain too many boulders, and might therefore risk damaging the trawl, or where the biogenic community was known to be highly sensitive to mechanical damage. Box-cores was stopped immediately in locations where the box corer appeared to be suffering damage from rocks.

The Comanche 38 ROV has two colour cameras. Its primary camera is a high-definition (HD) mini-Zeus video camera recording video with green lasers 10 cm apart, and from which frame grabs can be captured real-time. The second camera is a high definition (HD) camera (1Cam Alpha, Sub C Imaging, 24.1 megapixels) and two green lasers 6.25 cm apart for size indication, which is also capable of capturing high-resolution still images. A third camera is used by the pilots for navigation, but is not recorded. Similarly, small cameras viewing the ROV umbilical cable attachment to the ROV, and viewing the stern of the ROV, are visible to the pilots during operations, but are not recorded. Digital still camera images can be recorded from the 1Cam Alpha, but there is not a dedicated camera for still images.

Among the sampling goals of the mission were to calibrate colour photographs of invertebrates using a standardized colour chart and uniform camera settings. High definition video footage was recorded using the mini-Zeus camera aimed at an invertebrate, with the colour chart, at a measured distance from the ROV, and at standardized camera settings. These colour calibration images were usually collected at the beginnings of dives, focusing on 3 different biological specimens, before returning the mini-Zeus camera to its default settings, which compensate for exposure to give the optimal lighting, but may distort the true colours of some organisms.

Finally, ROV-based biological collections not aimed at corals, sponges, or microbial seeps focused on echinoderms and on the epibionts on seafloor cobbles. One goal with the seafloor cobble study was to separate glacial dropstones (or ice-rafted debris) from cobbles derived from bedrock or glacial deposits, but this was not always possible. Another goal was to compare encrustation patterns among depth zones and study areas. Additional details on these two studies are reported on separately by two students from the Mercier lab (MUN Ocean Sciences), Sophie Wolvin and Kathryn Murray.

Water sampling for nutrients, stable isotopes of dissolved nitrogen, carbonate chemistry, fishes, and plankton are related to the ROV program scientific objectives, but are also reported on separately.

Figure 29-1: cruise track of the 2021 CCGS *Amundsen* expedition, leg 2. Locations of ROV dives indicated with yellow squares.

Figure 29-2: A) Comanche 38 ROV, fully loaded on the CCGS *Amundsen* foredeck before Dive 24 at Scott Inlet. Note two multifunction arms, porch for holding larger tools including 11 push cores in holsters, sampling skid, with lexan box and green sediment scoop for an additional method of sampling surface sediments. The sampling skid contains two hydraulically operated sample drawers, port and starboard, which can be opened independently. Mini-zeus camera is above, 1Alpha-Cam is below starboard, and additional pilot camera is blow port.

29.3 Preliminary Results

Two successful dives and their data are presented in the following section. A complete description of all dives is provided in appendix 5. Table 29-1 shows the summary of sites surveyed and sampled with the Comanche 38 ROV.

Table 29-1: Summary of sites surveyed and sampled with the new Comanche 38 ROV and other tools during the 2021 CCGS *Amundsen* expedition. Numbers refer to the number of deployments of particular sampling equipment in an area. Otherwise, X refers to extensive collection, while x refers to more limited collection.

Date	Site	Depth (m)	ROV Dive #	MBES	3.5 kHz	Drop video	Baited Camera	CTD/H_2O spl.	Box core	Piston & Gravity Cores
16 July	Conception Bay test dive	150	C12							
17-18 July	S Labrador Slope								2	
19 -21 July	Makkovik	700	C13-15	X	X	2	2	3	2	1
22-July	Nain area			x	X			1		2
23-July	Saglek Bay					1	1	1		
24-25 July	NE Saglek Bank	800	C16-19	x	X	2	2	4		
26 July	steaming									
27 July	NE Hatton Sill	700	C20	2006	X	1	1	1		1
28 July	Steaming/weather									
29 July	Davis Strait	1300	C21	X	X	1		1		2
30 July	Steaming, weather									
31 July	Southwind Fjord	50	C22	x	X	3		1		1
1 Aug	Steaming, ice									
2 Aug	Disko Fan	900	C23	2013	x	1		1		2
3 Aug	Steaming, ice									
4-6 Aug	Scott Inlet	200-600	C24-27	X	X	3	2	6		
7 Aug	Clark & Gibbs Fjord	250		x	x			1	2	3
8 Aug	Steaming, ice									
9-10 Aug	Cumberland Sound	many				10			1	2
11 Aug	steaming									

29.3.1 *Dive C13: Makkovik 1 (55.53179N, -58.9591W), 700-515 m. 19 July 2021.*

This was the first scientific dive of the mission, and also the first scientific dive executed with this ROV. Given that the ROV did not dive during Amundsen Sea Trials in June, and that the ROV test dive in Conception Bay had to be aborted due to electrical problems, it was not surprising that there would be a learning curve for operating a new ROV on the ship. Furthermore, because the Comanche 38 is operated from the foredeck of the ship, without a tether management system (TMS, or "cage"), coordination of ship movement and ROV movement, and cable management near the surface, required a different approach to ship-handling. Even had the ROV been successful tested during sea trials, this would have been the first dive below 250 m (the depth of the Saguenay Fjord sea trials location). Therefore, we expected, correctly, that some of the time allocated to this dive would be consumed with learning how to use this ROV effectively from the Amundsen. More than 1.5 hours of the dive was spent with the ROV off bottom while the ship was adjusting its position relatively to the ROV and the planned transect line (see map, Figure 29-3). Furthermore, a software error in the second camera (alpha-cam) meant that no digital still camera (DSC) images were recorded during this dive.

This dive began on flat to gently inclined soft bottom with abundant anemones of at least 3 species, plus cerianthids, where we collected push cores for Algar lab. We quickly encountered the first rock wall, which was steeply inclined, but not vertical, with slopes between 50 and 70 degrees, according to the 2020 multibeam sonar. Many parts of this rock wall had a veneer of sediment on them, visible, but thin enough that the rock could be seen beneath it. We were unable to see enough fresh, unweathered and unencrusted, views of the rock face to assess rock type, but it appeared to be well-indurated igneous or metamorphic rock, based upon the fracture and erosional patterns. Wherever the slope lessened, on ledges within the rock face, fine-grained sediment was observed accumulating. The origin of this sediment is unknown, but is likely resuspended from the shallow sandy Makkovik Bank nearby, rather than hemipelagic sediment of biogenic origin (A. Normandeau, GSC, pers. comm.).

The fauna on these steeply inclined rock walls was dominated by a variety of sponges, mostly demosponges and some glass sponges (Figure 29-4). We saw one unidentified carnivorous sponge (possibly *Asbestopluma*). Where the rock wall became steeper, we saw a few *Primnoa* corals, and 1 *Paragorgia* coral. Unfortunately, the time lost to working out the joint navigation of the ship and the ROV meant that we were unable to complete the planned transect, and in particular, we did not as far as the second, steeper rock face, with slopes exceeding 70 degrees. Seeing very few corals, we did not collect corals along the cliffs, but we did collect one sponge as a voucher specimen for sponge ID and one sea pen.

Where the slope lessened, at the top of the first underwater cliffs, the bottom returned to a sandy mud bottom with abundant anemones, much like the bottom at the beginning of the dive.

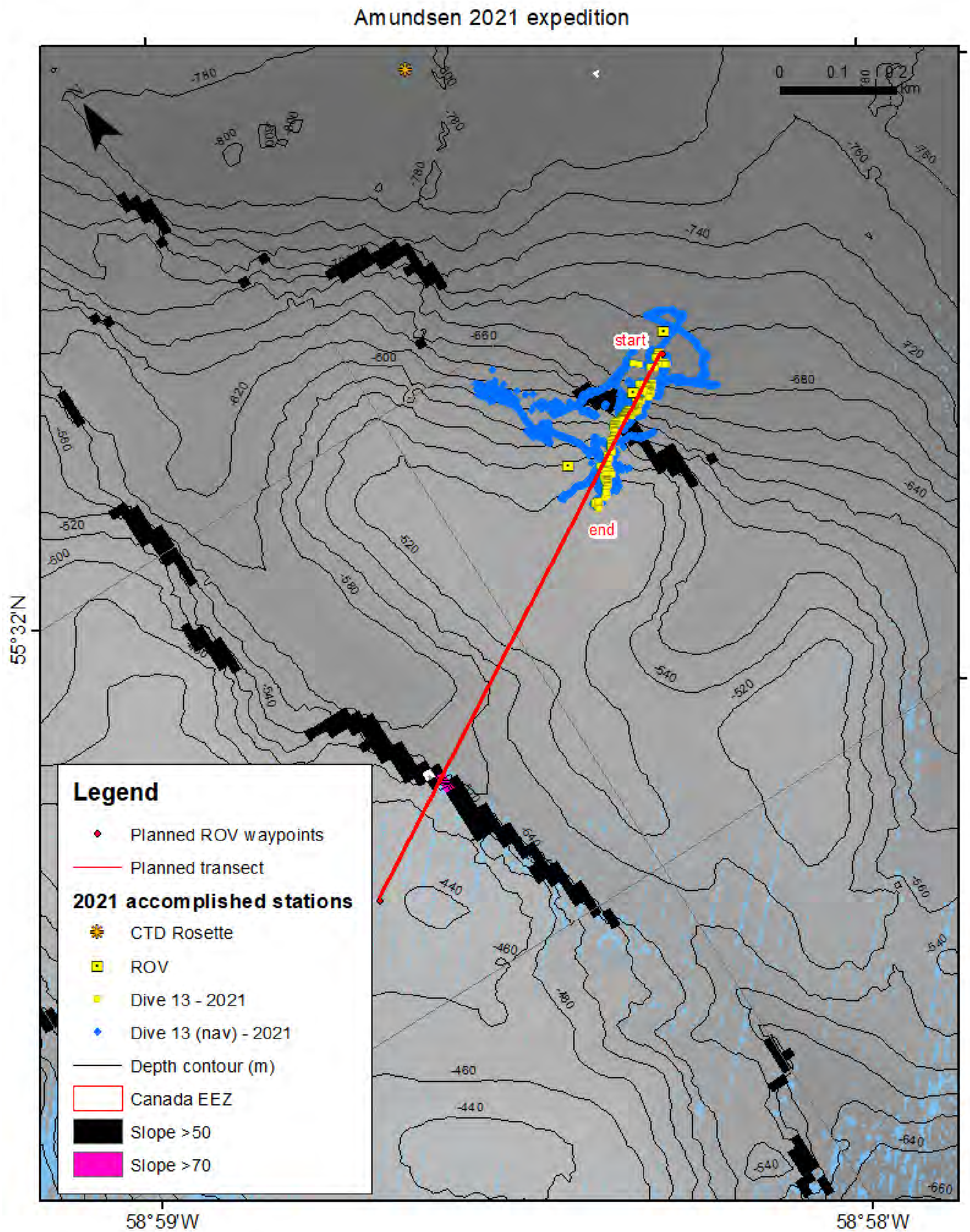


Figure 29-3: Map of Makkovik dive 1, showing planned and accomplished ROV and drop-video transects during the 2021 CCGS *Amundsen*.

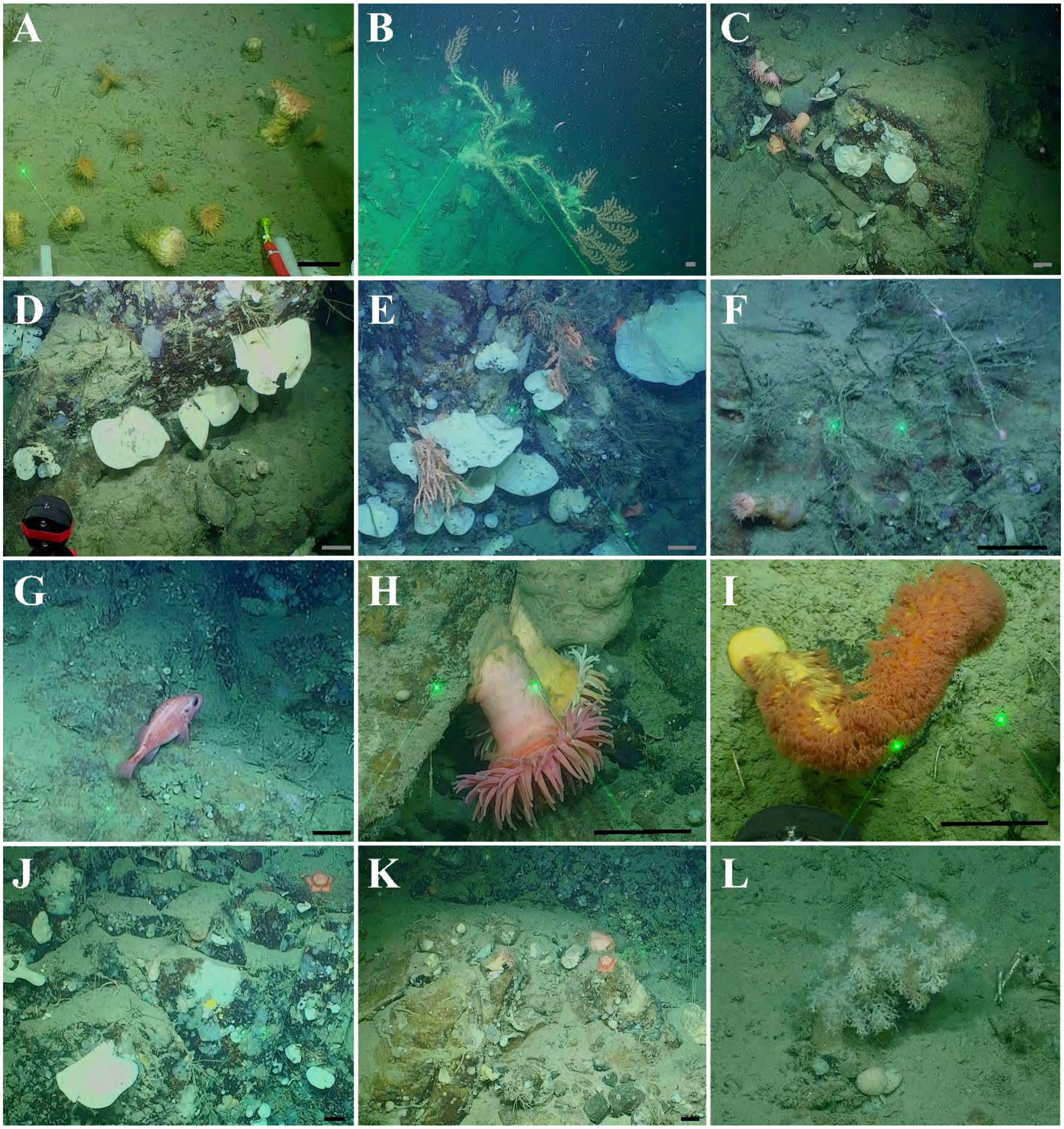


Figure 29-4: Photo-plate of sediment-draped bedrock observed during the ROV investigation at Makkovik dive C13. Lasers are 10 cm apart. Images are frame-grabs from the mini-Zeus HD camera, and are not full resolution. A) Soft bottom area at beginning of dive, with a field of sea anemones. B)Partially dead colony of *Paragorgia arborea*, C) rocky substrate colonized by an unidentified sponge, D) close-up of sponges, E) close-up of sponges and small colonies of *Primnoa resedaeformis*, F) close-up of dead branch colonized with hydroids, G) Redfish (*Sebastes* sp.), H) Close-up of sea anemone, I) close-up of sea pen *Anthoptilum* sp., J-K) diversity on rocky substrate, L) Nephtheidae soft coral.

29.3.2 *Dive C21: Davis Strait (Acanella site), 63° 20.6094N / 58° 11.5092W, 1310 m. July 29, 2021*

At this site, two 12-hour dives were planned, but due to inclement weather conditions on the first day at Davis Strait, only one dive was completed.

The planned transect for the Davis Strait site was about 1 km in length, starting at a depth of 1300 m and ending at 1282 m (Figure 29-5). The completed transect length during the dive was about 1400 m, and covered a depth range of 1336-1293 m. Bottom temperature at this site was 3.5°C and salinity was 34.8 PSU.

Dive Objectives

The main dive objectives for this site were:

1. To make the first attempt of deploying and recovering coral staining chambers with calcein solution on *Acanella* colonies.
2. To collect push-cores on *Acanella* colonies and 1-2 m away from *Acanella* colonies.
3. To sample *Acanella* corals, other invertebrates, and dropstones at this location for aging, growth rate and boron isotope analysis, DNA, and biodiversity in the area.
4. To collect video transect data to assess abundance, distribution, and density of *Acanella* corals at this site, as well as abundance and biodiversity of other invertebrates.

Completed Operations

Two coral staining chambers were deployed during the dive, which had calcein solution inside a balloon at a concentration of 150mg/L, mixed with seawater. This was the first *in situ* attempt to stain bamboo corals with calcein in Canadian waters. Both staining chambers were deployed on small *Acanella* colonies. The first staining chamber contained an *Acanella* colony about 10 cm in height and 10 cm wide (Figure 29-6). At first attempt, the calcein solution was too buoyant and did not sink within the chamber (Figure 29-6A). The ROV then maneuvered the chamber, lifting it slightly off the seafloor to mix the solution, which was successful. The first chamber stained the *Acanella* colony for about 7 hours before being recovered at the end of the dive.

The second chamber was deployed on a different *Acanella* colony, which was about 7 cm wide (Figure 29-6B). The balloon containing calcein was punctured before the chamber was on the seafloor in an attempt to make the solution sink better than attempt 1. Because of this, some of the calcein solution leaked out of the bottom of the chamber before being set down on the seafloor, meaning the final concentration of calcein solution within the second chamber is unknown. The second chamber was recovered at the end of the dive and stained the *Acanella* colony for about 6.5 hours. Three tent stakes were placed around each of the stained coral colonies and a floating marker was also placed near the colonies (Figure 29-6). Keratoisis corals at Disko Fan were stained with a similar procedure, but doubling the salinity of the staining solution to encourage mixing. The stained corals will be revisited and collected in 2023 for growth rate analysis.

Six push cores were taken in pairs of two, with one core on top of an *Acanella* colony and one core 1-2 meters from the sampled colony (Figure 29-7). These cores will be used to analyze the fauna living in the sediment beneath *Acanella* colonies and fauna 1-2 m away from *Acanella* colonies for comparisons.

Transect data was collected throughout the dive at a speed of 0.2-0.3 m/s. The transect began at the location of the staining chambers and returned to the staining chambers along a parallel path for collection at the conclusion of the dive. Transect video was often paused to collect samples. 39 samples were collected during the dive, with a majority of them being *Acanella* corals (see appendix). Other samples collected include bottom water, a black coral, sea pens, sponges, and rocks with living fauna attached.

5.

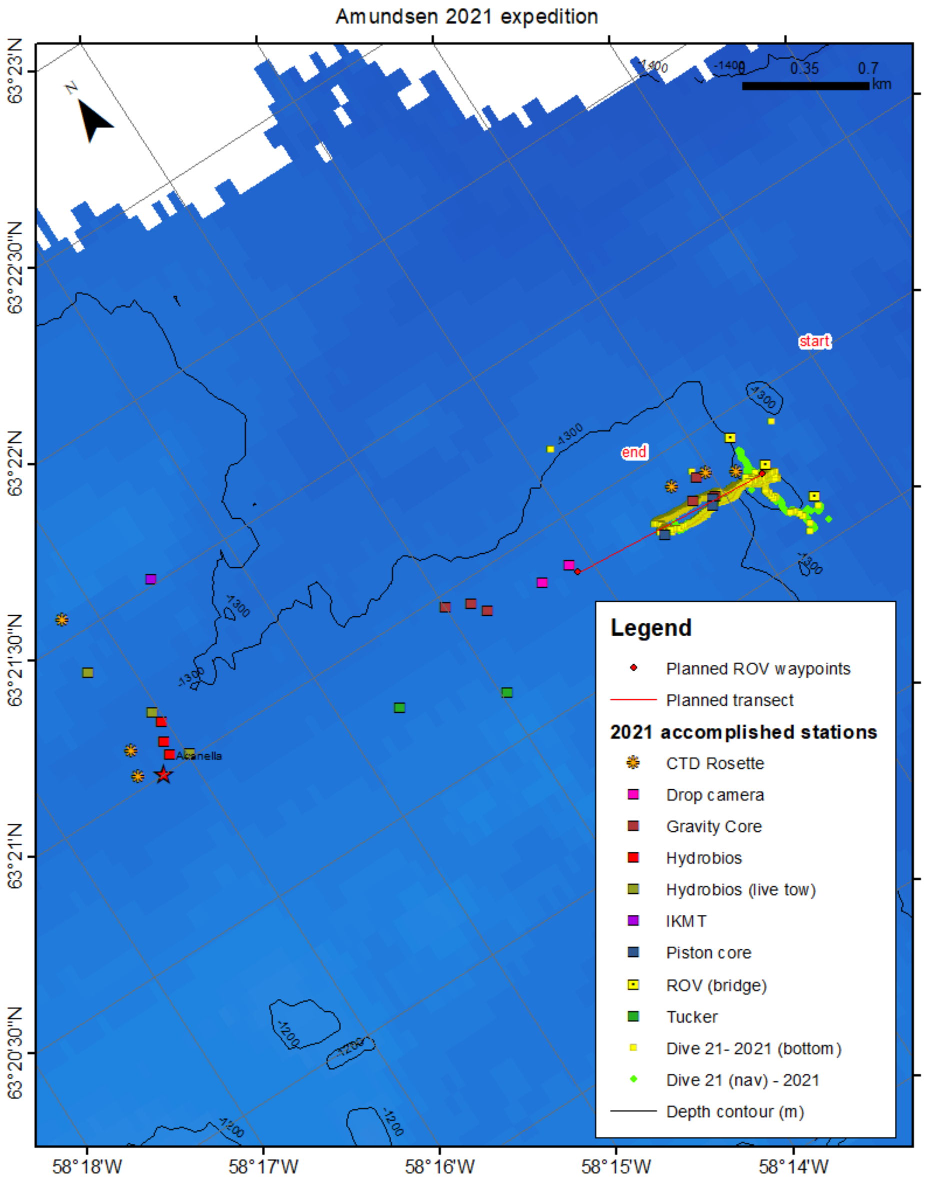


Figure 29-5: Map of ROV dive C21, at Davis Strait site.

Main Observations

Main bottom type observations from the dive include a mostly muddy environment, with unexpected rocky, steep ridges also observed (Figure 29-7). In the rocky environments, bottom type was mainly gravel and boulders. The approximate steepness of the rocky ridges was about 30° based on observations. In the muddy environments, there were some small and large boulders observed occasionally within the mud. Some boulders had an abundance of fauna living on them, but not all.

Biologically, the site is diverse in terms of species observed throughout the dive. The main species observed was *Acanella arbuscula*, however an abundance of black corals of various sizes were also observed (*Stauropathes arctica*).The black corals were often similarly sized to the small *Acanella* corals, and were also commonly mistaken to be *Acanella.* Other species observed include sea pens (*Anthoptilum, Funiculina*), soft corals (*Anthomastus*), sponges (*Asconema, Geodia, Euplectella*), sea anemones and Cerianthids, many small fish and skates.

The *Acanella* corals observed at the site were consistently present throughout the dive, yet were never seen in dense coral forests as possibly expected based on bycatch data. All *Acanella* observed were singular colonies. They varied slightly in size, but were most commonly only 5-10 cm in height and width. There were at least two clusters of whole scallop shells observed towards the end of the dive as well. They appeared to be remains of shells congregated in specific locations, and the transport mechanism is unknown.

Post-Dive Experiment

With two collected *Acanella* corals, a test was done on board the ship for toxicity and effectiveness of the calcein solution. The samples were first photographed, and then placed in an aquarium with an aerator, with 150mg/L calcein solution in a 4°C room. The samples were stained for 6 hours, and then placed in a different aquarium, with an aerator and bottom water from the site. The samples were then monitored for 2 days before being removed from the seawater. Based on observation, the *Acanella* samples were alive, but their polyps were closed after being stained and when removed from the seawater. Fluorescence microscope analysis will be done at MUN to assess how the stain concentration marked the skeletons and the protein layers.

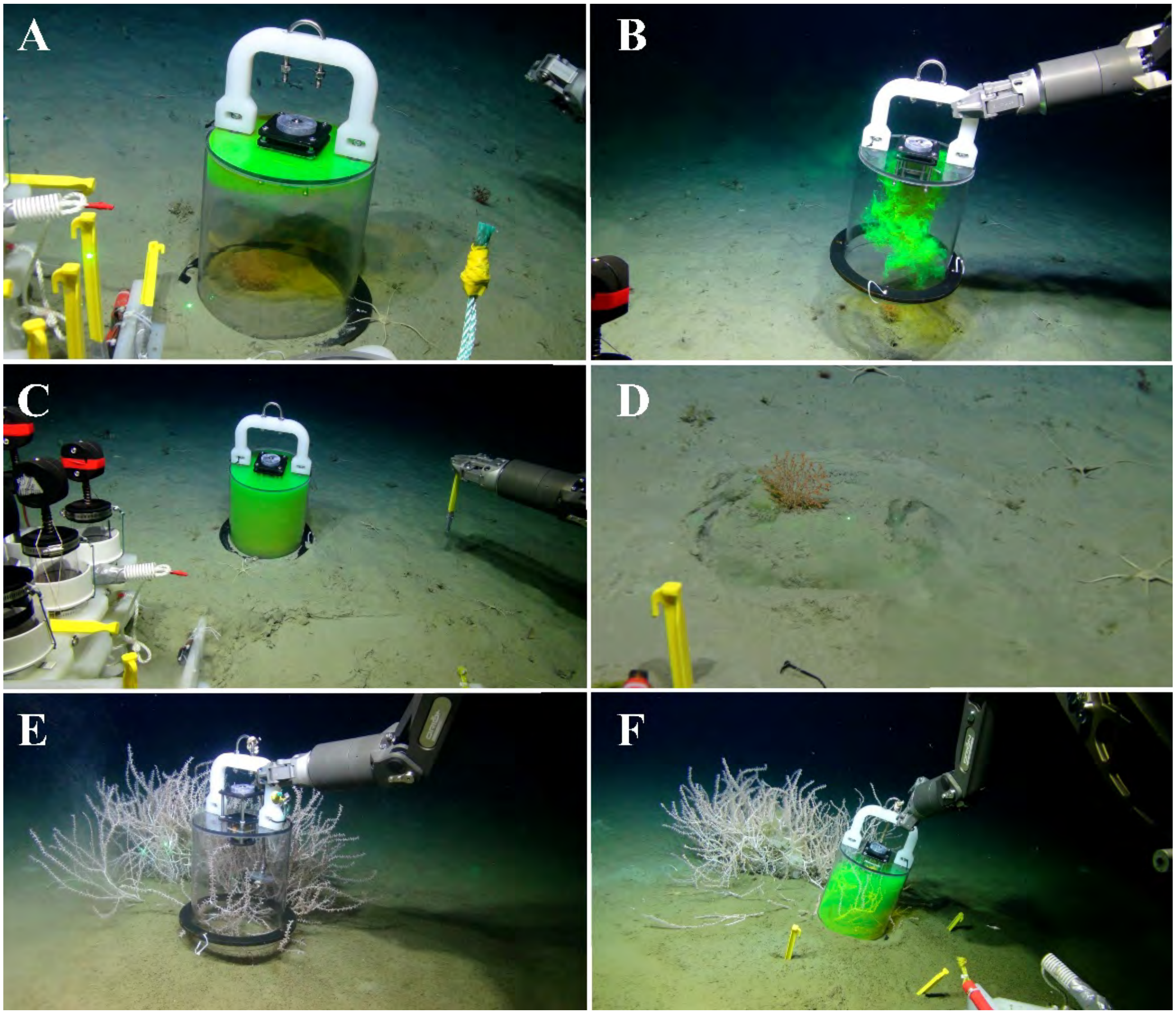


Figure 29-6: Staining chamber deployment. A. First deployment at Davis Strait, when stain solution remained buoyant in top of chamber. B. Second deployment at Davis Strait, opening stain before chamber fully lowered. C. Staining chamber in place, Davis Strait. D. *Acanella* coral, post-staining, Davis Strait. E. Placing the staining chamber on a Keratoisis coral at Disko Fan. F. Recovering the chamber after staining, at Disko Fan.

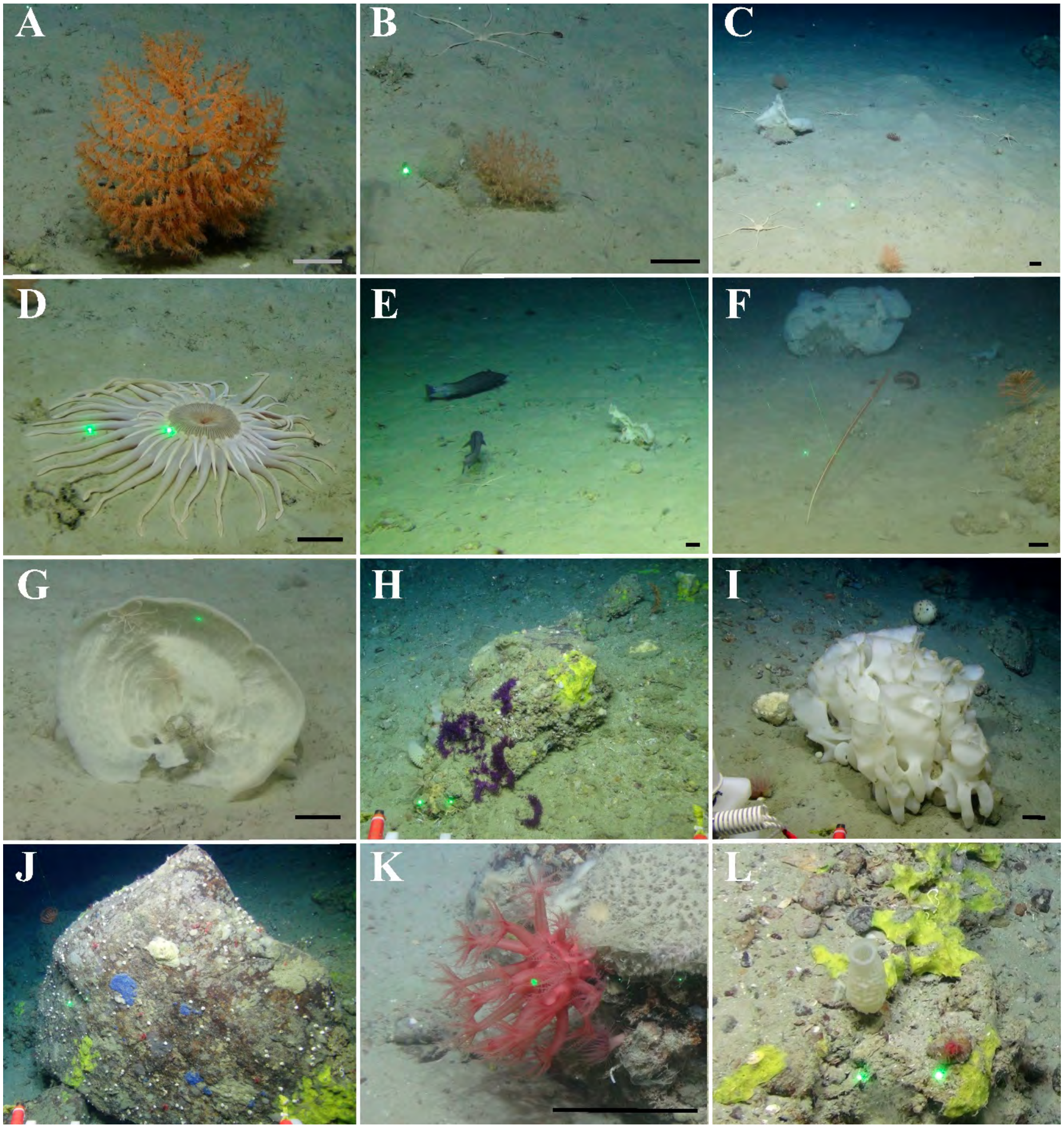


Figure 29-7: Photo-plate of ROV dive 21, at Davis Strait site. A) Black coral (probably *Stauropathes arctica*), B) bamboo coral *Acanella arbuscula*, C) soft bottom with some *A. arbuscula* colonies, D) large cerianthid, E) blue hakes, F) sea pen *Funiculina quadrangularis*, *Anthoptilum* sp., black coral, and glass sponge *Asconema* sp., G) unidentified sponge (sampled), H) stoloniferous coral (purple), probably Clavuraliidae, and encrusting yellow sponge, I) *Asconema* sp., J) boulder colonized with sponges, K) mushroom coral (likely *Anthomastus* sp.), L) vase sponge (?*Euplectella* sp., and encrusting yellow sponges).

29.4 **Conclusions**

29.4.1 *Scientific conclusions*

The Makkovik site is of great scientific and conservation significance. The new observations at this site were possible only by use of an ROV, which is capable of exploring vertical rock wall habitats. Our ROV, CTD and multibeam sonar data present a combined geomorphic and oceanographic explanation for the habitat of large gorgonian corals, especially Primnoa resedaeformis and Paragorgia arborea, in the trough systems on the inner Labrador shelf. The high biodiversity on rock wall habitats, and the high variety of different habitats found within the Makkovik Trough site make it of high conservation importance for invertebrates and fishes. Because the probable extent of this habitat, as mapped using multibeam sonar on this year's cruise, lies partially within the Nunatsiavut territorial waters (Imappivut zone), any potential conservation decisions in this area will be made in close cooperation with the Nunatsiavut government.

The NE Saglek Bank sites were characterized by a high abundance and moderate diversity of gorgonian corals, dominated structurally by large Primnoa corals and Geodiid sponges on boulders, but dominated numerically by smaller soft corals growing on intervening gravel and cobbles. The discovery of abundant microbial mats and authigenic carbonate crusts at the NE Saglek Bank II site can explain the persistent hydrocarbon slicks recorded at the surface near this site in RadarSat imagery (Jauer & Budkewitsch 2010 MPG; Jauer et al. 2013 GSC open file). High abundance of large gorgonian corals and geodiid sponges persists to at least 800 m, but is apparently substrate-limited, and related to the availability of large boulders. Large numbers of Primnoa corals were collected from the NE Saglek Bank site for sclerochronology, carbonate production analysis, and geochemistry.

The Hatton Sill site, in the depth zone surveyed, is dominated mostly by astrophorid sponges, but contained abundant Primnoa corals where boulders occurred. Sandy sediments deposited in the current shadows of boulders indicated the very strong currents normally occur at this site. In the 900 m depth range, these sponges are forming sponge mats, which occur at the surface and have also been buried within the sediment. The geomorphology of both the NE Saglek Bank and Hatton Sill sites is consistent with a winnowed glacial outwash plain or related ice-contact sediment source, with additional ice-rafted debris supplying boulders to the site.

The small bamboo corals at the Davis Strait site were not observed to form dense forests as their larger cousins at the Disko Fan site do. The Acanella corals were small, generally less than 15 cm tall, and < 15 g wet weight, despite the very high biomass of Acanella corals collected near this area in fisheries bycatch. Although the area was dominantly muddy, as in other previously studied Acanella habitats elsewhere in the Northwest Atlantic, there were rocky ridges with a distinct fauna occurring in several of the areas surveyed. Apparent species diversity associated with the Acanella habitats was less than that found in the large gorgonian coral habitats (Primnoa, Keratoisis), but infauna diversity has yet to be assessed from push core samples collected on this cruise.

The coral staining chambers were successfully deployed in both types of bamboo coral habitats, for the two dominant species, Acanella and Keratoisis. This expedition included the first such staining experiments on deep-sea corals in Canadian waters. Marked corals will be collected in 2023, after two years of growth. Corals stained in aquaria on board the ship showed no apparent adverse reaction to the stain at the same concentrations applied to the corals in situ. Strength of the staining in the skeleton will be assessed in the lab this fall.

The bamboo coral forests in Disko Fan remain a subject of key research interest. The ROV and drop camera surveys did not cover enough area or depth range to determine the lateral or bathymetric extent of the bamboo coral forests. The forests are largely monospecific stands of Keratoisis corals, and individual thickets may represent clones, a hypothesis that will be tested by genetic analysis of samples collected on this cruise. Coral samples collected will be used to complete growth rate analysis, with 14C validation of growth ring chronology. Boron isotope analysis of their skeletons will be used to assess changes in pH during the lifetime of individual coral stems.

ROV push coring of microbial mats and hydrocarbon seeps at Scott Inlet was successful. Microbial mats exhibited high concentrations of methane, and were successfully sampled for microbiota living at different depths within the sediment column.

29.4.2 *Operational conclusions*

Within the environmental limits of its capabilities (i.e. current strength, depth rating), the ROV performed very well, under the skilled CSSF piloting, and wheelhouse operations of CCGS Amundsen. Captain Gariépy handled the ship with extreme proficiency during ROV dives, in often challenging conditions of wind, current, and ice.

The ROV functioned very well, after the initial few dives and the period of learning how to operate this light-weight ROV without a cage from the Amundsen, and deploying the ROV from the front deck rather than through the moon pool. The Comanche ROV's ability to navigate strong currents is limited by its light weight, operation without a cage, and limited thrust. Some of the high-current environments sampled (e.g. NE Saglek Bank, Hatton Sill) will likely require a stronger and heavier ROV for more efficient surveys, and possibly a DP ship.

The ROV sampling tools were used to their full extent: the two multifuction arms, the sampling skid, lexan box, push cores, sampling scoop, coral cutter, and niskin bottles were all used multiple times in different dives.

The Amundsen ROV will need to develop a system to protect the umbilical cable from ice damage.

The two colour cameras provide different views. A dedicated Digital Still camera would be a valuable addition to the ROV toolkit.

The fact that a full rack of push cores obstructs the camera view may pose a limitation for some types of ROV work. For example, 3D reconstructions of abiotic or biotic features would require an unobstructed view from the main camera. Solutions may involve different fixed zoom settings for the main camera, or separate dives in the same location with and without push cores, to meet different objectives.

30 Microbial baseline collection of Labrador Sea lease blocks and microbial characterization of a hydrocarbon seep at Scott Inlet

Project leader: Meng Ji[1], Casey Hubert[1] (chubert@ucalgary.ca)

Cruise participants – Leg 2: Meng Ji[1]

[1] *Department of Biological Sciences, University of Calgary, Calgary AB*

30.1 Introduction

30.1.1 *Objective 1: Collect surface sediment and seawater for developing microbial baselines in the Labrador Sea near oil and gas lease blocks*

The GENICE project aims to investigate the potential for bioremediation of an oil spill should one occur in the Canadian Arctic and sub-Arctic waters. As climate change reduces the extent and duration of sea ice cover, shipping and industrial development in Arctic marine environments is expected to escalate, increasing the risk of oil and fuel spills in this extreme 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 to innocuous products such as CO_2 (ZoBell 1946; Atlas 1981). Previous large scale oil spills such as the Deepwater Horizon incident revealed microbes to be a key element in breaking down hydrocarbons to use as an energy source. Microbial communities exhibited succession patterns over weeks and months of the spill wherein the baseline diversity of bacterial communities transformed to periodically enrich hydrocarbon-degrading microorganisms (Kimes et al. 2014). Our sampling objective in the Labrador Sea is to collect deep-sea sediment and seawater to establish microbiological baselines near leasing regions where oil and gas activities may take place in the future. Baseline data enhances the expedient understanding of the structure, diversity, and complexity of pre-spill bacterial communities and its potential to respond to a spill (Angelova et al. 2021).

30.1.2 *Objective 2: Characterize the microbiology of a natural Arctic methane seep in Scott Inlet, Baffin Bay*

A natural hydrocarbon seep in Scott Inlet, Baffin Bay, was first identified by the Geological Survey of Canada in 1978 (Levy 1978). Hydrocarbon seeps offer a natural laboratory for studying microbial communities associated with hydrocarbon degradation. The Scott Inlet seep was visited aboard the *Amundsen* during Leg 2c in 2018 using the ship's Super Mohawk II remotely operated vehicle (ROV) and Leg 3 in 2019 using the ship's Rosette for water sampling and Van Veen for sediment sampling at and near the seep. Video footage from the 2018 ROV survey revealed many white bacterial mats (i.e. *Beggiatoa*) around the seep site, named Station 0 (71.37812 N, –70.07452 W; 260 mbsl) and gas bubbles rising from some of the mats. Methane concentrations in the water above the seep was found to be significantly higher than sites 1km and 5km NE, NW, SE, and SW of the seep (Cramm et al. 2018). Our objectives were to characterize the microbiology of permanently cold hydrocarbon seep ecosystem and isolate the cold-adapted hydrocarbon-degrading bacteria at the Scott Inlet seep. Using the new Comanche ROV, soft sediment at and near the seep was sampled using push cores. Extruded cores were sectioned and preserved for downstream DNA-based community profiling. Metagenomics will be complemented by transcriptomic (RNA) and/or proteomic (protein) analyses to understand cold-adapted hydrocarbon metabolism *in situ.* Seep water for methane measurements was also sampled at and near the seep.

30.2 **Methodology**

30.2.1 *Water sampling:*

The ship was equipped with a CTD-Rosette fitted with twenty-four 12L Niskin bottles (Figure 30-1). Sensors on the CTD allowed it to capture profiles of chlorophyll fluorescence, photosynthesis-active radiation (PAR) and dissolved oxygen concentration, in addition to determining water temperature and salinity. A full water column up to four depths was taken at three sites (Labrador Sea 652, Saglek Bank, HiBio-C) using the Rosette. Intermediate depths were selected to lie above and below the pycno- or thermocline, where a change was evident from the CTD data. See Table 1 for a summary of station coordinates and depths.

Collected seawater was stored in 5L and 10L Milli-Q rinsed carboys and brought to the lab to be filtered through 0.2µm Pall membrane filters using a Sentino vacuum pump and Pall filtration manifold. Filters were folded using sterile forceps, placed into Whirl-Pak bags, and stored at -80°C for future DNA extraction and 16S rRNA gene amplicon sequencing.

At the two Labrador stations (LS 644, LS 652), true surface water (~15L) was also taken using a rope and bucket to be filtered and preserved in the same manner.

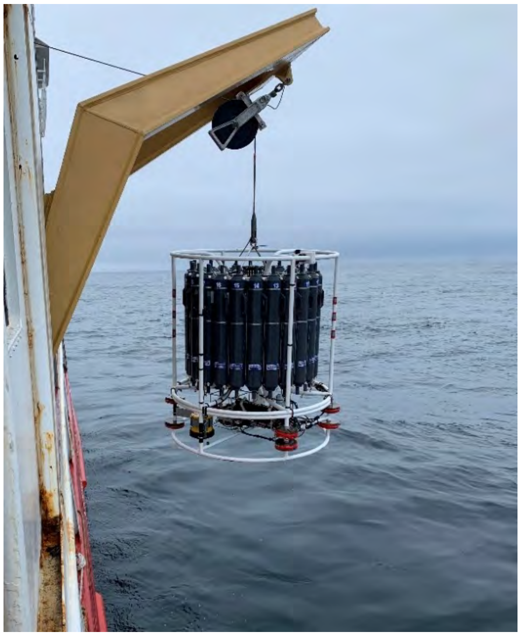
Table 30-1 presents the operations conducted during Leg 2.

Table 30-1: Coordinates and depths for all stations sampled during Leg 2 aboard *Amundsen* 2021.

Station	Operations	Latitude	Longitude	Station depth (mbsl)
Labrador Sea 644	Bucket, 2 box cores	54.81978	-53.22371	947
Labrador Sea 652	Rosette, bucket, box core	55.65057	-55.54266	2438.69
Makkovik 2	Box core	55.51756	-58.9382	693.71
Saglek Bank R16	ROV Niskin	60.31.3554	-61.14.448	611
Saglek Bank R17	ROV Niskin, ROV sediment scoop	60.31.1394	-61.14.8224	621
Saglek Bank R18	ROV Niskins	60.298584	-61.138648	858
Saglek Bank R19	Rosette, ROV Niskins, ROV sediment scoop	60.311412	-61.148242	806
HiBio-C	Rosette	60.46234	-61.17252	966.73
Scott Inlet R24	ROV Niskins, ROV push cores, ROV sediment scoop	71.227622	-70.43692	264
Scott Inlet R26	ROV Niskins, ROV sediment scoop	71.260388	-70.117366	492
Scott Inlet R27	ROV Niskins, ROV sediment scoop	71.201828	-70.148404	239.7

30.2.2 *Box cores:*

Surface sediment was collected at three stations (LS 644, LS 652, Makkovik 2) using the box cores aboard the *Amundsen.* At LS 644, two box core casts were deployed to obtain duplicate sediment samples while one cast was deployed at the other two stations. Once the box core came back on deck, overlying water was drained using a pump and the temperature of the core was recorded (Figure 30-1). From each box core, ~2mL of surface sediment (0-5cmbsf) was collected using an ethanol-sterilized metal spatula into triplicate 2mL cryovials. Further triplicate 'bulk' surface sediment was also collected into Whirl-Pak bags. These samples could be used should initial analyses indicate that certain sites warrant a more in-depth study. All sediment samples were stored at -80°C.

A. 

B. 

Figure 30-1: A) CTD-Rosette being deployed off starboard side of *Amundsen*. B) Taking the temperature of the box core on deck

30.2.3 *Fixation for cell counting:*

Surface sediment and seawater samples were collected at three stations (LS 644, LS 652, Makkovik 2) to be fixed for future cell counting. Prior to arriving at the sampling station, a 4% paraformaldehyde was mixed in a 50mL Falcon tube using 6mL of 37% formaldehyde and 44mL of phosphate buffer solution (PBS). To fix sediment samples from box cores, ~200µL of sediment was taken with a cut 1mL syringe and added to 1.8mL of 4% paraformaldehyde in 2mL screw top tubes. To fix seawater samples from Rosette or bucket casts, 940µL of sample water was pipetted into 60µL of 37% formaldehyde in 2mL screw top tubes. Fixed samples were then vortexed and stored at 4°C.

30.2.4 *Comanche ROV:*

Niskin bottles for methane analysis and DNA filtration: The *Amundsen* was equipped with a newly purchased Comanche ROV (Figure 30-2). Two 5L Niskin bottles were affixed to the ROV to sample water for methane measurements and DNA analysis. Water samples from the ROV Niskin bottles were collected on seven dives (4 dives in Saglek Bank and 3 dives in Scott Inlet). Once the ROV was back on deck, a milli-Q rinsed tubing was attached to the spout of the Niskin bottle and inserted into a 50mL glass serum bottle. Each serum bottle was rinsed with the Niskin 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 100µL 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. The remaining water was collected in 5L carboys to be filtered for DNA as described in section 2.1.

Figure 30-2: Comanche ROV being deployed.

ROV sediment scoop: The ROV was equipped with a 3-quart plastic feed scoop used to scoop surface sediment (0-5/10cmbsf). At sites of interest in Saglek Bank dives 2 and 4 and Scott Inlet, the scoop was operated by the ROV arm to scoop up soft sediment and then placed in the drawers of the ROV. Once the ROV was brought back on deck, triplicate cryovials were filled with ~2mL of sediment using an ethanol-sterilized metal spatula. Further triplicate 'bulk' surface sediment was also collected into Whirl-Pak bags. The exception was from dive 4 in Saglek Bank, where only ~1mL of sediment was collected into one single cryovial due to lack of sample.

ROV push cores: The ROV was equipped with twelve push core holsters capable of holding eleven push core tubes (35cm long and 7cm wide) per dive. Upon seeing gas bubbles arising from white bacterial mats at the Scott Inlet seep, four push cores were taken, denoted Bubble Mat 01. One push core was taken for pore water analysis by Dr. Chris Algar (Dalhousie University) while the remaining three push cores were used for triplicate analysis. Another seep site with visible white bacterial mats 3.4m east of Bubble Mat 01 was cored like Bubble Mat 01, where one core was used for pore water analysis while the remaining three were taken as triplicates. To compare microbial diversity and compositional differences at hydrocarbon seeps and adjacent sediment with no visible gas bubbles or bacterial mats, we took three more push cores at a soft sediment pool 6m southwest of Bubble Mat 01 and 8.1m southwest of Bubble Mat 02.

Once the ROV was back on deck, push cores were uncapped, the sediment portion was measured, and overlying water was drained using a syringe and tubing. All the cores from the seep sites were fractured throughout due to the gas build up (Figure 30-3). Moreover, bubbling was still seen in some cores before and during extrusion. Each core was placed on the extruder platform and sectioned into 0-1cm, 1-2cm, 2-4cm, 4-9cm. One 2mL cryovial was filled to ~2mL and frozen at -80°C for DNA analysis, and one 15mL Falcon tube was filled to ~10mL and flash frozen in liquid nitrogen for ~5 seconds for RNA/protein analysis and frozen at -80°C. Leftover bulk sediment was transferred into a sterile pee jar at intervals of 0-9cm and >9cm to be flash frozen in liquid nitrogen and stored at -80°C if initial analyses warrant in-depth analyses. The rest of the leftover bulk sediment was also transferred into a sterile pee jar at intervals of 0-4cm and 4-9cm to be stored at 4°C for future incubation experiments.

30.3 Preliminary results

No analyses were performed on the ship.

30.4 Acknowledgements

Thank you to Cécile Langevin and Dylan Roux for operating the CTD-Rosette for water sampling. Thank you to Thomas Williams and Guillaume Blais for helping me collect seawater by deploying the manual bucket. Thank you to Simone Booker for helping me get water samples for methane analysis and the subsequent poisoning of the samples. Thank you to Barry Brake, Peter Lockhart, Chris Morrisey, and Keith Tamburri for operating the ROV and getting our samples. Thank you to Chris Algar, Bárbara Neves, Laura Piccirillo and Hannah Sharpe for helping me process the multiple push core samples from the ROV. Thank you to the Canadian Coast Guard personnel who operated all equipment on deck. Thank you to Chief Scientist Maxime Geoffroy for developing a station schedule that allowed us to achieve great success in our sampling goals for this expedition. Thank you to the Amundsen Science team for ensuring proper operation of equipment and the opportunity to participate on this leg. Thank you to the crew of the CCGS *Amundsen* for a safe, comfortable, and successful expedition.

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Figure 30-3: A) Push core from a seep showing fractures throughout the sediment. B) Push core with white bacterial mats on the surface sediment. C) Push core from a sediment pool adjacent to seep sites. D) Push core on the extruder being subsampled into vials and jars.

Table 30-2: All stations sampled for water and sediment aboard Leg 2 of the 2021 Amundsen expedition. Future analyses of these samples include microbial community analysis (16S rRNA gene amplicon sequencing, metagenomics, transcriptomics, proteomics), cell counting, and methane measurements.

Station	Type	Depths sampled (mbsl)	Analysis
Labrador Sea 644	Water	True surface	Microbiology
	Sediment	982	Microbiology
Labrador Sea 652	Water	True surface 2.05 (Rosette surface) 23.6 50 2429 (Rosette bottom)	Microbiology
	Sediment	2438.69	Microbiology
Makkovik 2	Sediment	693.71	Microbiology
Saglek Bank R16	ROV Water	586	Microbiology, methane
Saglek Bank R17	ROV Water	611	Microbiology, methane
	Sediment	622	Microbiology
Saglek Bank R18	Water	802	Microbiology, methane
Saglek Bank R19	Water	2.42 (Rosette surface) 50.11 200.5 758.3 (Rosette bottom)	Microbiology, methane
	ROV Water	804	Microbiology, methane
	Sediment	806	Microbiology
HiBio-C	Water	2.23 (Rosette surface) 49.97 199.08 961 (Rosette bottom)	Microbiology, methane
Scott Inlet R24	ROV Water	263	Methane
	Push core	264	Microbiology
Scott Inlet R26	ROV Water	489	Microbiology, methane
	Sediment	492	Microbiology
Scott Inlet R27	ROV Water	239.2	Microbiology, methane
	Sediment	239.7	Microbiology

31 Baited Camera

Project leaders: David Cote[1] (David.Cote@dfo-mpo.gc.ca), Sheena Roul[1]

Cruise participants – Leg 2: David Cote[1], Sheena Roul[1]

[1] *Fisheries and Oceans Canada, St. John's, NL*

31.1 Introduction

Baited cameras are a useful tool to characterize benthic fish, fauna and habitat. The baited camera system was deployed at seven stations; Makkovik 5, Saglek, Saglek 1, Saglek 2, Hatton Sill, Scott Inlet 1, Scott Inlet 2 (Figure 31-1). The baited camera was used in the 2021 Amundsen Leg 2 expedition to meet the following objectives: 1. To expand coverage of previous Integrated Studies in the Coastal Labrador Ecosystem (ISCLE) 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) further south off Makkovik, north in the Labrador Sea to the Hatton Basin Marine Refuge and into Baffin Bay; and, 2. Collect pilot data on the inner Labrador Shelf to support the Imappivut marine planning initiative in collaboration with the Nunatsiavut Government.

31.2 Methodology

The deep-sea camera system was comprised of one camera (a Sony 4K camera), a SubC LED light and lasers and one Soundtrap to measure marine sound. 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 31-1). 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 100kg of large chain link was attached to the bottom four edges of the frame.

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. Rope was stored in garbage buckets, each bucket holding approximately 200 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 ~30m/min. A deckhand controlled 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 three large surface floats was attached using a shackle. The high-flyer was equipped with a strobe light and an AIS beacon to help with camera recovery in poor weather conditions. The frame was left on the bottom for approximately >3 hours, however the footage was limited to the battery life of the Sony 4K camera (approximately 2.5 h).

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 downloaded and saved to an external hard drive.

31.3 Preliminary Results

Of the eight camera deployments, seven were successful, but light issues prevented usable data collection at Makkovik 4. Hatton Sill and Sagbank 2 deployments were also truncated when the frame tipped over for a period of time due to high currents (see Table 32-2). Another challenge was the limited battery life of the Sony 4K camera (approximately 70-130 minutes). Despite this, seven camera deployments were successful in capturing footage of both fish and invertebrates. The stations in Makkovik 5, and Saglek had higher abundance and diversity than the Northern stations in Baffin Bay (Table 32-2).

At least ten species of fish were identified at the cameras (Table 32-2; Figure 31-2 to Figure 31-4) and other invertebrate taxa such as squid, crabs, squat lobsters, shrimp, snails, sea stars, corals, and sponges were also observed.

Table 31-1: Metadata associated with drop camera stations for Leg 2 Amundsen expedition (2021).

Station ID	GPS Coordinates on Bottom (Start)	GPS Coordinates on Bottom (End)	Time Deployed (UTC)	Approximate Time on Bottom (min)	Approximate Bottom Depth (m)
Makkovik 5	55.5211782 -58.9172903	55.5247310 -58.9222290	18:28:55	415	685
Saglek	58.6594938 -62.5904983	58.6591435 -62.5918922	06:43:06	426	120
Sagbank 1	60.5301709 -61.2614417	60.5215902 -61.2673920	23:53:53	613	602
Sagbank 2	60.4686560 -61.2112648	60.4544545 -61.2062263	00:16:32	838	800
Hatton Sill	61.4434759 -60.7281020	61.4387138 -60.7359620	21:39:46	797	614
Scott Inlet 1	71.3790255 -70.0707147	71.3791102 -700707147	18:32:02	708	265
Scott Inlet 2	71.4280950 -70.1400325	71.4280340 -70.1445408	06:25:29	448	482

Table 31-2: Biodiversity observed at baited camera stations for Leg 2 Amundsen expedition (2021).

Station ID	Bottom Type	Video Quality	Biological Productivity	Megafauna/flora observed
Makkovik 5	Mud in anemone fields	Good	High abundance of hagfish, with lots of plankton in the water	Anemones, Salps (13:38, 30:00, 27:00), hagfish (22:50), fish larvae (3:37), Greenland halibut (10:41, 13:35 attacking hagfish, 34:59, 6:43 stung by anemone), Squid (15:28, 18:22, 10:36), skate (20:33), nice shot of a jelly (24:03)
Saglek	Mud and shell hash	Good, cloudy at times due to high concentration of plankton	High abundance of plankton	Various jellyfish, brittle stars, sea urchins, crab (16:16), snails, shrimp, amphipods, sculpin, sea stars, hermit crab, wolfish
Sagbank1	Sand and cobble	Good	High abundance of corals	*Primnoa* corals, soft corals, myctophids, snails, squat lobster, sponges
Sagbank2	Sand	Good, frame moving occasionally from surface float drag, dragging for 24 minutes	Low abundance of corals, high abundance of eels	Soft coral, sponges, halosaur (27:01), cut-throat eel, squid, grenadier (24:00), hagfish

Hatton Sill	Mud with some rocks	Good, camera tips over for 65 minutes	High abundance of corals, low fish productivity	Corals, sponges, sea anemones, amphipods, squat lobster, grenadier (13:00),
Scott Inlet 1	Cobble with some mud	Good, slightly cloudy due to high abundance of plankton	High abundance of Arctic Cod (18:05) and brittle stars	Juvenile Arctic Cod, Brittle Stars, various jellies, unidentified fish (20:45, 25:03), myctophids, shrimp, snail fish
Scott Inlet 2	Bedrock, boulder and cobble with anemones and sponges	Good	Low fish productivity	Arctic cod (20:55), shrimp (23:35), Greenland shark (8:25)

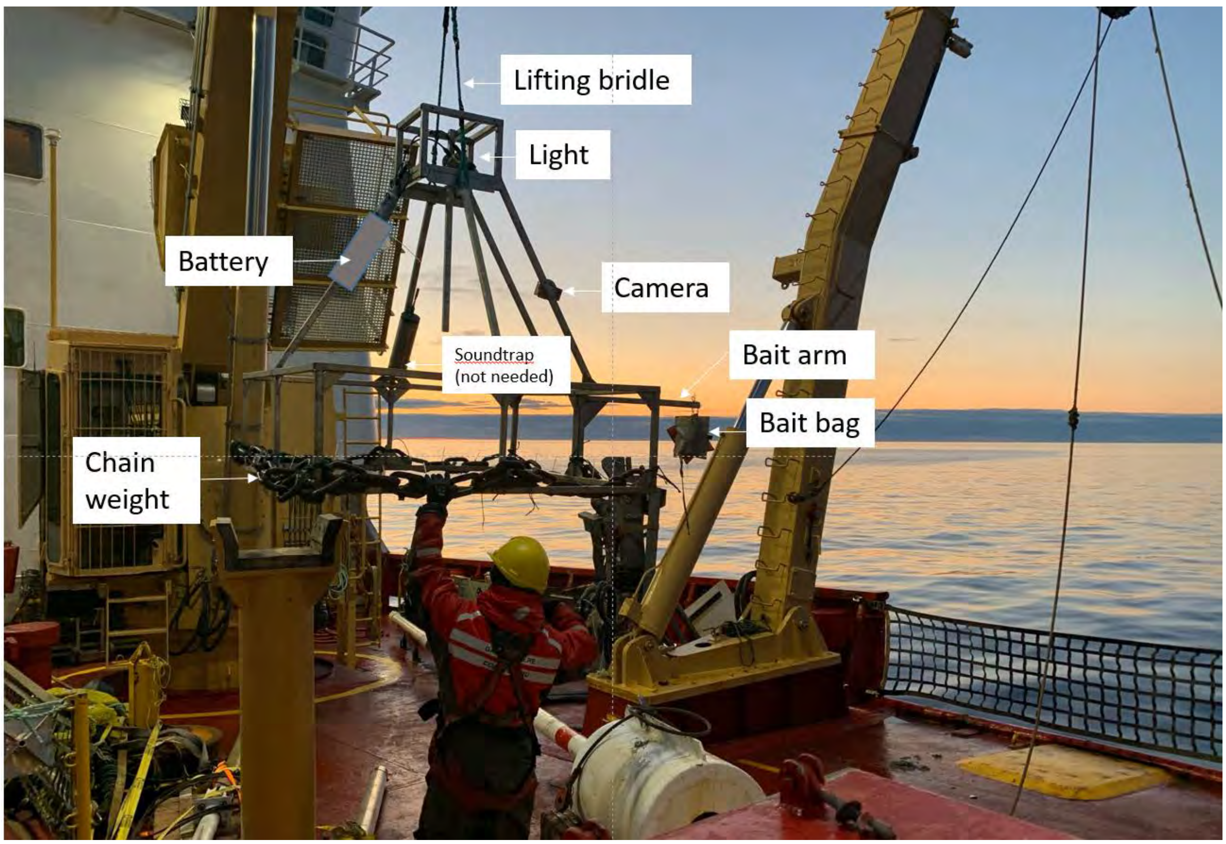

Figure 31-1: Baited camera configuration for Leg 2 Amundsen expedition (2021).

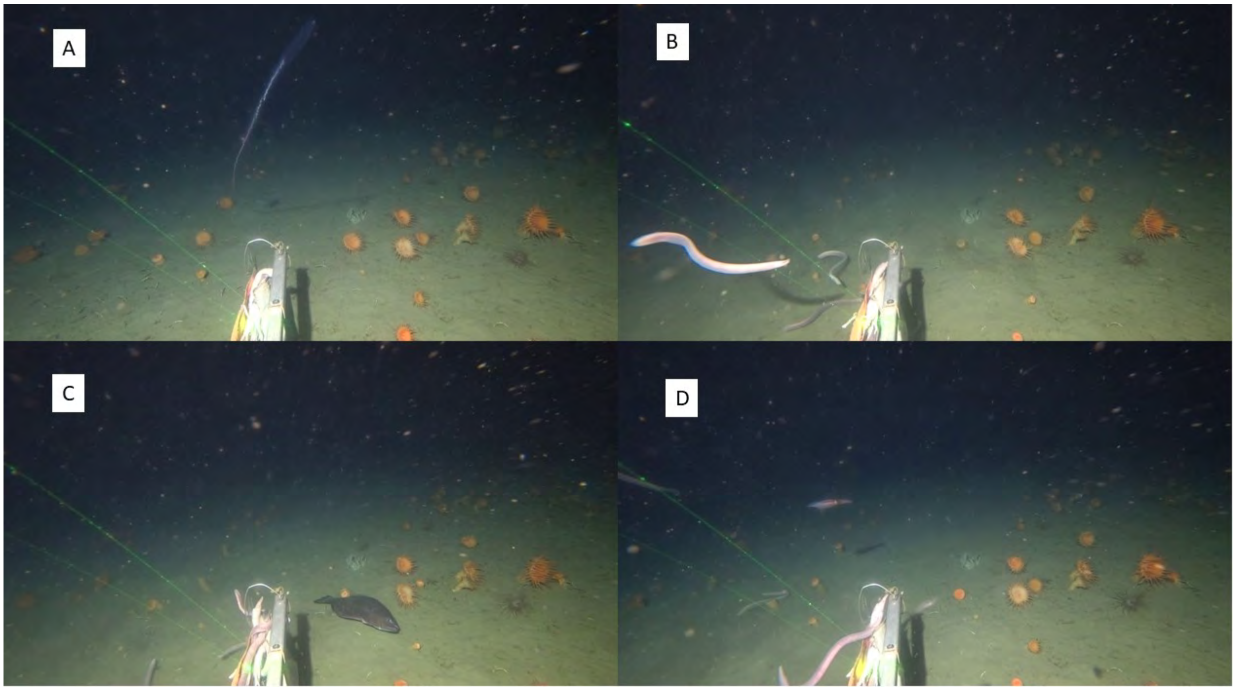

Figure 31-2: Photo captures of baited camera video at Makkovik 5 station. A: Salp;, B: Hagfish:, C: Greenland Halibut;, and D: squid.

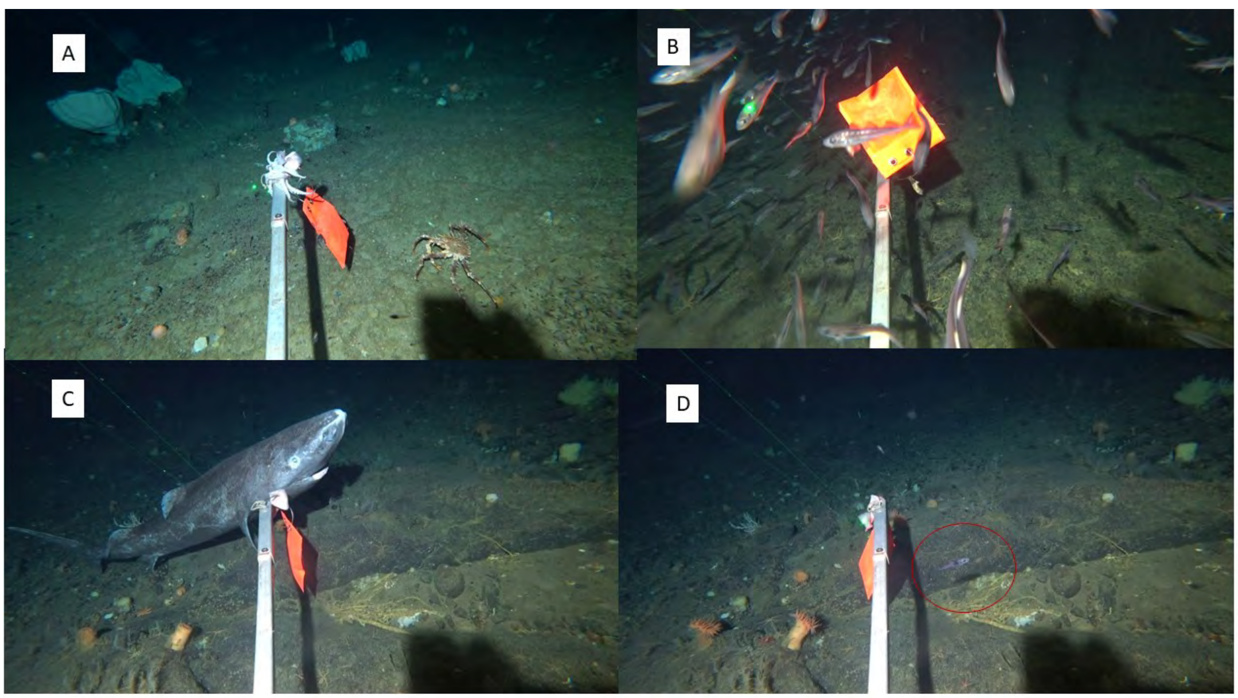

Figure 31-3: Photo captures of baited camera video. A: Hatton Sill, Atlantic Stone Crab, B: Scott Inlet 1, Arctic Cod; C and D: Scott Inlet 2, Greenland Shark and Arctic cod.

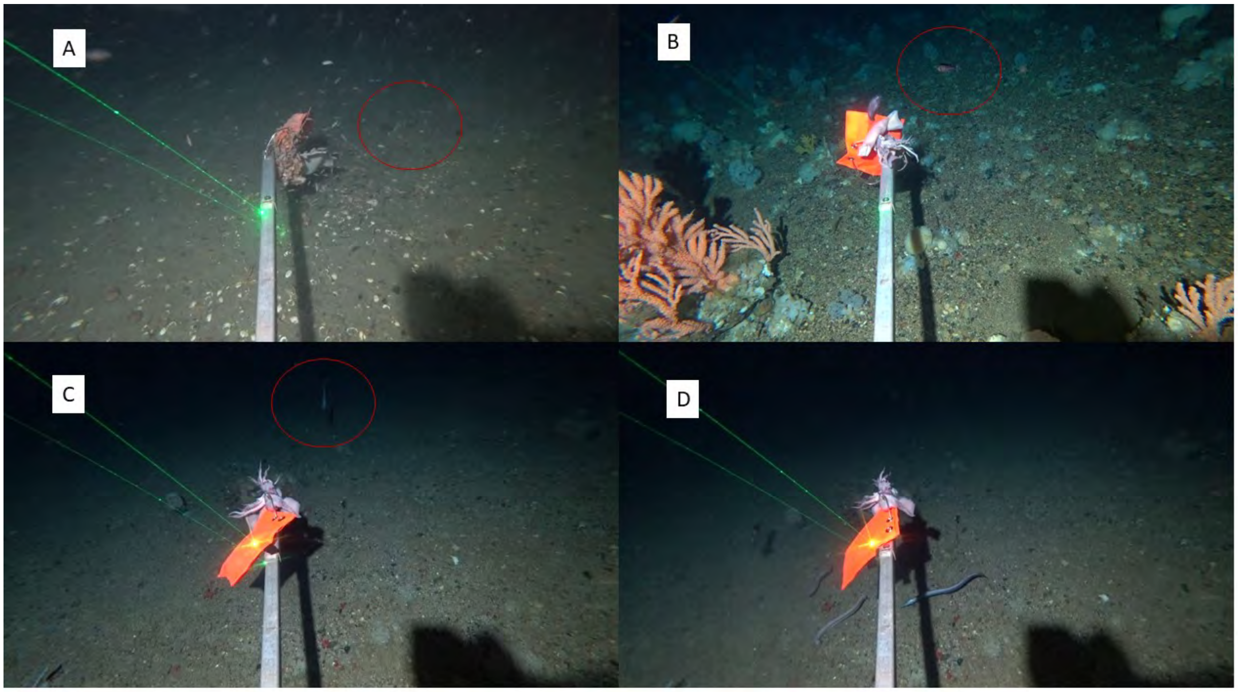

Figure 31-4: Photo captures of baited camera video. A: Saglek, Wolfish; B: Sagbank 1, Myctophid; C and D: Sagbank 2, Halosaur, Slat-jaw Eel and Hagfish.

32 Drop Camera

Project leaders: David Cote[1] (David.Cote@dfo-mpo.gc.ca), Sheena Roul[1]

Cruise participants – Leg 2: David Cote[1], Sheena Roul[1]

[1] *Fisheries and Oceans Canada, St. John's, NL*

32.1 Introduction and Methodology

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 2 of 2021 to: 1) Extend the surveys of ISICLE (Integrated Studies in the Coastal Labrador Ecosystem) stations off Makkovik and conduct preliminary exploration of the shelf off Saglek Fjord, 2) Scout areas of interest for potential ROV dives (Saglek Bank, Hatton Sill, Davis Strait and Disko Fan), and 3) Survey supplementary deeper water sites to ArcticNet seafloor mapping operations in Southwind Fjord and Cumberland Sound. Results for objective 3 are provided elsewhere in this report.

The deep-sea camera system comprised of two cameras (a SubC deep-water camera and Sony 4K camera) and LED lights. This equipment was fixed to a modified box core frame (Figure 32-1). The modified box corer apparatus containing the drop camera setup was attached to a winch cable system 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. The deckhand operating the winch could determine if the camera was on bottom by examining the tensiometer on the winch, which would show a drop in tension when the drop camera system touched the bottom. From there on, a "yo-yo" method was employed whereby the camera would be raised ~1-2 m off the bottom (as measured by the length of winch cable retracted), and dropped on the bottom again, and this procedure was repeated for 30 minutes. At Disko Fan, where surveys were conducted to measure the extent of bamboo coral forests, touch downs were reduced to once every 2 minutes to minimize potential impacts.

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).

11 drop camera deployments were conducted during Leg 2 of the 2021 Amundsen Expedition.

Camera deployments were successful though some imagery over muddy seafloors was obscured by sediment plumes for brief periods. However, all drops were successful in providing an understanding of the bottom conditions at each site.

Soft seafloor sediments off Makkovik supported anemone and seapen fields (Figure 32-2, Figure 32-3) that occurred in close proximity to the *Primnoa* coral and gardens that occured on vertical rock walls. The shallow station off Saglek supported an epifaunal community rich in echinoderms (Figure 32-4), whereas the high current slope habitats of Saglek Bank contained diverse benthic communities within the structure created by Neptheid and Primnoa corals and various sponges (Figure 32-5, Figure 32-6). At Saglek Bank 2, microbial mats characteristic of hydrocarbon seeps were also common (Figure 32-6). Hatton Sill was dominated by various sponges, with little other epifauna (Figure 32-7), whereas Davis Strait had abundant sea pens and was the only drop camera site with Antipatharian black corals (Figure 32-8). Disko Fan was had the poorest epifaunal community, though it had relatively high abundances of Mysids, shrimp and fish such as Greenland halibut (Figure 32-9).

Figure 32-1: The drop camera system attached to a modified box core frame utilized in Leg 2 of the 2021 Amundsen Expedition

Table 32-1: Metadata for drop camera stations of Leg 2, 2021

Station ID	GPS Coordinates on Bottom (Start)	GPS Coordinates on Bottom (End)	Time Deployed	Approximate Time on Bottom (min)	Approximate Bottom Depth (m)
Makkovik 4	55.5381255 -58.9385202	55.5405412 -58.9424812	2021/07/20 17:37:23	30	651
Makkovik 5	55.5556080 -58.9726823	55.5583082 -58.9744983	2021/07/20 18:50:26	30	650
Saglek Fjord	58.6690982 -62.6071880	58.6679332 -62.6025087	2021/07/23 03:45:15	30	120
Saglek Bank 1	60.5172732 -61.2471858	60.5174598 -61.2520307	2021/07/24 21:21:24	30	602
Saglek Bank 2	60.4965192 -61.2228543	60.4968142 -61.2320312	2021/07/26 06:27:54	30	700
Hatton Sill	61.4467203 -60.5792662	61.4408922 -60.5636773	2021/07/27 02:24:21	30	900
Davis Strait	63.3477993 -58.2189618	63.3415938 -58.2194710	2021/07/29 00:25:25	30	1280
Southwind CS-4.4	66.9231512 -62.4648960	66.9216342 -62.4637670	2021/07/31 22:21:23	30	345
Southwind CS-4.3	66.9563195 -62.4967943		2021/07/31 23:48:16	30	287

Southwind CS-4.2	66.9912353 -62.5545180	66.9897045 -62.5475878	2021/08/01 01:17:19	30	365
Disko Fan	67.8839257 -59.3800892	67.8799508 -59.3698763	2021/08/02 02:07:51	30	949

Table 32-2: 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 2b of the 2020 Amundsen Expedition.

Station ID	Bottom Type	Video Quality	Biological Productivity	Megafauna/flora observed
Makkovik 4	Mud with patches of boulder and cobble	Medium-Good. Disturbed sediment obscures view occasionally	High for epifauna, like venus flytrap anemones	Venus Flytrap anemones, Neptheid soft coral (20:27, 21:11), polychaetes (21:38), grenadier (22:13, 15:07), cerianthids, shrimp (24:06), starfish (25:18, 10:34), worm tubes, sponge (20:28, 21:45, 26:32), skate (3:02), pout (5:17, 5:33, 8:03), Pennatula sea pen (2:29, 8:00, 14:24, 14:56), Buccinum snail shell (10:34), Anthopthilum sea pen (question mark sea pen; 9:01, 11:36, 12:01), unidentified fish (12:01), Xenophyophore? (13:35)
Makkovik 5	Muddy bottom	Good	High for venus flytrap anemones, medium for sea pens	Venus flytrap anemones, Anopthilum sea pen (17:44, 18:01, 18:31, 18:45, 19:39), cerianthids, tulip sponge (17:21, 3:31), Neptheid soft coral (18:20, 1:15), grenadier (18:45, 20:20, 22:18, 26:45), Pennultula sea pen (18:50, 19:39), Greenland halibut (19:28), threebearded rockling (21:25, 6:00, 7:18), unidentified fish (22:39, 24:06), squid (25:05: 31:24, 6:15)
Saglek Fjord	Boulder, cobble, gravel, shell hash bottom, transitioning to small cobble with mud	Good	Very high for echinoderms such as brittlestars, sea cucumbers and sea urchins	Sea cucumber, sea lillies, brittlestars, urchins, anemones, Neptheid soft coral (9:45, 10:18, 11:40, 14:24...), hermit crab (9:45, 22:19, 32:45, 34:33), basketstar (11:09, 12:17, 16:05), starfish (11:40, 12:13, 12:45...), shrimp (11:46, 26:10, 31:51), sunstar (13:21, 17:56), sponge (13:42, 14:08, 14:32), Buccinum gastropods (15:07, 28:39), bryozoan (15:07), unidentified fish (22:16, 33:08, 30:54, 31:50), polychaete (25:35), cushion anemone (28:56, 3:54), scallop (30:52)

Saglek Bank 1	Sand, gravel and boulders	Good	High abundance of Anthomastus, sponges and Neptheid soft corals. Primnoa common on boulders.	Anthomastus, Primnoa corals, Neptheid soft coral, Asconema sponge, Geodia sponges, flytrap anemone, tulip sponge (1:39), various other sponges, starfish (2:51, 5:16, 7:08), grenadier (2:06, 22:40), hydroids (3:38), unidentified crab (4:53, 10:18), unidentified fish (5:12), shrimp (9:03, 26:12), crinoid (10:50), squat lobster (12:55, 18:21, 26:12, 28:11), Polymastia (22:24, 29:38), polychaete (23:43), redfish (24:50), octopus (30:05)
Saglek Bank 2	Gravel and cobble with patches of boulders	Good	Hard substrate not as covered as in other areas of Saglek Bank. Neptheid soft corals, sponges, anemonies and Primnoa at medium abundance. Octopus relatively abundant.	Geodia, cutthroat eel (24:45), Anthomastus, hydrocarbon seep (25:52, 35:07, 1:30, 1:42, 3:48, 5:17), anemone, starfish (26:19, 33:32, 0:46), Buccinum gastropod (26:19, 5:34), various sponges, Pennultula sea pen (26:27, 27:24, 28:11, 31:14, 0:06, 3:24), pillow anemone (26:33), Anopthilum sea pen (27:22, 27:40, 1:51), unidentified eel like fish (27:22, 33:18, 6:18, 7:37, 8:25, 16:36), Neptheid soft coral (27:24, 32:54, 34:28), Myctophid (29:00, 5:40), octopus (29:30, 4:11, 9:49,16:36, 17:35), stone crab (30:37), cerianthid (30:49), Heteropolypus soft coral (31:51), Primnoa (33:01, 34:34, 1:49, 3:43, 5:10, 5:17, 6:15, 6:56, 8:59, 10:30. 11:40), Acanthagorgia? gorgonian coral (33:01), shrimp (33:49, 5:36, 6:18), grenadier (0:01), polymastia (0:26, 5:59), garbage (3:59), unidentified fish (6:08), hydroids (6:32), Paragorgia (7:34), redfish (11:40), crinoid (11:47, 18:37), blue hake (13:51)
Hatton Sill	Sponge mats with silt	Good visibility except when obscured by silt	High abundance of various sponges, though few Geodia compared to nearby sites. Other epifauna and fish (except squat lobster) at relatively low densities.	Golf ball sponges, Astrophorid sponges, Geodia sponge (9:49), various unidentified sponges, starfish, Neptheid soft coral (27:23, 31:49, 33:05, 1:23, 9:04, 18:42), Anthomastus, Radicepes gorgonian (25:29, 33:15, 33:36, 4:08, 7:57, 8:35, 9:50, 13:04, 16:38, 18:50), anemone (26:18, 26:52, 27:23, 28:27), grenadier (26:31, 12:51), squat lobster (25:54, 27:27, 28:04, 31:10, 34:49, 3:21, 4:02, 4:59, 5:07, 9:49, 10:53), snailfish? (29:01),

				urchin (32:33, 7:39), sea pen (33:30, 3:21, 8:10, 13:09, 18:30), Asconema (0:44, 3:21), unidentified fish (2:52), brittlestars (mostly under dislodged sponges; 3:21, 8:21, 11:41, 14:55, 16:05, 17:35), fishing line (4:41), Arctinernus anemone(8:41, 9:39, 12:30),
Davis Strait	Mud with rare boulder, transitioning to boulder fields with mud	Video obscured at times by sediment	Anopthilum fields at start of transect with brittlestars at moderate densities. Few fish species.	Anopthilum sea pens (25:38), brittlestars (25:38), blue hake (25:43, 14:30), other sea pens (28:33, 30:43, 32:18, 34:12, 1:42, 2:10), Flytrap anemone (28:37, 5:25, 12:08, 13:04), Neptheid soft coral (28:39), cerianthid (29:10, 29:52, 30:48, 1:48), various sponges (29:52, 1:29), Acanella bamboo coral (29:56, 31:43, 32:26), unidentified fish (32:20), anemones (33:00), urchin (0:52, 1:15, 1:42, 2:10), sunstar (1:42), grenadier (4:08), Asconema (6:56, 11:22, 16:48, 17:46, 18:25), large white cerianthid (8:40), Acanella (8:40), octopus (12:32), gastropod (18:25), antipatharian black coral (31:17, 8:56, 18:25, 21:28), Anthomastus (21:05, 21:20), crinoid (21:20)
Disko Fan	Mud with occasional boulder	Fewer close ups due to reduced touchdowns (to avoid damaging any bamboo coral fields	Relatively high densities of Greenland halibut and mysids or shrimp. Very little epifauna.	Asconema (30:18), skate (31:23), shrimp (32:00, 9:33), cerianthid (34:16, 16:49), starfish (34:24, 11:34, 20:32), Greenland habitat (0:47, 3:22, 4:08, 6:35, 12:28), starfish (3:37, 4:21, 5:29, 13:07, 21:07, 21:44, 22:27, 22:40, 23:00), unidentified fish (7:41), sponges on boulders (10:19, 12:28), mysids (11:28), unidentified cnidarian (15:07), dead coral skeleton (20:00)

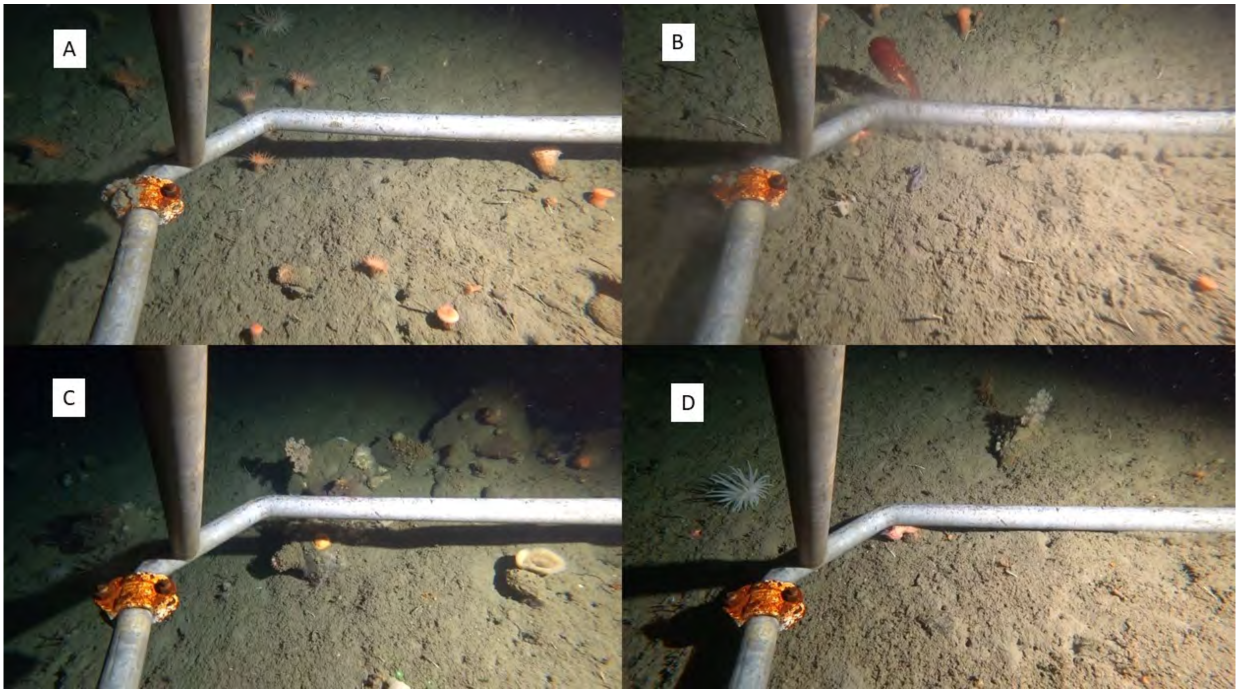

Figure 32-2: Images of drop camera transect Makkovik 4 including Venus flytrap anemone fields over mud bottoms (A), an Anthoptilum sea pen and a pout on mud seafloor (B), soft corals, anemones and sponges on boulders (C) and an Venus flytrap anemone, soft coral and cerianthid on mud bottom (D)

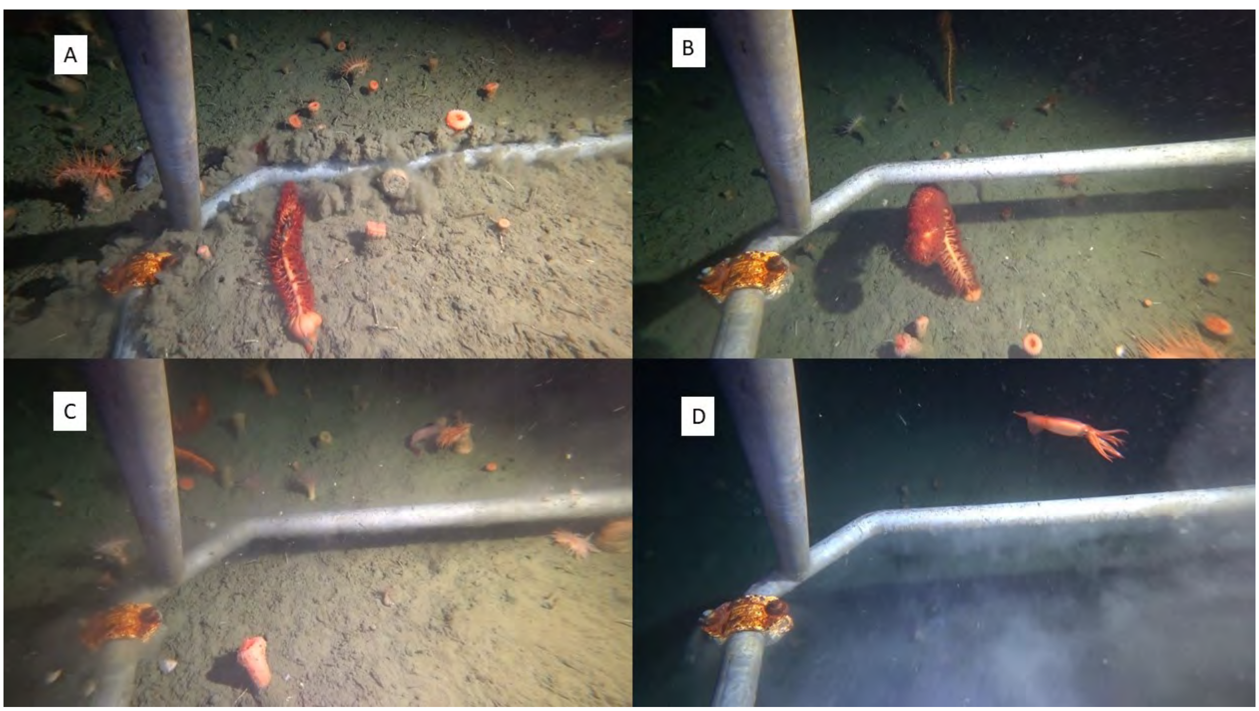

Figure 32-3: Images of drop camera transect Makkovik 5 including Anthoptilum sea pen and Venus flytrap anemones over mud bottom (A, B), threebearded rockling in anemone and sea pen field (C), squid (D)

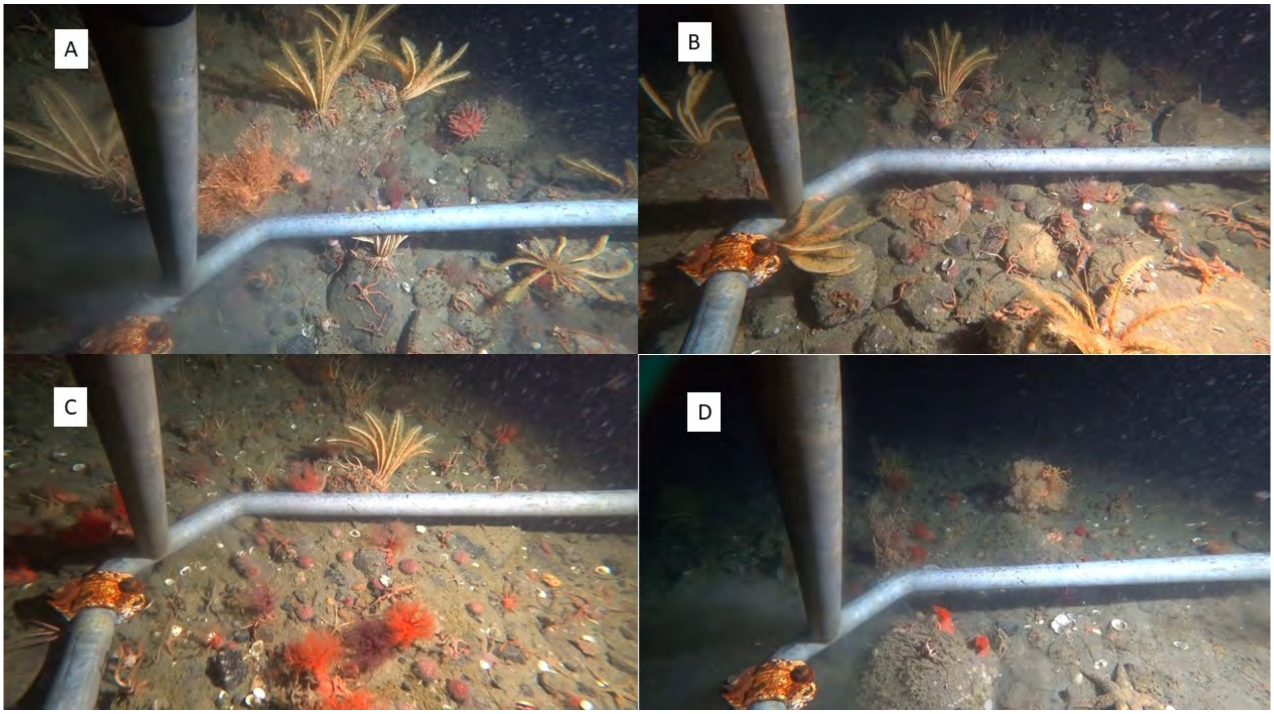

Figure 32-4: Images of drop camera transect Saglek Bay including crinoids, anemones, brittlestars, and basketstars over boulder and cobble bottoms (A, B), sea cucumbers, crinoids and brittlestars over hard bottoms (C) and starfish, basketstar, and sea cucumbers over boulders and shell hash (D).

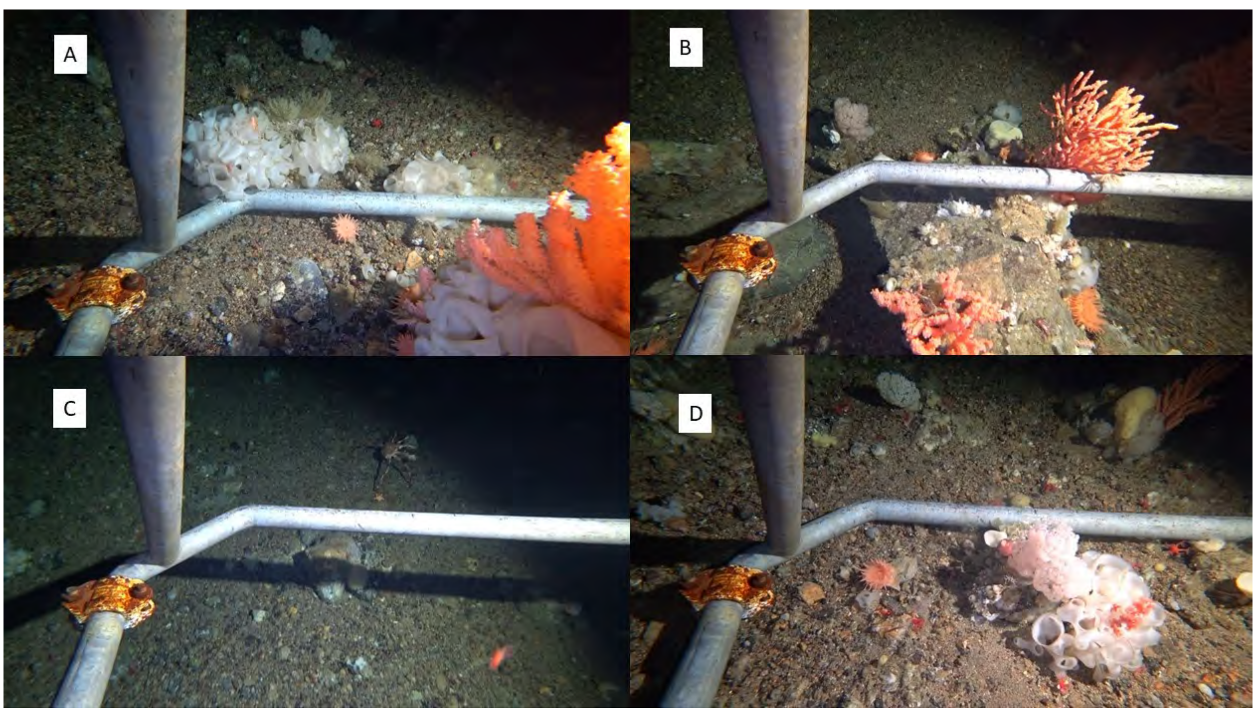

Figure 32-5: Images of drop camera transect Saglek Bank 1 including *Primnoa* corals, *Asconema* sponges and an anemone over hard subrates (A), *Primnoa* and Neptheid corals, anemones and sponges on boulder and gravel substrates (B), a crab traversing gravel (C), Neptheid and *Primnoa* corals, sponges including *Asconema* and anemones (D).

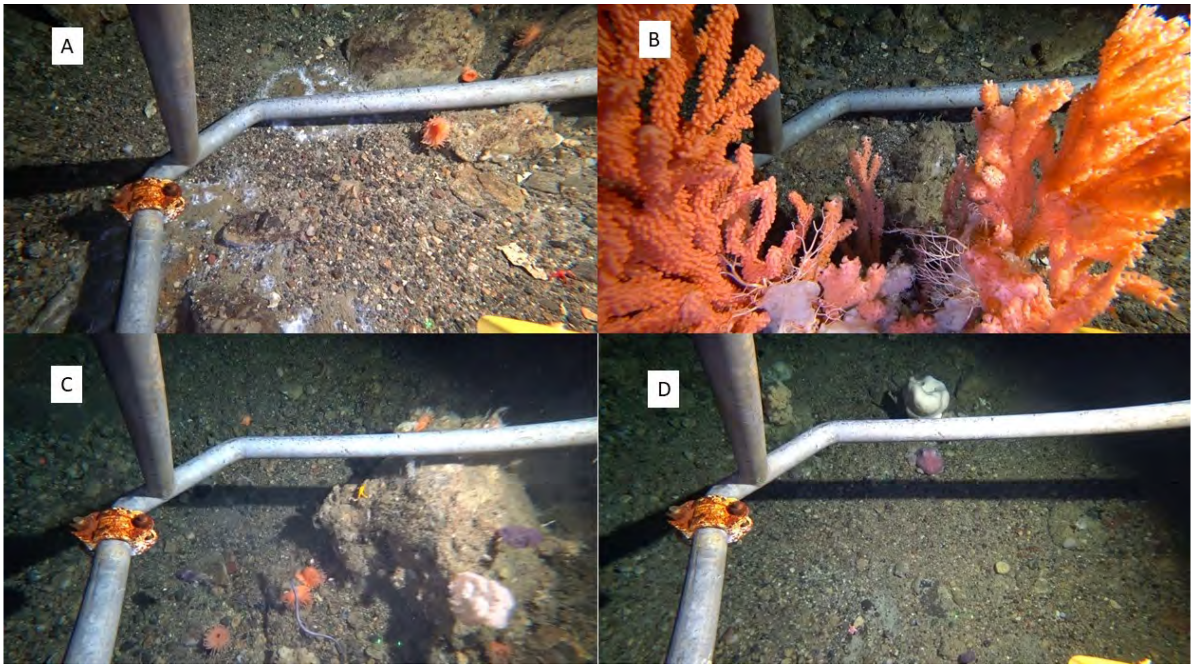

Figure 32-6: Images of drop camera transect Saglek Bank 2 including white microbial mats associated with hydrocarbon seeps adjacent to anemones (A), *Primnoa* corals on coarse substrates (B), an octopus and cutthroat eel swimming past Neptheid soft corals, anemones and starfish over coarse substrates (C) and an octopus lying in front of a *Geodia* sponge (D).

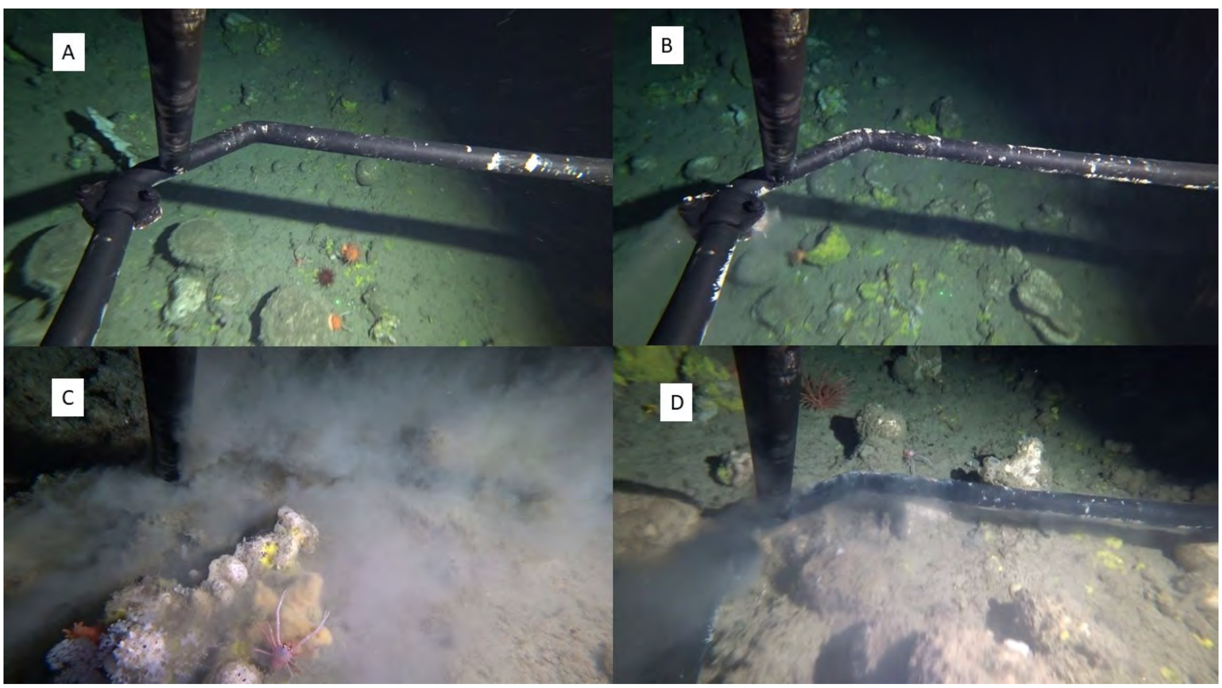

Figure 32-7: Images of drop camera transect Hatton Sill including urchins and anemones over a sponge dominated bottom (A), various sponges (B), a squat lobster sitting on a sponge (C), and an anemone and squat lobster living among sponges (D).

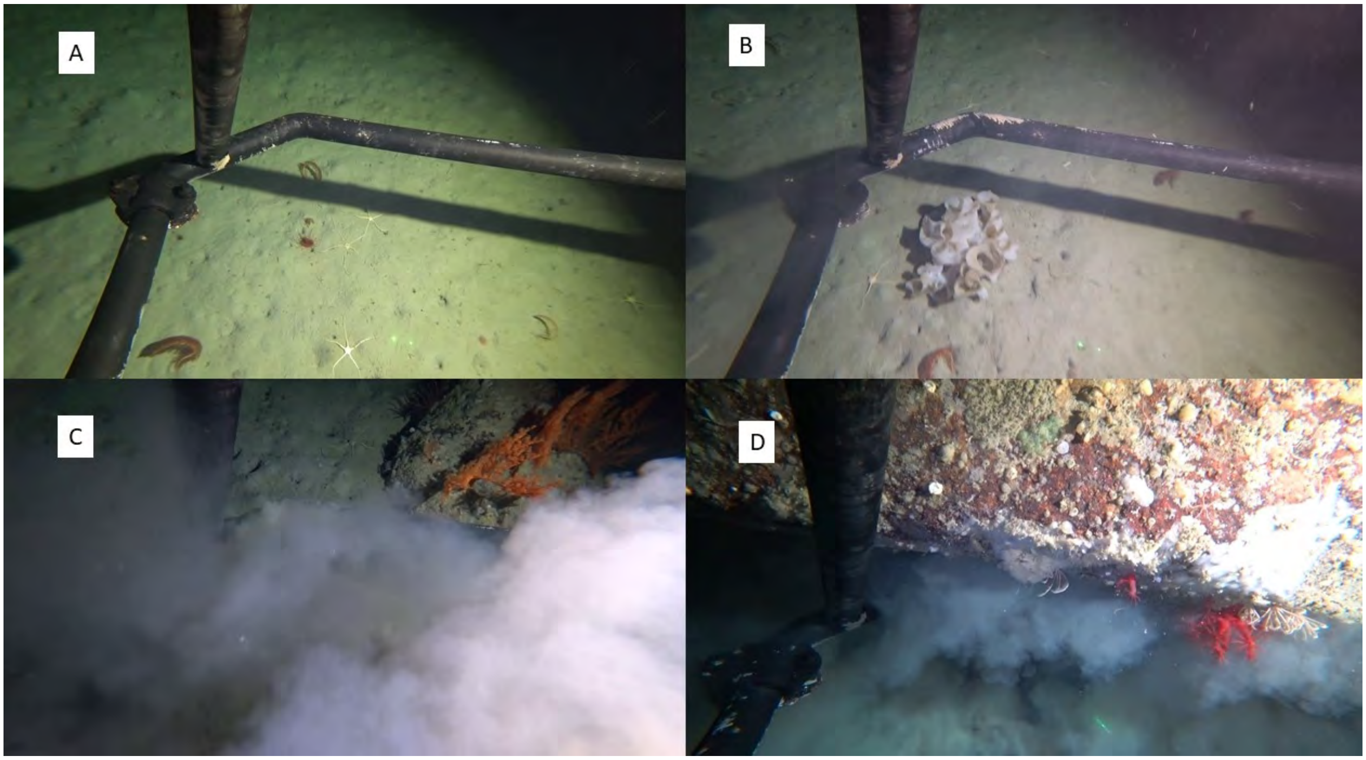

Figure 32-8: Images of drop camera transect Davis Strait including *Anthoptilum* sea pens and brittle stars over a muddy bottom (A), an *Asconema* sponge amongst *Anthoptilum* sea pens (B), a black coral species living on a rare boulder (C), and a crinoid and *Anthomastus* soft coral living on a boulder (D).

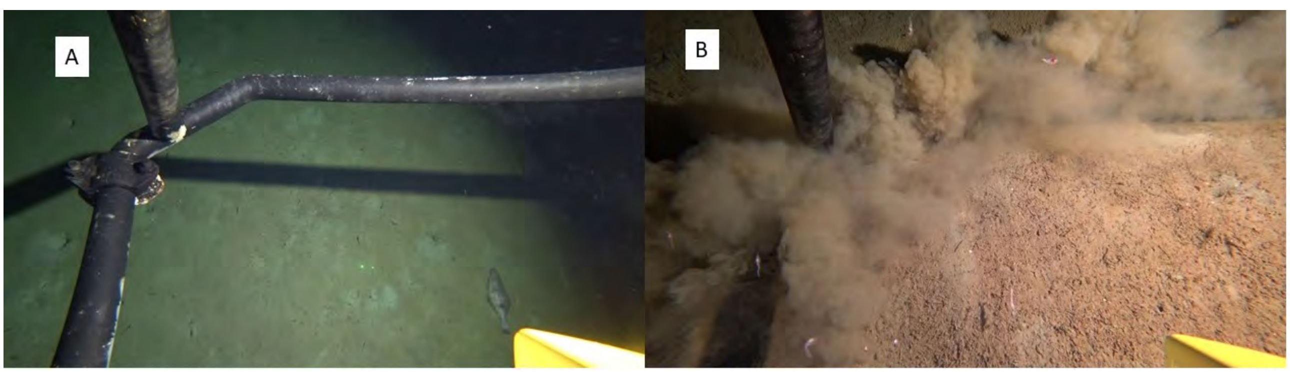

Figure 32-9: Images of drop camera transect Disko Fan including a Greenland halibut (A) and mysids (B) over muddy bottoms.

33 Sediment biogeochemistry and benthic pelagic nutrient coupling

Project leader: Christopher Algar[1] (chris.algar@dal.ca)

Cruise participants – Leg 2: Christopher Algar[1], Maria Armstrong[1], Haley Geizer[1]

[1] *Dalhousie University, Halifax, NS.*

33.1 Introduction

Sediments underlying continental shelf and slope sediments (<1000m 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 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.

33.2 Methodology

To accomplish the objective, sediment cores were collected using both ROV push coring and sub sampling of box cores (Figure 33-1) to examine sediment carbon remineralization pathways along a gradient of sites from coastal (Southwind Fjord), to continental shelf (Makkovik), and slope (644, Davis Strait, Disco Fan), along with a cold seep site (Scott Inlet) (Table 33-1). 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. Oxygen penetration depths were determined using microsensor profiling (Figure 33-2). 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).

Table 33-1: 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
644	54.82082	-53.22509	982	4	Box core	NA	1	3
Makkovik	55.53037	-58.96281	519	7	ROV	NA	4	3
Davis Strait	63.4016	-58.53774	1085	6	Box core	1	3	3
Southwind Fjord	66.75127	-62.31235	38	12	Box core	2	6	4
Disko Fan	67.88232	-57.38227	949	9	Box core	3	3	3
Scott Inlet	71.37939	-70.076283	264	2	ROV	NA	2	NA

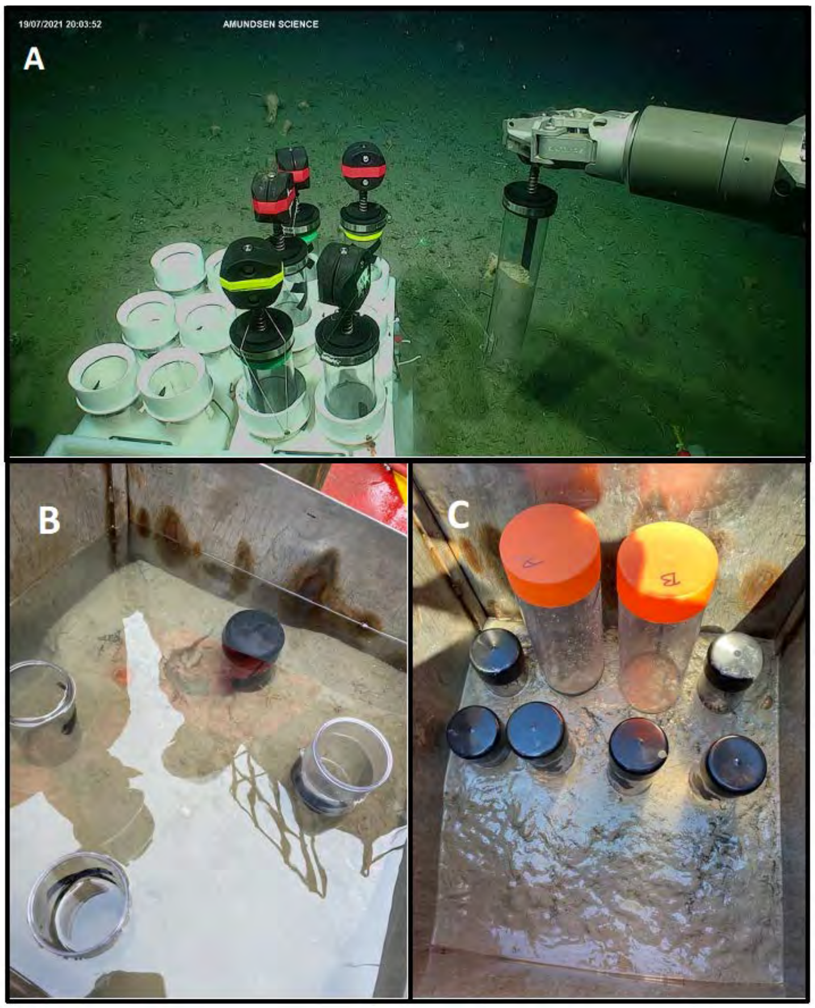

Figure 33-1: Photos demonstrating A) push core collection from the ROV at the Makkovic site. B) Core positions while subcoring a box core from: B) 644 and C) Southwind Fjord

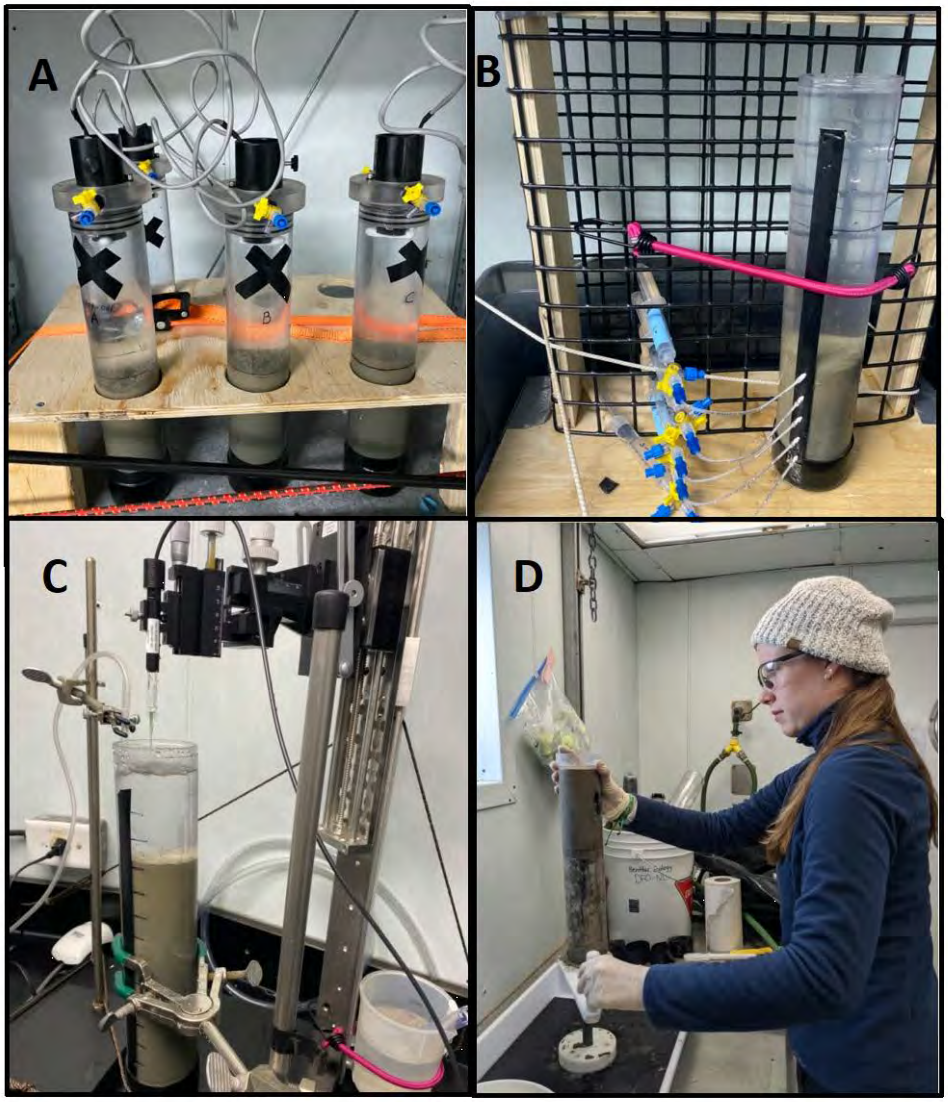

Figure 33-2: Images demonstrating the experimental setup for: A) flux incubations, B) porewater extraction, C) microsensor profiling, and D) core sectioning.

Flux incubations: Flux incubations were conducted at sites 644, Makkovik, Southwind Fjord, Davis Strait, and Disko Fan. Cores for incubations at the Makkovik site were collected using ROV push cores, while at all other sites, incubations were performed with sub cores from box core deployments (Table 33-1). Fluxes were not performed at Scott Inlet seep site, due to the limited number of cores that could be collected. Upon retrieval, cores were placed in a ~3°C cold room and measured, photographed, and color changes with depth noted (Figure 33-3). 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. Overlying water was replaced just before the start of the flux incubation with bottom water collected from a CTD rosette deployed at the coring site. In addition, a control incubation was performed with only Rosette bottom water (no sediment). Flux incubations were conducted for a period of 24-48 hours. Oxygen measurements were made approximately every 4 hours and nutrient samples (NO_x^-, NH_4^+, PO_4^{3-}, SiO_2) were collected every 8 hours. 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.

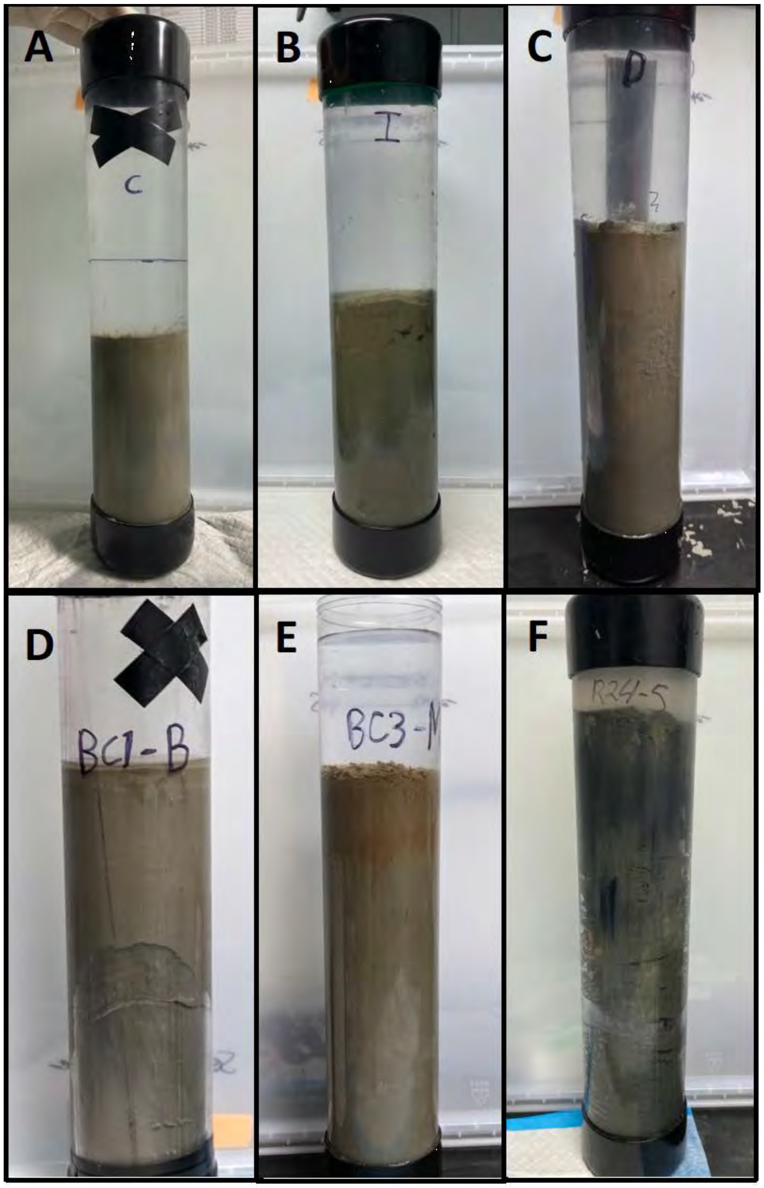

Figure 33-3: Representation cores from each sampling site, A) 644, Core ID: 644-BC2-C, B) Makkovik, Core ID: MKVK-J14-3-I, C) Davis Straight, Core ID: DS-BC2-C, D) Southwind Fjord, Core ID: SF-BC1-B), E) Disko Fan, Core ID: DF-BC3-M, F) Scott Inlet, Core ID: SI-R24-5-A.

After the flux was complete, cores were section at 0-2cm, 3-5cm, 5-10cm increments (Figure 33-2D). A small sample (<1mL) was collected for genomic sequencing (16S and metagenomics) from 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).

Porewater sampling: At all sites cores were collected for the characterization of porewater chemistry. When possible, cores were collected in triplicate to assess spatial heterogeneity (Table 1), but this was not always possible due to operational constraints such as the number of cores that can be placed on the ROV or the number of subcores that could be taken from a box core deployment. Porewater samples were extracted at 2 cm intervals through pre-drilled holes in the core liners using Rhizons (Figure 33-2B). After collection samples were sub-dived for analysis. Aliquots were taken for Fe^{2+}, DIC, and nutrients (NO_x^-, NH_4^+, PO_4^{3+}). DIC and Fe^{2+} (fixed with Ferrozine 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. At the Scott Inlet cold seep site porewater samples were also preserved with zinc acetate for analysis of dissolved sulfide. Following porewater extraction the remaining sediment was sectioned at the same intervals as the flux cores and saved for determination of carbon and nitrogen using a CHN analyzer, along with grain size. Samples were also preserved for microbial sequencing, although it is unclear to what extent porewater extraction may bias the results.

Microsensor Profiling: To determine oxygen penetration into the sediments, microsensor profiling was conducting 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 33-2C). During the initially week of the cruise electrical issues with the programmable stepper motor prevented the collection of oxygen profiles from the 644 and Makkovic sites. The issue was repaired by week 2 and profiling was performed at Davis Strait, Southwind, and Disko Fan sites. Oxygen profiling was not performed at the Scott Inlet seep site, because of concerns that dissolved sulfide in the overlying water would impact the stability of the oxygen microsensor. Oxygen profiling measurements were performed in the cold room (~3°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. At the Disko Fan site three cores were collected for microsensor profiling to assess spatial heterogeneity, however at the Davis Strait and Southwind Fjord sites limitations in the number of cores that could be collected meant only a single core was available for microsensor profiling. At Davis Strait one of the porewater cores was used for oxygen profiling before Rhizon porewater extraction, while at the Southwind Fjord site oxygen profiling was performed on dedicated sediment cores.

At both Davis Strait and Disko Fan sites oxygen penetrated several cm into the sediment. At Davis Strait profiling was conducted over the top 2.5 cm of sediment, and oxygen displayed a smooth exponential decrease, suggesting steady state behaviour (Figure 33-4A). At 2 cm O_2 was still > 50 μM and extrapolation using a decaying exponential fit suggested that oxygen penetrated 5 cm into the sediment. At the Disko Fan site oxygen penetration appeared shallower, between 1.0-1.5 cm, and oxygen spikes appeared with depth likely because of bioirrigation (Figure 33-4B). These transient, non-steady state oxygen dynamics at Disko Fan will make quantitative examination of these oxygen profiles difficult.

At Southwind Fjord cores were collected for microsensor profiles, both within the scar of a submarine landslide which occurred in 2019, and just outside it. The goal was to determine if there are biogeochemical differences due to the re-exposure of old sediments to oxygen within the landslide scar compared to the reference site. However, oxygen profiles at the sediment-water interface in both locations were similar (Figure 33-4C). This may not be surprising since the oxygen penetration depth was shallow, ~3 mm, and is most likely in the layer of sediment deposited since the landslide. Therefore, the top 5 cm of the cores was removed, and oxygen penetration remeasured. The hope is that this depth should be within the older sediments exposed by the landslide (will be confirmed later using ^{210}Pb dating). A slight difference was measured in oxygen penetration between the landslide and reference cores once the top 5 cm were removed. Oxygen penetration was deeper in the reference sediments compared to the “older” landslide sediments, (Figure 33-4D), suggesting higher oxygen demand in the sediments exposed by the landslide. Further post cruise analysis of the porewater chemistry should shed light on the significance and reason for this difference.

33.3 Preliminary results

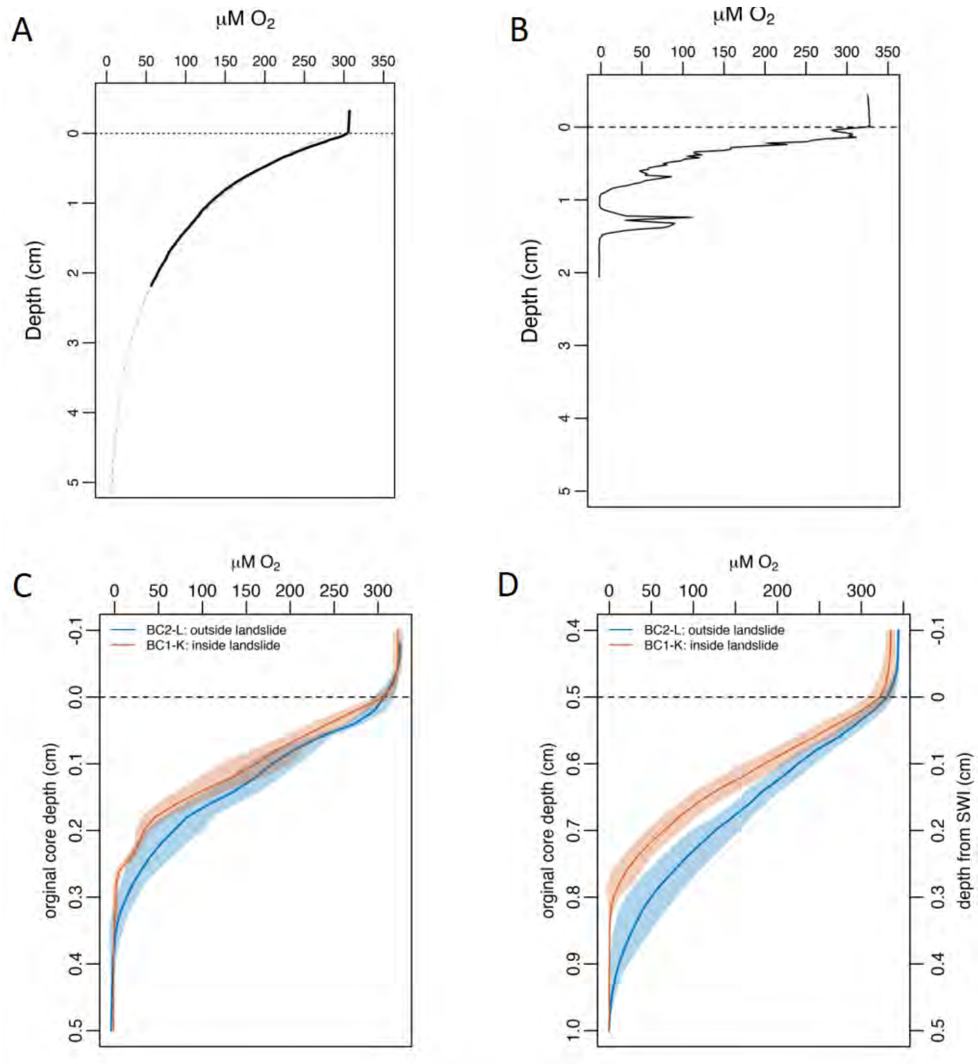

Figure 33-4: Preliminary oxygen microsensor profiles: A) Representative oxygen profile from Davis Strait site. Solid black line is the measured oxygen profile. Dashed grey line is a decaying exponential fit extrapolated to zero O_2. B) Representative oxygen profile from Disko fan displaying transient oxygen dynamics characteristic of bioirrigation. C) Composite oxygen profiles from Southwind Fjord both inside and outside the landslide scare. Each profile is composed of three individual microsensor profiles. Shading represents standard deviations. D) Composite oxygen profiles from the cores in C) but with the top 5 cm of sediment removed

34 PeCaBeau – Permafrost Carbon on the Beaufort Shelf

Project leaders: Lisa Bröder[1,2] (lisa.broeder@erdw.ethz.ch)

Cruise participants – Leg 4: Michael Fritz[3], Matt O'Regan[4], Atsushi Matsuoka[5], Bennet Juhls[3,6], Taylor Priest[6], Julie Lattaud[1], Antje Eulenburg[3], Daniel Rudbäck[4], Thomas Bossé-Demers[7]*, André Pellerin[8]*, Dustin Whalen[9]*, Thomas Carsson[9]*

[1]Department of Earth Sciences, ETH Zürich, Zürich, Switzerland
[2]Department of Earth Sciences, Vrije Universiteit Amsterdam, Amsterdam, The Netherlands
[3]Alfred Wegener Institute Helmholtz Centre for Polar and Marine Research, Potsdam, Germany
[4]Department of Geological Sciences, Stockholm University, Stockholm, Sweden
[5]School of Marine Science and Ocean Engineering (SMSOE)/Institute for the Study of Earth, Oceans, and Space (EOS), University of New Hampshire (UNH), Durham, NH, USA
[6]Max Planck Institute for Marine Microbiology, Bremen, Germany
[7]Université Laval, Québec City, QC
[8]Institut des sciences de la mer, Université du Québec à Rimouski, Rimouski, QC
[9]Geological Survey of Canada, Natural Resources Canada, Dartmouth, NS
**not funded through ARICE program (Arctic Research Icebreaker Consortium: www.arice.eu)*

34.1 Introduction and Objectives

The continental shelves of the Arctic Ocean are rapidly responding to global climate change. Rising air temperatures and declining summer sea-ice extent have direct consequences for the shelf environment. The ingression of warm water to the shelves impacts the coasts, which are more frequently eroded by fall storms during longer ice-free seasons, and accelerates subsea permafrost thaw. Furthermore, river runoff is warming and affecting associated particulate and dissolved matter fluxes important for aquatic life in the nearshore zone. These changes in the Arctic may have profound ramifications for regional ecosystems and the broader Earth climate system because: a) increasing coastal erosion and shifting fluvial fluxes are releasing greater quantities of soil carbon and nitrogen to the nearshore zone that may be exported to the shelf and beyond, and b) warming and freshening of the water column is affecting the biogeochemistry of the shelf water, its interaction with the sea floor and air-sea gas exchange. These ramifications and their controls on carbon turnover, ocean acidification, and greenhouse gas fluxes between sediment, sea and atmosphere are important but poorly understood. Coastal erosion and permafrost degradation are alarmingly active in the southern Canadian Beaufort Sea: strong coastal erosion and terrestrial permafrost degradation lead to the release of large quantities of sediment, organic carbon and nutrients into nearshore waters (Lantuit et al., 2012). Furthermore, the large freshwater and dissolved and suspended sediment load of the Mackenzie River strongly affect water column hydrography in a spatially inhomogeneous fashion with unclear consequences for the carbon budget on the shelf and deep ocean (Wegner et al., 2015).

The overall goal of this project is to quantify the fluxes, burial rates, composition and fate of organic matter (OM) in the southern Beaufort Sea. We aim to differentiate between sources deriving from permafrost coastal erosion, Mackenzie River discharge and submarine permafrost degradation, and to investigate how these sources have changed in the Holocene. The major objectives are described below.

Objective 1: To better understand the role of the Beaufort/Mackenzie system in mitigating and/or facilitating carbon dynamics, we will characterize organic matter transformation from riverine and coastal sources to the water column and surface sediment during its transport from source to sink (sediment sampling, water column sampling, remote sensing).

To achieve this objective, 4 sub-goals are identified:

1.1 Quantification of the dissolved, particulate and sedimentary OM fluxes in the Beaufort/Mackenzie area.

1.2 Qualitative analysis of OM in the Beaufort/Mackenzie area using bulk and molecular geochemical methods.
1.3 Estimates of concentrations of dissolved and particulate organic carbon, and primary production using satellite remote sensing data and collect in situ hyperspectral data.
1.4 Quantify lateral transport time on the Beaufort Shelf using compound-specific radiocarbon techniques on material collected along shelf-slope transects (as done on the Laptev Shelf by Bröder et al., 2018).

Objective 2: To evaluate whether modern sedimentation and carbon burial rates depart significantly from the long-term baseline. To do so we aim to recover paleoenvironmental sediment records to constrain past fluxes, and permit comparison of coastal and riverine sediment pathways over time. This will be achieved through gravity/piston coring for longer sedimentary sequences, and surface sediment sampling.

2.1 Quantification of carbon burial rates on the Beaufort Sea floor in space and time based on Pb/Cs, radiocarbon and paleomagnetic chronologies.
2.2 Development of paleoceanographic time-series documenting changes in the oceanographic and sea-ice conditions during the Holocene using micropaleontological sedimentological and organic geochemical methods.
2.3 Provision of material to WKP1 for determining origin and fate of organic matter (Objectives 1.2 and 1.4).

In addition to the overarching objectives 1 and 2, several specific sub-projects were conducted in conjunction with the PeCaBeau sampling efforts.

34.2 Methodology

Sampling operations focused on the Southern Beaufort Sea with additional stations in the Amundsen Gulf and McClure Strait (see Figure 34-1). The cruise track centered around five major transects from shallow (≤ 20 m) into deep water beyond the shelf break and in the Mackenzie Trough. Along the entire cruise track, mapping surveys using multi-beam and sub-bottom echosounders were conducted, in particular to define deep coring locations. Optical measurements were performed under way and at specific locations (radiometry). Water-column profiling (CTD and rosette water sampling) and sediment sampling (shallow multicores and long cores) took place at locations defined in Table 34-1.

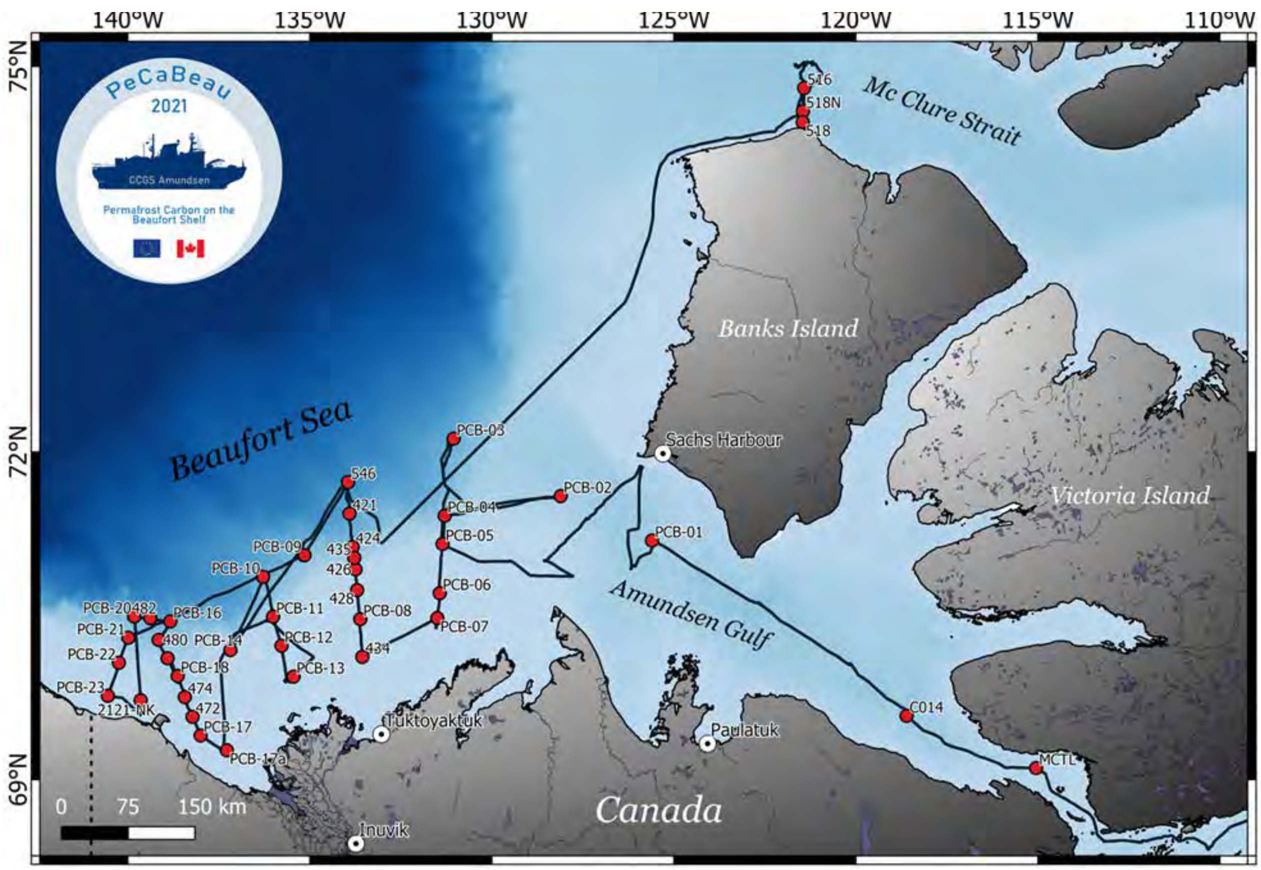

Figure 34-1: Map of the study area with Leg 4 cruise track outlined in black and sampling stations involving PeCaBeau activities marked with red circles. For details on which operations were conducted at each sampling station, see Table 1.

Table 34-1: Sampling locations and conducted activities per station. PC: piston core; TWC: trigger weight core; GGC: giant gravity core; GC: gravity core. *: long coring stations where in situ temperature measurements were taken

Station ID	Latitude (deg)	Longitude (deg)	Depth (m)	Sampling activities			
				Rosette	Radiometry	Multicores	Long cores
PCB-01	71.23288	-125.59845	411	X	X	X	
PCB-02	71.622	-128.10599	314	X		X	
PCB-03	72.1131	-131.04676	1044	X	X	X	PC+TWC
PCB-04	71.4511	-131.2942	531	X	X	X	PC+TWC
PCB-05	71.20294	-131.35189	75	X		X	
PCB-06	70.76183	-131.42986	50	X		X	PC+TWC
PCB-07	70.53483	-131.49528	52	X	X	X	GGC
PCB-08	70.52486	-133.61348	69	X		X	
PCB-09	71.10243	-135.14449	675			X	PC+TWC*

Station ID	Latitude (deg)	Longitude (deg)	Depth (m)	Sampling activities			
				Rosette	Radiometry	Multicores	Long cores
PCB-10	70.90951	-136.28213	954	X	X	X	
PCB-11	70.54748	-136.00951	74	X		X	GGC+TWC*
PCB-12	70.27986	-135.77562	57	X	X	X	GC
PCB-13	69.99163	-135.44577	32.	X		X	PC+TWC*
PCB-14	70.24	-137.18	58	X		X	
PCB-16	70.50464	-138.83203	799	X		X	GGC+GC*
PCB-17	69.43113	-137.99893	54	X		X	PC+TWC*
PCB-17a	69.28782	-137.27927	20	X		X	GC
PCB-18	69.99839	-138.62824	272	X	X	X	PC+TWC*
PCB-19	70.16379	-138.90782	372	X		X	
PCB-20	70.5492	-139.81988	782	X	X	X	
PCB-21	70.35477	-139.98316	458	X	X	X	PC+TWC*
PCB-22	70.12136	-140.24488	48	X	X	X	PC
PCB-23	69.81033	-140.54852	33	X		X	
421	71.46966	-133.9093	1156	X			
424	71.1755	-133.82445	584	X			
426	70.97641	-133.74497	95	X			
428	70.78958	-133.69872	75	X			
434	70.17647	-133.55512	46	X	X		
435	71.07808	-133.77688	302	X	X		
472	69.60975	-138.2213	124	X	X		
474	69.79853	-138.43304	173	X	X		
480	70.33447	-139.15267	560	X	X		
482	70.53421	-139.37998	560	X	X		
546	71.74206	-133.94863	1611	X	X		
MCTL	69.11418	-115.04719	170			X	
2121-NK	69.76867	-139.64636	36				PC

Station ID	Latitude (deg)	Longitude (deg)	Depth (m)	Sampling activities			
				Rosette	Radiometry	Multicores	Long cores
516	74.84704	-121.41703	493			X	
518N	74.68005	-121.45099	526			X	GC
518	74.59903	-121.45739	437	X			
C014	69.62043	-118.60309	522		X		
514	75.00759	-121.38886	490	X			

34.2.1 *Water column profiling – CTD and Rosette water sampling*

The collection of water samples for downstream analyses (see following sections) was performed at 34 sites using a Rosette water sampler on a CTD system "SBE911 Plus", (Seabird-Electronics, USA) (Figure 34-2). In addition to sampling, a number of physicochemical parameters were measured using sensors fitted to the CTD system, including:

- Pressure, [digiquartz, db]
- Salinity, [psu] (SBE)
- Temperature [ITS-90, deg C] (2 x SBE 3+)
- Conductivity [mS/cm] (2 x SBE 4C)
- Oxygen concentration [µmol/kg] (SBE 43)
- Fluorescence (Seapoint)
- Fluorescence [mg/m3] (WET Labs ECO CDOM)
- Photosynthetic active radiation (PAR) [µmol photons/m2/sec]
- Beam transmission [%] (WET Labs C-Star)
- Nutrients (Nitrate/Nitrite) (SUNA)

Water sampling was performed using the Rosette system, consisting of 24 Free Flow bottles, each with a volume of 12 L. A full CTD cast was carried out at a speed of 1 m s^{-1}, with the downcast used to obtain data on the physical parameters. The depth of the deep chlorophyll maximum (DCM) was determined during the downcast. The lowest depth reached, termed 'bottom', was typically around 10 m above the seafloor, determined using the altimeter. Water sampling was performed during the upcast.

Figure 34-2: CTD rosette system being deployed by A frame from the starboard side of the ship

Once the CTD was back on deck, water sampling began in a specified order, beginning with gases, followed by water chemistry and finishing with sampling for microbial communities. The measurements or analyses that will be performed on water samples include:

- Dissolved methane concentrations
- Stable water isotopes (^{2}H and ^{18}O)
- Alkalinity
- Dissolved inorganic carbon (DIC)
- Nutrients (N, P, Si)
- Total suspended solids (TSS)
- Dissolved and particulate organic carbon concentrations (DOC and POC)
- Colored and fluorescent dissolved organic matter (cDOM and fDOM)
- Radiocarbon (^{14}C) and stable carbon isotope (^{13}C) analyses for POC, and DIC
- Phytoplankton pigments using High performance liquid chromatography (HPLC)
- Particle absorption spectra (ap(λ))
- Total absorption (particulate & dissolved) (a_{tot})
- Lipid biomarkers
- Dissolved black carbon concentrations and ^{14}C
- Microbial omics (phylogenetic marker gene sequencing, metagenomics and metatranscriptomics)
- Microbial microscopy and cell sorting (fluorescence *in situ* hybridisation and flow-assisted cell sorting)
- Carbohydrate analysis (quantification of monosaccharides and polysaccharides along with composition of different polysaccharides)

For the majority of analyses outlined above, the water samples were transported to the lab and divided into dissolved and particulate phases through a process of filtration. Samples acquired for chemical compound analysis were filtered through pre-ashed glass fiber filters (Whatman GF/F, 0.7 µm pore size) using peristaltic or vacuum pumps at a pressure of ~100 mbar. The filters (particulate fraction) and a part of the filtrate (dissolved fraction) were stored at -20 °C and +4 °C respectively. Water samples that were taken to investigate microbial communities were sequentially filtered through a 3 µm and 0.2 µm polycarbonate membrane filter (47 mm in diameter) using a vacuum pump at a pressure of ~200 mbar and subsequently stored at -80 °C.

34.2.2 *Remote Sensing – Optics*

Hyperspectral water reflectance above and in the water was measured in order to improve optical satellite data for low sun elevation. Three systems have been used: 1) Two floats (Figure 3a) carrying Trios Ramses radiometers, one to measure the downwelling irradiance just above the water surface and the other to measure the upwelling radiance just below the water surface; 2) In-water profiler (Figure 34-3b) measuring the downwelling radiance with two Trios Ramses radiometers installed with a 18 cm offset; 3) Above-water system (Figure 34-3c) measuring the downwelling radiance from sky, the upwelling radiance from water and the downwelling irradiance. Radiometric measurements were only carried out when the sun elevation was >0° and wave and ice conditions allowed the deployment of the floats.

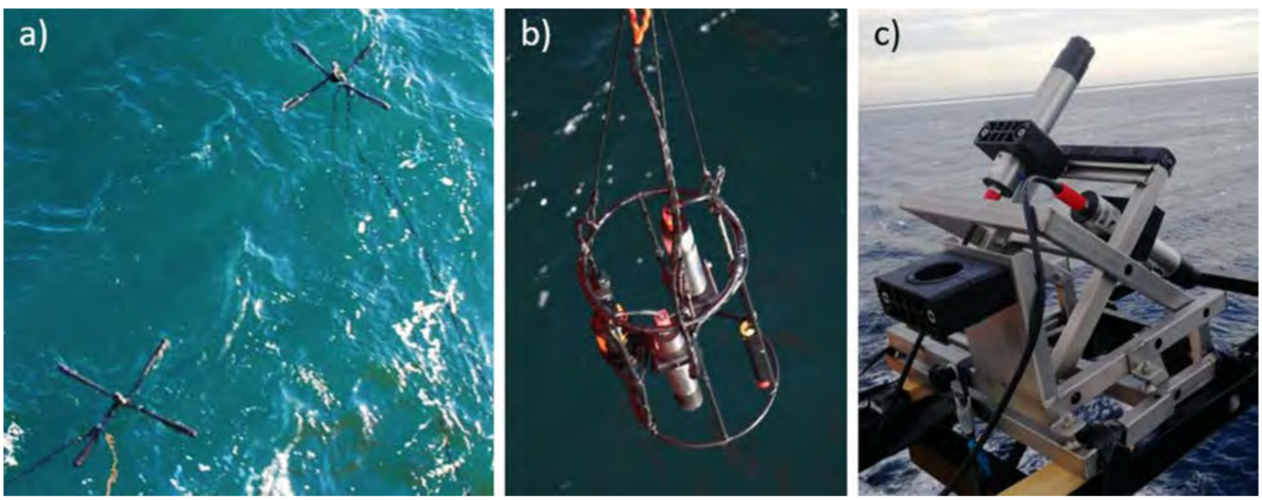

Figure 34-3: a) Floating, b) In-water, and c) above-water radiometric systems

34.2.3 *Sediment Sampling*

Coring

The PeCaBeau team collected sediment samples from 27 stations during the expedition. This included short multi-cores (<50 cm) and longer piston and gravity cores (<5.5 m). The multicorer (MUC) belonged to AWI Bremerhaven, and was brought onboard specifically for the PeCaBeau operations. It is capable of simultaneously collecting up to 8, 60-cm long, 10-cm diameter cores that often capture a pristine bottom-water sediment interface (Figure 34-4). The multicorer weighs 300-400 kg, is 3 m wide and 3.5 m high. To achieve the desired penetration depth, up to 10 individual ~10 kg lead weights can be added to the core head.

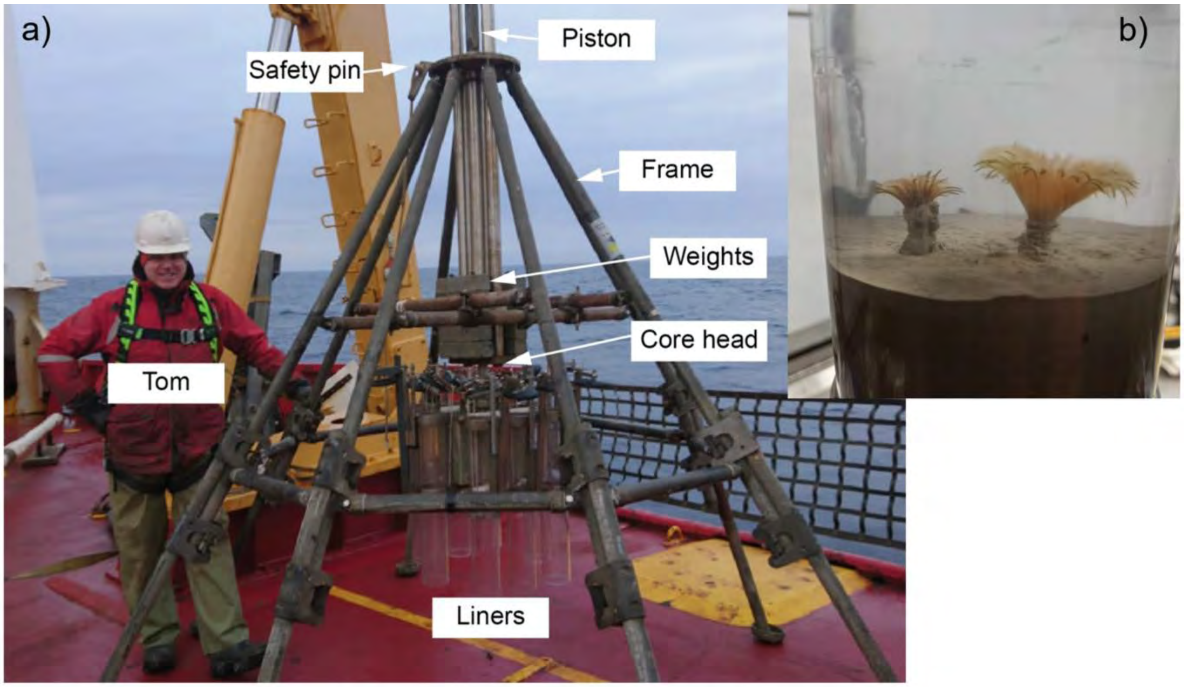

Figure 34-4: a) The Oktopus multicorer from AWI Bremerhaven on the foredeck of CCGS *Amundsen*. b) A multicore liner with sediment and overlying water, including living anemones

The individual tubes from each MUC were allocated for different purposes. In general, four of the tubes were sliced at 1-2 cm intervals for sedimentary properties and biomarker analyses, one tube was sealed and stored as an archive, two tubes were taken for pore water analyses, and a final tube was reserved for solid phase geochemical sampling. Slicing of the MUC samples was done in the Benthos lab of the ship (Figure 34-5). Sliced samples were bagged and placed in the -20 °C freezer.

Figure 34-5: A sequence of images illustrating the slicing a sediment core from the MUC

Longer sediment cores were obtained using one of two core barrel assemblies: a 9-m long core barrel with an 850-kg coring head, or a 3-m long barrel with 160 kg core head. Both barrels were fitted with 3 m length of 10 cm diameter clear plastic core liners. All Piston Cores (PC) were collected using the 9-m long core barrel with the 3-m long barrel deployed as the Trigger Weight Core (TWC). Two types of gravity core were obtained: a Giant Gravity core (GGC) consisting of the 9-m long assembly, and the basic gravity core (GC) with the 3-m long assembly.

In-situ temperature data

At seven of the long coring stations, in-situ temperature measurements were collected using ANTARES miniature temperature probes. These were attached to the outside of the 9-m long core barrel at a spacing of about 1.5 m (Figure 34-6). The probes were inserted into stainless steel fins attached to the core barrels using hose clamps. The temperature probes were programmed for a 1-s sampling interval, and 4-5 probes were used on each core. To monitor the angle of the core barrel while embedded in the sediments, a Star Oddi DST magnetic orientation sensor was used. The sensor recorded the temperature, pressure (depth), ambient magnetic field strength, tilt (in 3 directions), and the azimuth. This sensor was attached to the core barrels using hose clamps and positioned just below the core head (Figure 34-6).

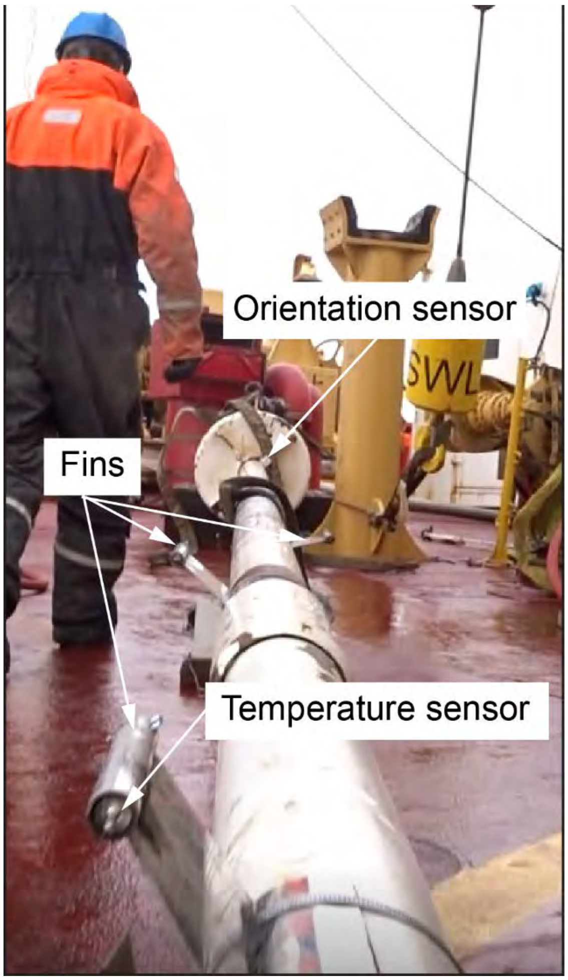

Figure 34-6: Core barrel with temperature and orientation sensors attached on the foredeck of CCGS *Amundsen*.

Multi-sensor core logging

A recently refurbished Geotek MSCL was provided by *Amundsen Science* and set-up in the Paleo Lab. The sensors were oriented in the horizontal direction for whole-core logging. Measurements of the gamma-ray derived bulk density, compressional wave velocity, electrical resistivity and magnetic susceptibility were acquired. On the piston, gravity and trigger cores, these measurements were acquired at a downcore resolution of 1-cm. An archived multi-core from each station was also measured, primarily to determine the bulk density of the sediments. These measurements were performed at a resolution of 0.5 cm.

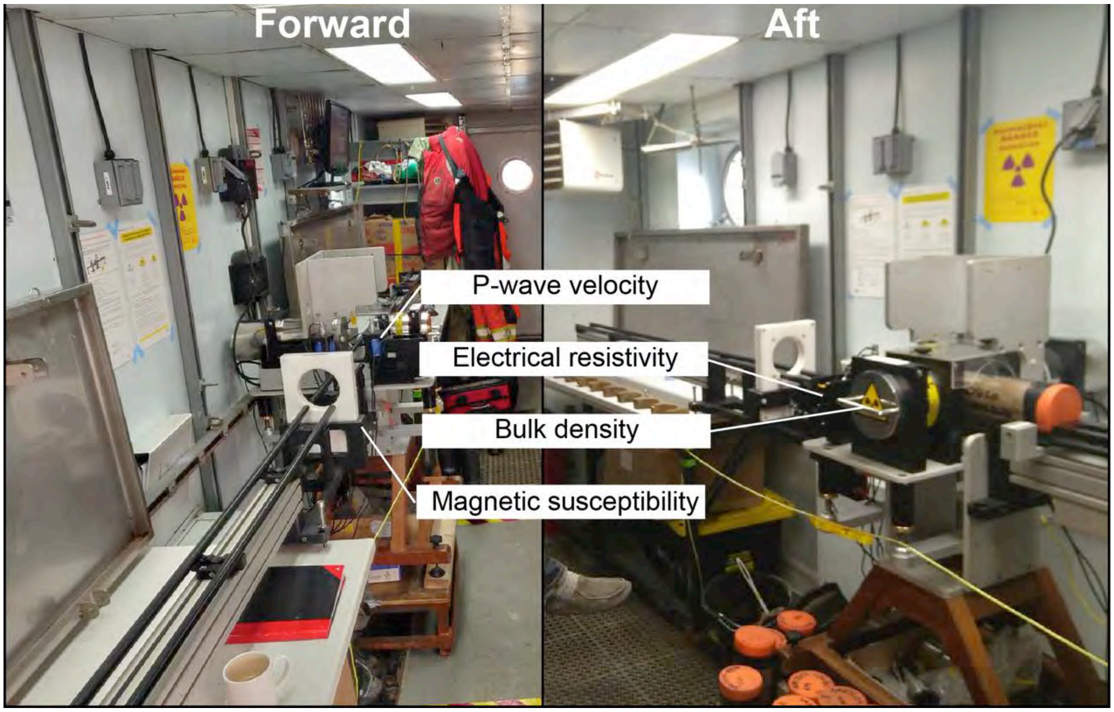

Figure 34-7: Two views of the Geotek multi-sensor core logger set-up in the Paleo lab

Porewater and solid phase geochemistry

Pore waters were extracted from the multi-cores using rhizones. Samples were prepared for shore-based analyses of trace elements, anions and cations; rare earth elements; DOC and DIC. Sampling was generally conducted at a resolution of 1 cm between 0-10 cm, 2 cm from 10-20 cm, and 5 cm from 20-50 cm. For low-resolution sampling, cores were subsampled every 2 cm until 5 cm and every 5 cm from 5 to 40 cm.

One multi-core from each PCB stations was sampled for solid phase geochemistry in order to complement the porewater work. These were sliced at 5 cm intervals. Additional sampling was conducted on gravity/trigger weight cores from two specific transects; one was across the Mackenzie Trough (PCB 17a-19) and the other across the shelf (PCB 11-13). Samples for the solid phase geochemistry were placed in plastic bags and frozen, a small subsample (~15 g) was placed inside of glass vials, sealed with a butyl rubber septum and purged with N_2 gas to remove oxygen. These vials were stored in the refrigerator. For the longer gravity and trigger weight cores the samples were taken every 20 cm. Post cruise analyses will include sediment incubations of the anoxic vials to better understand organic matter remineralization rates. Frozen samples will be used to quantify the amounts of acid volatile sulfides and chromium reducible sulfides (AVS+CRS) as well as the different fractions of iron present in the sediment

Figure 34-8: Tomas Bossé-Demers from Université Laval extracting high-resolution pore water samples from a multicore in the Benthos lab on CCGS *Amundsen*

34.3 Preliminary Results

Data generated shipboard was limited to water column information from the CTD, core logging data from the MSCL, and geophysical data (sub-bottom and bathymetry) used for core site selection. This will be used to guide post-cruise sampling and analyses. We here include a table reporting the recovery of the long cores with station locations and abbreviations as detailed in Table 34-1.

Table 34-2: Summary of the long cores recovered during Leg 4

Core ID (Station_Type)	Sections	Core Length (cm)
PCB-11-GGC	3	292.5
PCB-11-TWC	3	220.5
PCB-12-GC	2	200
PCB-13-PC	2	153
PCB-13-TWC	1	77
PCB-16-GGC	4	350.5
PCB-16-GC	3	269
PCB-17-PC	4	327
PCB-17-TWC	3	232.5
PCB-17a-GC	2	124.5
PCB-18-PC	7	682
PCB-18-TC	3	288.5

PCB-21-PC	5	436.5
PCB-21-TWC	3	281.5
PCB-22-PC	1	46
PCB-3-PC	6	547.5
PCB-3-TWC	2	183.5
PCB-4-PC	5	442.5
PCB-4-TWC	2	195.5
PCB-6-PC	2	176.5
PCB-6-TWC	1	41
PCB-7-GC	6	544.5
PCB-9-PC	4	420
PCB-9-TWC	3	254
518N-GGC	3	314
AMD2104-1-GC	2	218
AMD2104-2121NK-PC	1+CC	59

34.4 Recommendations

Recommendations regarding piston coring operations by Thomas Carson (Marine Geoscience Technologist, Geological Survey of Canada):

- There should be no paint on the barrels where the couplings and cutter attach, we should be able to easily slide the couplings up and down the barrels enough to be able to see where the barrels meet. There are times that we cannot extract the liner from the barrels so we then have to remove the couplings in order to separate the barrels. If there is paint in this area it is very difficult to remove the couplings.
- The platforms for the bottle jacks have 2” wood material underneath them for elevation and support. We would recommend that there is a double 2” by 6” material under the platforms for more stability and higher elevation. It would be better if we can elevate the core string higher to make it more level when extracting the liner.
- The bottle jacks are too small. Every year they get broken from the big weight of the core string. We would recommend more heavy duty bottle jacks which would be bigger and would help with the elevation of the string. It would be a great help if some cans of Rust Check or some sort of rust inhibitor were onboard board to keep them lubricated and protected from the salt water.
- It seems we are low on catchers and some of the catchers onboard are not very good quality. We would recommend sending more good quality catchers for a coring season.
- The piston parts were low as well. We would recommend sending more piston parts including springs, rubbers, orings, orifices, main bodies, screws, and all other piston spares.
- I would recommend that the Coast Guard use brand new certified lifting straps every season. It is noticeable that the lifting straps being used might not pass a proper inspection. Newly certified shackles and other lifting tackle should also be up to date.
- With regard to recovery, as mentioned we do feel that in certain site locations where the sediment is soft and looks good in the sub bottom that we should be getting more recovery with the piston core. From GSC I brought some spare orifices for the piston and drilled out two different smaller sizes, this seemed to help with a bit more recovery on one of the sites. I also adjusted the torque on the rubber seal at the bottom of the piston so it would ride up the liner with the correct amount of friction. These tests take time to perfect and while each core sample is so important during the job it would be recommended that Amundsen Science spend a couple of days or even one day to deploy and recover the

piston coring system with various orifice sizes and various different torque pressure on the rubber seal to find the best recovery.

- The carts that are used for the box core and the cart used for the pilot (gravity) core need some attention. It is difficult to lock and unlock the wheels, some of the wheel locks do not work at all.
- The butterfly valve that GSC has engineered seems to work well on the core string without the trip arm, pilot core, and piston. The valve keeps the sediment protected when being recovered from the sea and also allows the water/air pressure to escape while the core string is penetrating the seabed. With a bigger core head this system would work very well and might be worth looking into for the future.
- In summary, the coring equipment was a big help to the success of this project. Everything worked well and the recommendations are provided for future improvements to the system.

Recommendations regarding water sampling:

The surface pump that was currently available from AS should be replaced or supplemented by a more compact system that can be employed by a single person, which could ideally be powered by a battery.

34.5 References

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Wegner, C., et al. (2015) Variability in transport of terrigenous material on the shelves and the deep Arctic Ocean during the Holocene. Polar Research.

35 ArcticNet Seafloor Mapping Project

ArcticNet Project Leaders:
Jean-Carlos Montero-Serrano[1] (jeancarlos_monteroserrano@uqar.ca)
Ian Church[2] (Ian.Church@unb.ca)

Network Investigators and collaborators:
André Rochon[1] (andre_rochon@uqar.ca)
Guillaume St-Onge[1] (guillaume_st-onge@uqar.ca)
Audrey Limoges[3] (Audrey.Limoges@unb.ca)
Patrick Lajeunesse[4] (patrick.lajeunesse@ggr.ulaval.ca)
Katleen Robert[5] (katleen.robert@mi.mun.ca)
Alexandre Normandeau[6] (alexandre.normandeau@canada.ca)
Calvin Campbell[6] (calvin.campbell@canada.ca)
Kristina Brown[7] (Kristina.Brown@dfo-mpo.gc.ca)

Cruise participants – Leg 2: Alexandre Normandeau[6], Thomas Carson[6], Hannah Sharpe[3], Bianca Barrett[5]

Cruise participants – Leg 3: Jean-Carlos Montero-Serrano[1] Kelsey Koerner[1,3], Alexis Belko[4,6]

Cruise participants – Leg 4: André Pellerin[1] and Maria-Emilia Rodriguez-Cuicas[1]

[1] Institut des sciences de la mer de Rimouski, Université du Québec à Rimouski, Rimouski, QC.
[2] Department of Geodesy and Geomatics Engineering, University of New Brunswick, Fredericton, NB.
[3] Department of Earth Sciences, University of New Brunswick, Fredericton, NB.
[4] Département de géographie, Marine Geosciences Laboratory, Université Laval, Quebec City, QC.
[5] Fisheries and Marine Institute, Memorial University of Newfoundland, St. John's, NL.
[6] Geological Survey of Canada-Atlantic, Bedford Institute of Oceanography, Dartmouth, NS.
[7] Fisheries and Oceans Canada, Institute of Ocean Sciences, Sidney, BC.

35.1 Introduction

The Arctic Seafloor Mapping project of ArcticNet has been conducting research to improve the understanding of geological processes and hazards (geohazards) in Baffin Bay to support stakeholder decisions on the use of offshore areas and provide northern communities with better knowledge for improving public safety. Fjords are known to be more susceptible to submarine and subaerial sidewall failures, producing some of the largest tsunamis on Earth. From the 14 largest tsunamis ever recorded, 10 occurred in glaciated environments such as fjords (Hingar et al., 2018) in environments similar to Baffin Bay. The 2017 Greenland tsunami serves as a reminder of the risk they pose and their dramatic consequences on northern communities. As such, the ArcticNet Arctic Seafloor Mapping project began working in fjord environments to assess the triggers and frequency of active marine geohazards and the potential consequences they pose to Baffin Bay communities. The part of this project focused on fjords was undertaken during Leg 2.

In addition to geohazard work, the ArcticNet Seafloor Mapping project also aims at characterizing seabed habitats in fjords and the biological diversity on the seafloor. Underwater camera work was carried out in order to ground-truth the bathymetry and backscatter data previously collected in Southwind and Pangnirtung Fjord (Normandeau et al., 2019). This data will be used in conjunction with the bathymetry and backscatter data to identify the habitats that exist in the fjords and map their extent within the fjord.

A final objective of the ASM project was to collect opportunistic surface sediment samples (top first cm of sediment at the sediment-water interface) from each box core. These samples will be used for subsequent identification of microfossils (e.g., dinoflagellate cysts, palynomorphs, diatoms, foraminifera). Phytoplankton are free floating, microscopic organisms that live in the upper water column or in sea-ice. Examples of phytoplankton include dinoflagellates, diatoms, and cyanobacteria. Opportunistic samples were collected using the phytoplankton net to document and characterize the dinoflagellate communities in the Canadian Arctic and Labrador Sea.

During Leg 3 and 4, scientists benefitted from the presence of the Canadian Coast Guard (CCGS) *Amundsen* in Northern Baffin Bay, the Northwest Passage, Beaufort Sea and McClure Strait to collect multiple surface sediments, sediment cores (box, gravity and piston) as well as water and sediments samples of selected rivers in these areas in order to:

1) characterize the spatial distribution patterns of siliciclastic grain size, bulk minerals, and elemental geochemistry of seafloor sediments;
2) document the post-glacial melting history of the outlet glaciers;
3) reconstruct past variations in sediment dynamics and sea-surface conditions (temperature, salinity, sea-ice cover duration, productivity) related to Late Quaternary climate changes across the Canadian Arctic;
4) establish a deglacial/Holocene high-resolution magnetostratigraphy for the Canadian Arctic Ocean;
5) document the evolution of primary and secondary productivity of the Canadian arctic ecosystem in relation with climate conditions;
6) identify and document the dinoflagellate communities living in Canadian Arctic;
7) determine the biogeochemical and sedimentological characteristics of water and sediments of rivers from the Canadian Arctic Archipelago region.
8) identify and DNA-sequence known diatom taxa from the North Water Polynya to contribute to a more comprehensive database of modern Arctic diatom data.

35.2 Methodology

35.2.1 *Kongsberg EM302 Multibeam Sonar*

The Amundsen is equipped with an EM302 multibeam sonar operated with the *Seafloor Information System* (SIS). Attitude is given by an *Applanix POS-MV* receiving RTCM corrections from a *CNAV 3050* GPS receiver. Position accuracies were approximatively < 0.8m in planimetry and < 1m in altimetry. Beam forming at the transducer head is done by using an *AML* probe. CTD-Rosette casts, when available, were used for sound speed corrections. During long periods without CTD casts, the WOA09 model was used. Mulitbeam bathymetry imagery (Figure 35-1) was critical in assessing ROV diving sites and selecting coring locations.

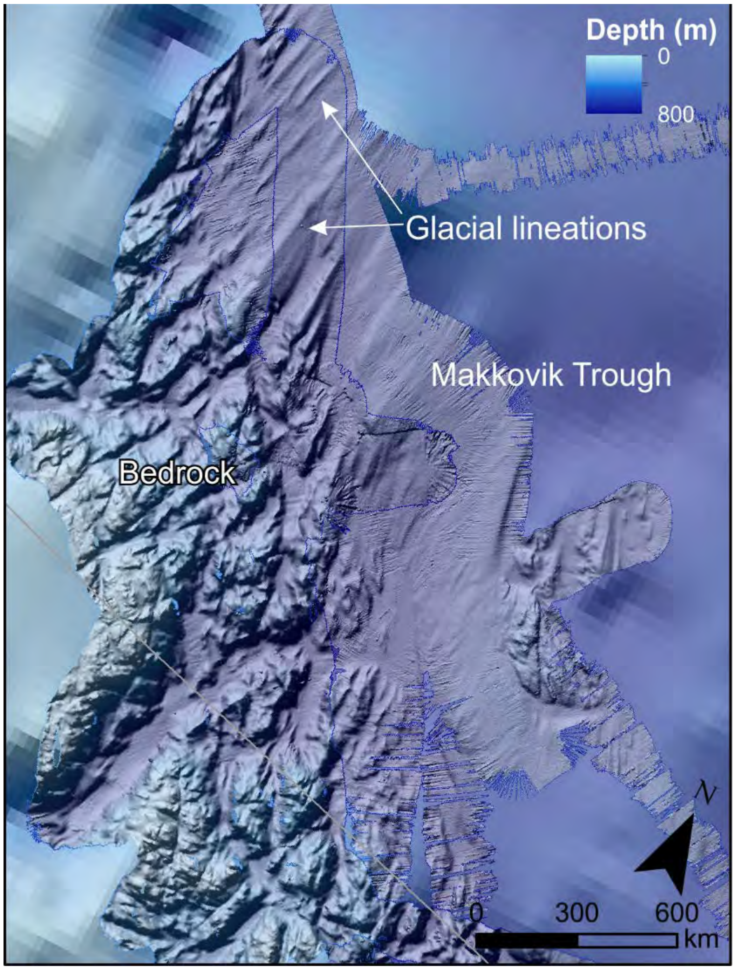


Figure 35-1: Example of multibeam bathymetry data collected in Makkovik

35.2.2 *Knudsen 3260 CHIRP Sub-bottom Profiler*

Since May 2016, a new Knudsen 3260 deck unit was installed onboard the Amundsen. Sub-bottom profiles were acquired along all transits at a frequency of 3.5 kHz to image sub-bottom stratigraphy of the seafloor. The sub-bottom profiles were critical in choosing coring site locations (Figure 35-2).

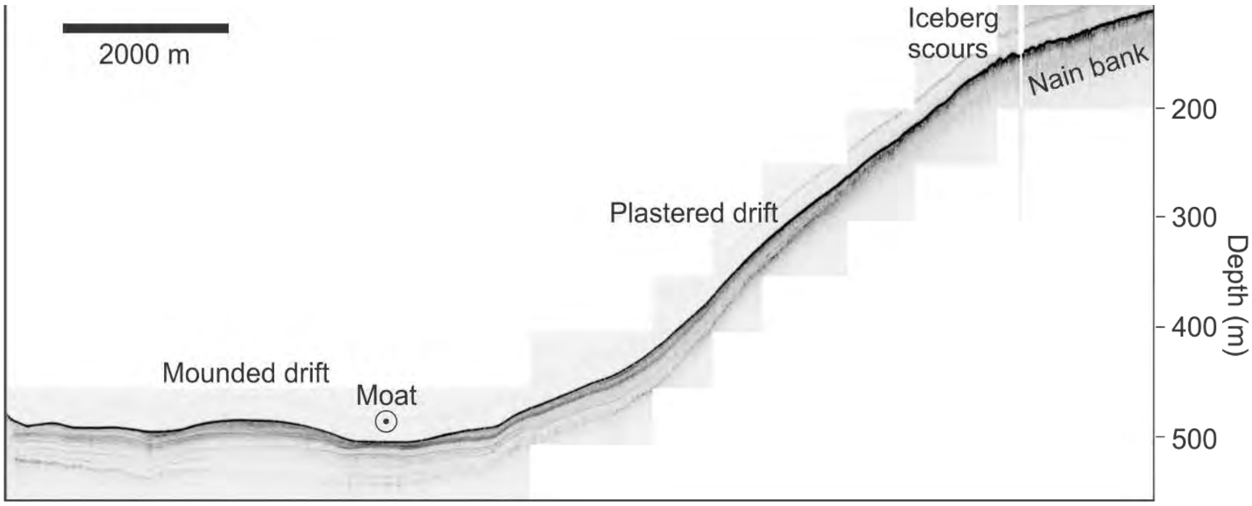


Figure 35-2: Example of a sub-bottom profile collect in Nain. A sediment core was collected on the mounded drift (Nai-8.5b)

35.2.3 *Coring – Leg 2*

A total of 32 cores (8 PC, 8 GGC, 3 GC and 13 BC) were collected during leg 2 (Figure 35-3). The piston core and giant gravity core both use the 9m-long string with the 2000 lbs core head. The piston core uses a trigger weight core to release the piston core whereas the giant gravity core uses a butterfly valve and is deployed without a trigger weight corer.

All core barrels were kept in sequence, from the bottom to the top, as the barrels were taken apart. Once the piston cores and gravity cores were recovered and on deck, the core tubes were cut down into 1.5 m sections. End caps were placed on each end of the core tubes and taped and then brought into the lab for further analysis. If present, material recovered in the cutter/catcher at the base of the piston and gravity cores was placed into a separate core tube. In the lab, the top and base of some of the 1.5 m sections were subsampled for constant volume measurements and shear strength measurements. These subsamples were taken only from undisturbed sediment and were not taken if the material was too soupy or consisted of sand as the measurements would not be valid in these materials. Constant volume sampling consisted of taking a subsample of a known volume of sediment using a pre-measured cylinder and placing the sub-sample in a sealed bottle to be further analysed for bulk density in the core lab at the Geological Survey of Canada-Atlantic (GSC-A). This measurement will be used to calibrate the bulk density measurements taken at the GSC-A. Shear strength measurements were taken using a torvane which was inserted into the sediment and turned at a constant rate until the sediment failed. This measurement will be used to later calibrate shear strength measurements taken in the core lab at the GSC-A. The core tubes were then covered with end caps, taped, measured, and sealed with wax. They were then placed upright in refrigerated storage.

Figure 35-3: Deployment of the piston core

Box cores were collected along each station. From the box cores, push cores were taken at 13 of the sites for the ASM project (Figure 35-4). Push cores were sampled from box cores using a small tube attached to a vacuum pump. The core tube was inserted and pushed into the box core material while the vacuum pump was on to prevent compression or suck-up of the sediment. The outer excess material was then removed and the core was capped with end caps, taped, measured, sealed with wax and put in the fridge upright.

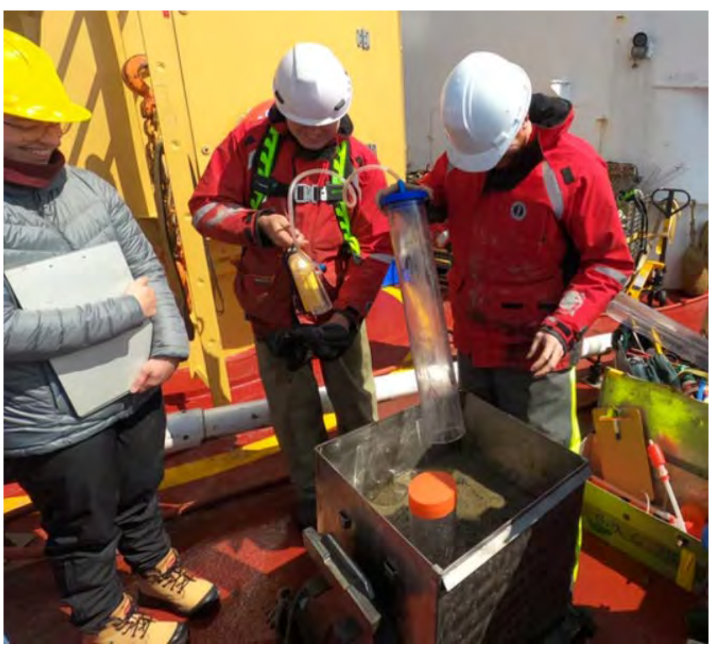


Figure 35-4: Example of a box core with push cores.

35.2.4 *Coring – Leg 3 and 4*

Box corer

The box corer (BC) collects up to 0.125 m3 of soft sediments at the seafloor and is suitable for any water depths (limited by winch cable length). It is used for minimum disturbance of the sediment/water interface. The BC was lowered at an average speed of 60 m/min (1 m/s). When the sampler was approximately at 100 m above the seabed, wire payout was slowed to approximately 20-25 m/min (0.33 to 0.42 m/s). On contact with the seafloor, a little extra wire was given to allow box penetration, and the winch was stopped. A few seconds thereafter, the corer was uplifted back at a slow rate, at approximately 10 m/min (0.17 m/s). It is at this time that the spade is levered into the mud and the apparatus is pulled out. Next, the wire speed was increased to 60 m/min (1 m/s). During the expedition, the box corer was deployed 18 times as part of the DFO KEBBAB program, 2 time as part of the Quaqtaq project and 5 times as part of the our ArcticNet program (Table 35-5). When the sediment volume was sufficient (which was the case for most deployments), two push cores (PVC tubes of 10 cm diameter and ~60 cm length) were taken from each box core using a vacuum pump to reduce compaction (Figure 35-4). The sediment/water interface from each box-core location was subsampled into one whirl-pak bags for subsequent grain size, mineralogical, geochemical, and magnetic analyses. Each push core samples and one whirl-pak bag (JCMS) were stored in a refrigerated container (4°C).

Gravity corer

The gravity core (GC; Figure 35-5) has a maximum recovery length of ~2.80 m (in a 3.05 m aluminum barrel) using a stainless-steel cutting head and penetrating the sediment under a 136 kg weight. A core catcher keeps the sediment in the corer when the latter is pulled upward. Winch speeds (lowering) ranged from 60 to 80 m/min (1-1.33 m/s) depending on estimated substrate properties. During the expedition, the GC was deployed once (Table 35-5).

Figure 35-5: Left: Gravity corer on the fore-deck of the CCGS *Amundsen* awaiting connection and deployment. Right: recovery of cores sections of gravity corer.

Giant gravity corer

The giant gravity corer (GGC) operates with a core head of 817 kg with two or three 3.05 m steel core barrels (91 kg each) connected with steel coupling sleeves attached with set screws, and a steel cutting head (Figure 35-5). A core catcher helps keep the sediment in the corer when the latter is pulled upward. A valve (rubber butterfly flaps) of 3.5 inches long was installed at the top end of the first 3m liner to allow a water flow through the liners during the descent and blocks water during the ascension. This valve prevents the water from flushing out the collected sample. This coring instrument allows the collection of long cores of up to a maximum length of 9 m. The GCC was lowered with an average speed of 60 m/min (1 m/s). The corer was lowered at about 80 m, stopped above the seafloor for 1 min and then lowered at a speed of 25-30 m/min (0.4-0.5 m/s) depending on sediment substrate properties determined previously through box coring. After a tension drop at the point of penetration about 10 m of cable slack was given to ensure that the weight allowed full penetration of the corer into the sediment. After penetration into the sediment, the corer was heaved at a speed of 10 m/min (0.17 m/s) until it was free from the sediment. Then the corer was heaved at a speed of 60 m/min (1 m/s) until near the sea surface. Once on deck, the plastic liner was cut into 1.5 m long sections and these sections were stored vertically in a refrigerated container (4°C) on the CCGS *Amundsen*. The 9m GGC was deployed one time during the expedition (Table 35-5).

Note that BC collected in conjunction with a PC and GGC allow recovery of the undisturbed sediment-water interface, which is usually perturbed when the PC and GGC enters the sediments. Ideally, push cores from box-cores can be correlated visually, chronostratigraphically, or geochemically with piston, trigger, and gravity cores from the same site.

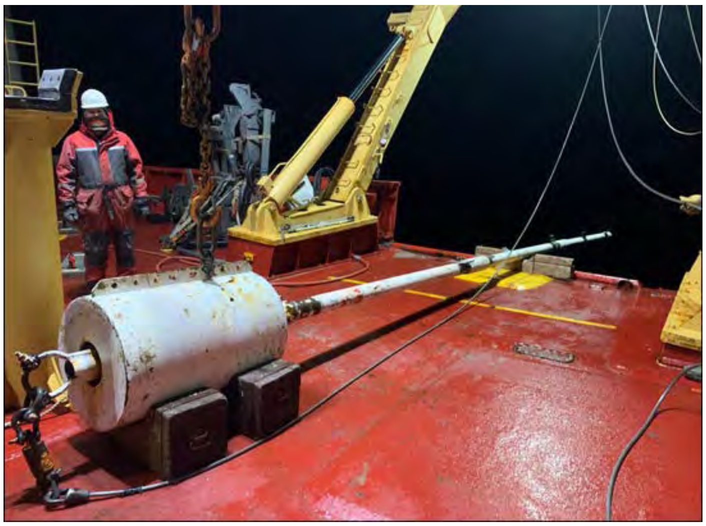


Figure 35-6: Giant gravity corer (9 m) on the fore-deck of the CCGS *Amundsen* awaiting deployment (@ M.-E. Rodriguez-Cuicas).

Core identification and labelling

The sediment core samples were labelled using the following numbering system:

AMD2104-01BC

AMD = Amundsen

21 = Year 2021

04 = Leg # 4

01 = core number (sequential series; i.e. 1, 2, 3,…., x)

BC = Corer type (e.g., PC= piston core, BC = box core, GC= gravity core, GGC = giant gravity core)

AB = Core section if applicable

The 1.5 m subsections of the PC, TWC, GC and GGC were labelled as per Figure 35-7 with A being the base and section AB being the lowest section, followed by BC, CD etc. sequentially. Where multiple push cores were taken from a box core, they were labelled by the addition of a sequential alphabetical identifier, e.g. 03BC-A, 03BC-B, 03BC-C, etc.

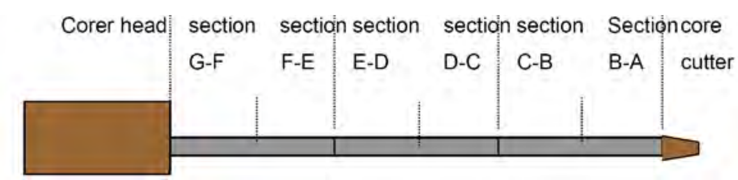


Figure 35-7: Labelling system for sections of piston and gravity cores.

Core samples will be retained in refrigerated storage on the CCGS *Amundsen* during Leg 4 to be removed on demobilization during early November in Québec City. Cores will then be shipped, and stored, and analyzed in detail at ISMER-UQAR.

MSCL analysis

In order to visualize the sedimentary framework (variation of facies and sedimentary structures) all whole sediment cores were run through a GEOTEK Multi-Sensor Core Logger (MSCL) that was calibrated according to established protocols. The MSCL provided downcore measurements (0.5 cm sampling interval) of bulk density (using gamma-ray attenuation) and magnetic susceptibility. All cores which were extracted from the seafloor during Leg 4 were run through the MSCL that was installed onboard in the PaleoGeoLab (Figure 35-8).

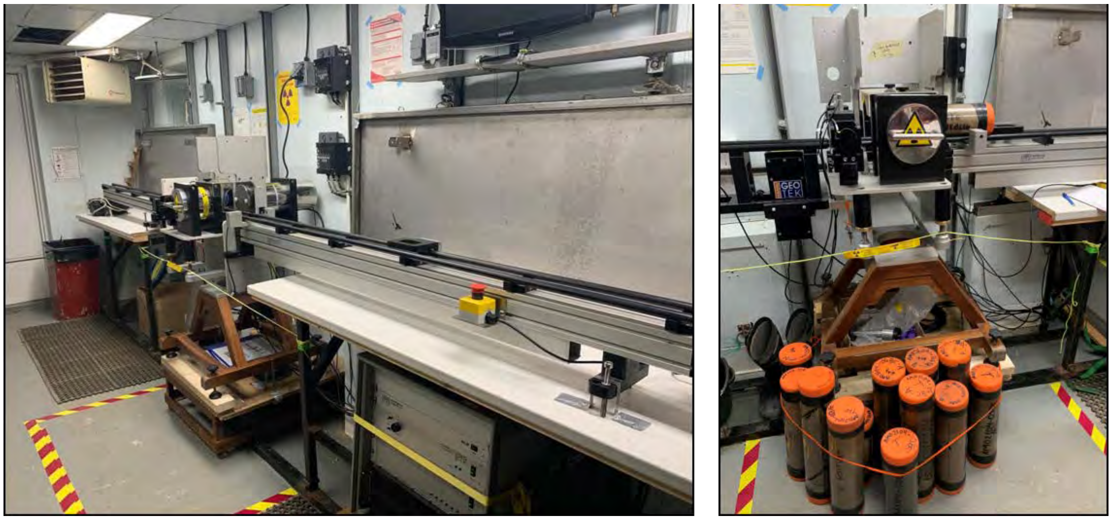


Figure 35-8: Installation of the MSCL on board of the CCGS *Amundsen* and core analysis process (@ M.-E. Rodriguez-Cuicas).

35.2.5 *Drop camera*

The video data from stations ID7, ID3 (CSF4.5), ID6, ID8, ID5, and ID9 were collected from the ship's zodiac vessel using the Deep Trekker DTPod Underwater Camera (Figure 35-9). This underwater camera allows for live video feed. It includes 300 meters of cable and a manually (hand) operated winch. The camera was deployed and recovered with the cable on a pulley device encased in metal (a.k.a. snatch block) attached to a pole from the zodiac which is a temporary installation and can be removed after operation is complete. After hanging the cable from the pulley system the camera operator would lower and retrieve the camera by hand maintaining a distance of approximately 1 ft. from the seabed.

Overall it was productive to deploy the Deep Trekker DTPod Underwater Camera using the zodiac as it allowed for more locations to be observed based on the fact that drop camera activities using the SubC deep-water 4K camera and a Sony 4K camera could be executed from the ship simultaneously. In addition to this, the weight of the Deep Trekker DTPod Underwater Camera (10kg) and the fact that the winch is operated by hand would suggest that deploying from the ship would not be feasible unless attached to another camera system. Issues encountered include spinning of the camera while recording. This was a challenge when having to review the footage and determine whether new ground was being covered. Future work could look at potential solutions for avoiding spinning of the cable. A potential solution could be to install a fin on the camera pod system.

The balance of the stations at Southwind Fjord, ID0 (CSF4.2), ID1 (CSF4.3), ID2 (CSF4.4), used a deep-sea camera system, which is comprised of two cameras – a SubC deep-water 4K camera and a Sony 4K camera as well as dual lights. The camera and lighting system is held in a box core frame and was deployed from the Amundsen ship using the crane located on the floor deck. For full details of the camera system please refer to the "Drop Camera" section of the report.

Figure 35-9: Example of imagery collected with the Deep Trekker DTPod Underwater Camera

In Pangnirtung drop camera operations from the zodiac using the Deep Trekker DTPod Underwater Camera were unsuccessful due to rough sea state. As a result, the video data at Pangnirtung was collected using the deep-sea camera system that is comprised of two cameras as described above.

In this scenario, given the sea state, the barge could have been a more suitable alternative in order to be able to use the Deep Trekker DTPod Underwater Camera.

35.2.6 *Phytoplankton Net*

The phytoplankton net is conical with a 30cm diameter, 75cm length, and 20µm mesh net (Figure 35-10). A vertical tow is conducted from ~ 5m above the seafloor to the surface at stations where water depth is less than 100 m. 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 can be attached to the shackle at the base of the net to facilitate sinking, but do not use excessive weight. Once the net is back onboard, the sides are rinsed with filtered local seawater to ensure all phytoplankton is collected in the godend at the base of the net. The godend is then unscrewed and the content is transferred to the sample bottle. Approximately 10 ml of formaldehyde was added to the sample with a transfer pipette, the bottle was filled up to the neck with filtered local seawater and sealed with black electrical tape. The bottles were then stored in its original box.

Figure 35-10: Phytoplankton net

35.2.7 *Mooring*

A mooring was collected in Southwind Fjord Baffin Island which had been recording physical properties of the water column for the past 2 years. The mooring consisted of a 20m-long line with a 500 kHz ADCP looking downward. Along the line, other sensors recorded temperature and conductivity. The mooring was first observed with the mulitbeam watercolum imagery (Figure 35-11). Once identified, the mooring was released and recovered on the foredeck.

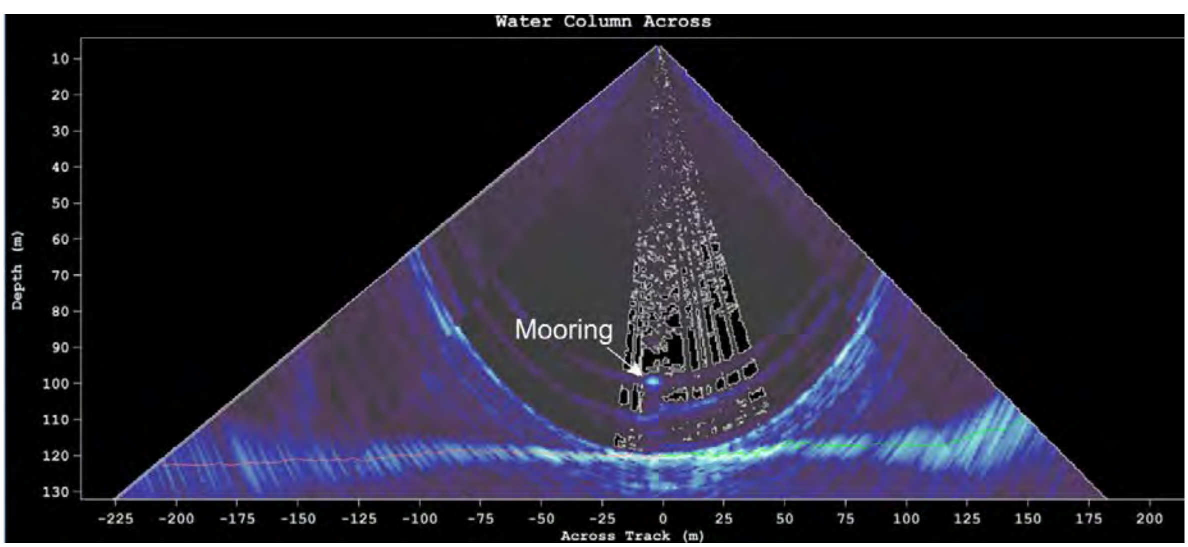


Figure 35-11: Mooring visible on the mulitbeam water column imagery.

35.2.8 *ROV Comanche*

Two ROV stations were dedicated to the ArcticNet ASM project: dive 22 and 27. Both aimed at characterizing marine geohazards. The first one, dive 22, aimed at a submarine landslide triggered by an iceberg colliding with the seafloor (Normandeau et al., 2021). The goal was to image characteristics of the headscarp at the iceberg pit/headscarp transition. Due to poor visibility, structure-for-motion could not be accomplished. Nonetheless, imagery showed high-resolution images of the seafloor associated with a landslide (Figure 35-12).

The second dive was on a turbidity current system offshore Scott Inlet. The goal of the dive was to image bedforms on the seafloor and the head of submarine channels to investigate whether the presence of a seep might be responsible for the presence of this system. For ROV specifications, the reader is referred to the ROV section of this cruise report.

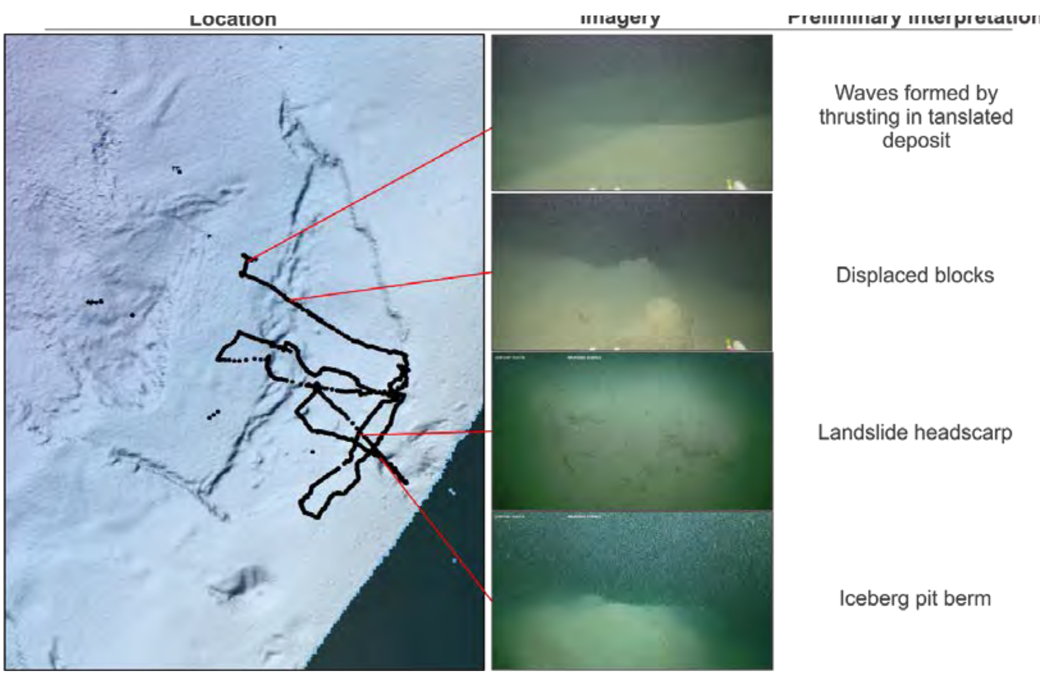


Figure 35-12: ROV imagery collected on the Southwind Fjord 2018 landslide

35.2.9 *Stations*

Details of the cores, surface sediment samples, phytoplankton nets and drop-camera that were collected during leg 2 are listed below. Data and samples are archived at the Geological Survey of Canada (Atlantic) (Table 35-1), the Marine Institute (Table 35-2), University of New Brunswick (Table 35-3) and Rimouski (Table 35-4). Maps of the different stations are presented in Figure 35-13 and Figure 35-14.

Table 35-1: Sediment coring, mooring and ROV dive stations for Leg 2 archived at the Geological Survey of Canada

GSC No.	Sample Type	Amundsen Science ID	Day / Time (UTC)	Latitude	Longitude	Location	Depth (m)	Core length (cm)
001	GGC	Makkovik	201/20:21:18	55.5447	-58.88081	Makkovik	779	578
002	BC	Nai-8.5a	203/09:24:36	56.59853	-60.81166	Nain - inner	130	A:21 / B:25

GSC No.	Sample Type	Amundsen Science ID	Day / Time (UTC)	Latitude	Longitude	Location	Depth (m)	Core length (cm)
003	PC	Nai-8.5a	203/10:37:24	56.59853	-60.81166	Nain - inner	133.5	488
004	BC	Nai-8.5b	203/14:44:21	56.69322	-60.28469	Nain - outer	473	A:38 / B:39.5
005	PC	Nai-8.5b	203/15:55:41	56.69294	-60.2851	Nain - outer	473	542.5
006	BC	Hatton Sill	208/ 07:43:41	61.4421	-60.56568	Hatton Sill	895	A: 38 / B:27 / C:28.5 / D:38.5 / E:28.5 / F:32
007	GGC	Hatton Sill	208/19:06:20	61.439	-60.57431	Hatton Sill	972	120
008	BC	Hatton Sill	208/20:11:29	61.44488	-60.56928	Hatton Sill	924	A:32.5 / B:34
009	GGC	Hatton Sill	208/21:24:04	61.44488	-60.57025	Hatton Sill	860	196
010	BC	Davis Strait	209/22:19:23	63.4016	-58.53774	Davis Strait	1080	A:34.5 / B:32.5 / C:35.5 / D:34.5
011	GC	Davis Strait	210/08:31:36	63.34838	-58.25756	Davis Strait	1280	120
012	GGC	Davis Strait	210/22:22:11	63.34666	-58.20126	Davis Strait	1296	217
013	GC	Davis Strait	210/23:42:00	63.3471	-58.20335	Davis Strait	1297	0
014	Mooring	SF-3.1	212/11:29	66.761698	-62.339844	Southwind Fjord	120	NA
015	ROV	SF-ROV / Dive C0022	212/13:38	66.76088	-62.337	Southwind Fjord	50	NA
016	BC	SF-6.2a	212/17:08	66.75127	-62.31235	Southwind Fjord	38	NA
017	BC	SF-6.2b	212/17:26	66.75258	-62.31158	Southwind Fjord	38	NA
018	CTD	SF-3.1	212/18:43	66.76079	-62.33408	Southwind Fjord	120	NA
019	PC	SF-6.1	212/23:22:54	67.02569	-62.58044	Padloping Through	805	659.5
020	BC	Disko Fan	214/02:20:39	67.88232	-59.38227	Disko Fan	950	38.5
021	PC	Disko Fan	214/22:56:23	67.96824	-59.48985	Disko Fan	868	44
022	GC	Disko Fan	215/00:02:39	67.9693	-59.49456	Disko Fan	878	45
023	PC	Scott Inlet-Deep	217/22:25:30	71.39629	-70.31316	Scott Inlet	700	253
024	BC	Scott Inlet-Deep	217/23:34:09	71.39612	-70.31252	Scott Inlet	700	A: 41 / B:41 / C:37.5 / D:36 / E:38.5
025	PC	Scott Inlet-Deep	218/00:51:00	71.3962	-70.31283	Scott Inlet	700	194
026	ROV	Scott Inlet ROV 4	218/17:57:01	71.33912	-70.26052	Scott Inlet	400-200	A:15 / B: 20 / C: 13

GSC No.	Sample Type	Amundsen Science ID	Day / Time (UTC)	Latitude	Longitude	Location	Depth (m)	Core length (cm)
027	PC	Scott Inlet Piston Core 3	218/22:00:02	71.39766	-70.31566	Scott Inlet	697.95	0
028	BC	Scott Inlet Box Core 2	219/01:07:42	71.33953	-70.25831	Scott Inlet	377.48	A:19 / B:19 / C:18 / D:17
029	GGC	Gib-3.1	219/14:26:00	70.64923	-72.47546	Gibbs Fjord	302	448.5
030	GGC	Gib-3.2	219/17:31:04	70.804	-72.20167	Gibbs Fjord	261	181
031	GGC	Cla-3.1	219/19:23:39	70.88742	-72.28746	Clark Fjord	267	89.5
032	BC	Cla-3.2	219/20:38:42	70.92842	-72.30155	Clark Fjord	207	A:10.5 / B:12
033	BC	Cla-3.1	219/21:17:46	70.88492	-72.29695	Clark Fjord	260	A:30.5 / B:30.5
034	GGC	Pangnirtung Piston Core	222/14:00:30	66.16406	-65.72013	Pangnirtung Fjord	150	277

Table 35-2: Drop camera stations for Leg 2. Data archived at the Marine Institute of Memorial University

SOUTHWIND FJORD						
Station ID	Approx. Depth (m)	Date MM/DD/YY	Time (UTC)	Transect Coordinates LATITUDE LONGITUDE (Degrees Decimal Minutes) (Decimal Degrees)	Video File Ref #	Duration (MM:SS)
ID7	147	07/31/2021	13:59	66 53.718 N 62 30.086 W (start) 66 53.629 N 62 30.007 W 66 53.587 N 62 29.998 W 66 53.586 N 62 29.997 W 66 53.541 N 62 29.978 W 66 53.484 N 62 29.957 W (end)	14-04-54 14-34-54	29:59 10:10
ID3 (CSF4.5)	171	07/31/2021	14:59	66 52.090 N 62 28.226 W (start) 66 52.039 N 62 28.140 W 66 51.999 N 62 28.123 W 66 51.965 N 62 28.108 W 66 51.944 N 62 28.097 W 66 51.922 N 62 28.089 W 66 51.898 N 62 28.067 W 66 51.876 N 62 28.019 W 66 51.865 N 62 28.002 W 66 51.829 N 62 27.966 W 66 51.820 N 62 27.956 W (end)	15-09-44 15-39-45	30:00 11:13
ID6	258	07/31/2021	16:27	66 51.102 N 62 28.158 W (start) 66 51.074 N 62 28.071 W 66 51.066 N 62 28.074 W 66 51.049 N 62 28.064 W 68 51.028 N 62 28.064 W 66 51.024 N 62 28.065 W 66 50.970 N 62 28.064 W 66 50.915 N 62 28.062 W 66 50.872 N 62 28.065 W 66 50.871 N 62 28.065 W 66 50.829 N 62 28.066 W 66 50.800 N 62 28.065 W 66 50.798 N 62 28.066 W (end)	16-40-05 17-10-05 17-20-30	29:59 10:23 00:07
ID8	150	07/31/2021	18:02	66 48.957 N 62 22.670 W (start) 66 48.855 N 62 22.630 W 66 48.840 N 62 22.583 W 66 48.801 N 62 22.539 W 66 48.769 N 62 22.492 W 66 48.746 N 62 22.481 W 66 48.720 N 62 22.458 W (end)	18-17-13	22:14
ID5	114	07/31/2021	18:48	66 47.590 N 62 23.366 W (start) 66 47.460 N 62 23.500 W 66 47.418 N 62 23.530 W 66 47.361 N 62 23.579 W 66 47.359 N 62 23.580 W 66 47.326 N 62 23.615 W 66 47.291 N 62 23.668 W 66 46.814 N 62 21.386 W (end)	18-59-58 19-20-37	20:37 00:09
ID9	164	07/31/2021	19:23	66 46.866 N 62 21.362 W (start) 66 46.775 N 62 21.368 W 66 46.753 N 62 21.367 W 66 46.719 N 62 21.358 W 66 46.702 N 62 21.357 W (end)	19-35-53	21:10

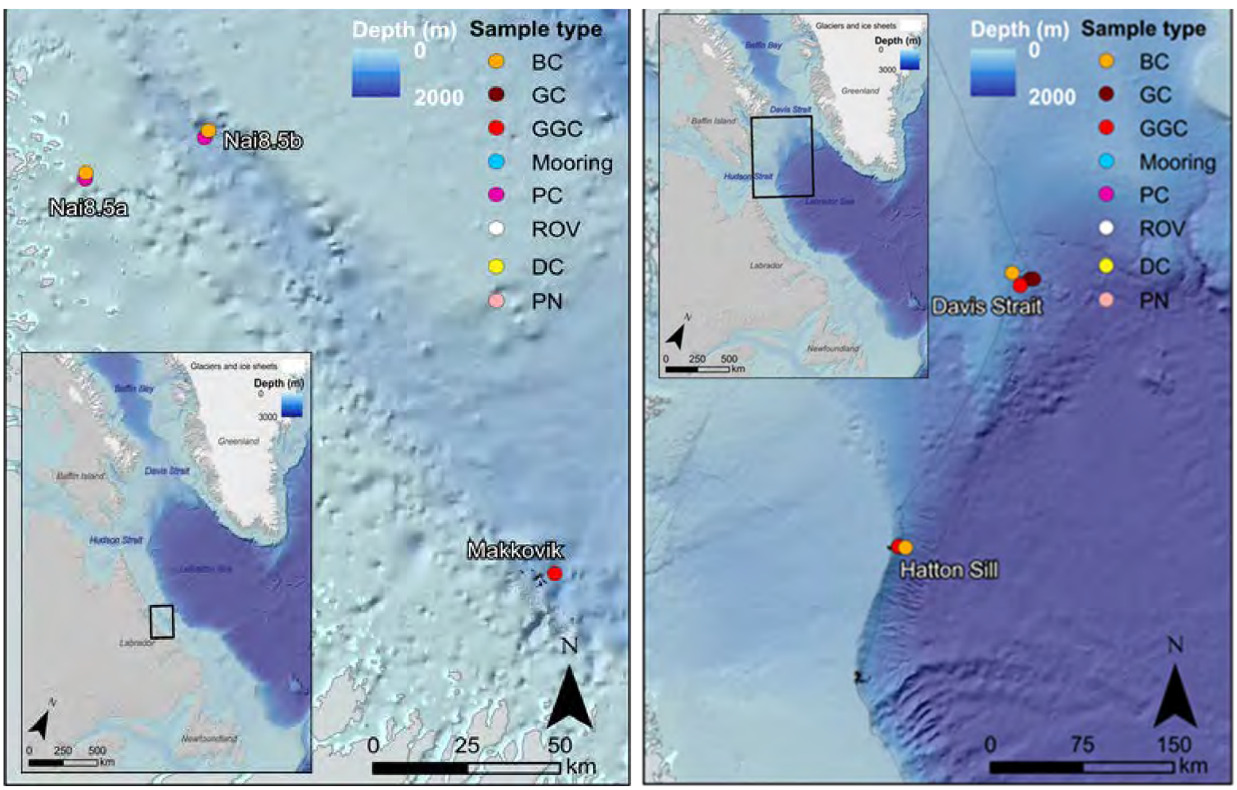
ID0 (CSF4.2)	365	08/01/2021	N/A	66.9912348 -62.5551383 66.9912353 -62.5545180 66.9897045 -62.5475878	29 & 30	~ 00:30
ID1 (CSF4.3)	287	08/01/2021	N/A	66.9563245 -62.4969320 66.9563195 -62.4967943 66.9546852 -62.4985827	21 & 22	~ 00:30
ID2 (CSF4.4)	345	08/01/2021	N/A	66.9233143 -62.4647698 66.9231512 -62.4648960 66.9216342 -62.4637670	27 & 28	~ 00:30
PANGNIRTUNG						
Station ID	Approx. Depth (m)	Date MM/DD/YY	Time (UTC)	Transect Coordinates LATITUDE LONGITUDE (Decimal Degrees)	Video File Ref #	Duration (MM:SS)
ID0	31	08/10/2021	17:47	66.1143428 -65.8671253 66.1145723 -65.8669267 66.1183917 -65.8607063	47 & 48	~ 00:30
ID1	102	08/10/2021	15:46	66.1378727 -65.8166835 66.1381298 -65.8162367 66.1381437 -65.8161928 66.1418718 -65.8087430	310 & 311	~ 00:30
ID2	71	08/10/2021	14:54	66.1355087 -65.7750063 66.1362587 -65.7725587 66.1383188 -65.7650477	309 & 310	~ 00:30
ID4	124	08/10/2021	20:21	66.1094720 -65.9208145 66.1098330 -65.9192877 66.1129107 -65.9112328	49 & 50	~ 00:30
ID6	85	08/10/2021	18:44	66.1188108 -65.9094730 66.1188858 -65.9093023 66.1220140 -65.9016405	364 & 365	~ 00:30
ID7	27	08/10/2021	19:45	66.0905415 -65.9765793 66.0906137 -65.9759653 66.0924232 -65.9725003	365 & 366	~ 00:30
ID8	77	08/10/2021	16:46	66.1236553 -65.8661422 66.1238380 -65.8657532 66.1252075 -65.8581680	45 & 46	~ 00:30
ID9	120	08/10/2021	12:50	66.1530110 -65.7532407 66.1533807 -65.7518522 66.1573767 -65.7416638		~ 00:30
ID10	144	08/10/2021	11:07	66.1636548 -65.7226133 66.1637512 -65.7214968 66.1665097 -65.7113687		~ 00:30
ID11	80	08/10/2021	08:39	66.1745370 -65.7219862 66.1746493 -65.7219432 66.1766245 -65.7121440		~ 00:30
ID12	91	08/10/2021	06:39	66.1870720 -65.6788312 66.1870108 -65.6785693 66.1824775 -65.6847095		~ 00:30
ID13	80	08/10/2021	09:30	66.1638307 -65.6974798 66.1640430 -65.6971778 66.1663200 -65.6901518		~ 00:30
ID14	106	08/10/2021	07:40	66.1751023 -65.6657540 66.1751352 -65.6654888 66.1795563 -65.6602602		~ 00:30

Table 35-3: Sediment samples for Leg 2. Samples archived at University of New Brunswick

Time (UTC)	Station ID	Type	Latitude	Longitude	Depth (m)
2021/08/09 21:07:23	Cum-8.2	Piston core	64.9734107	-64.8467843	797.91 m
2021/08/09 22:15:30	Cum-8.2	Surface sediment & 2 push cores	64.9733522	-64.8467463	798.25
2021/08/07 21:17:46	Cla-3.1 BC	Surface sediment	70.8849162	-72.2969520	260.79
2021/08/07 01:07:42	Scott Inlet BC2 2	Surface sediment	71.3395323	-70.2583063	377.48
2021/08/05 23:34:09	Scott Inlet Deep BC	Surface sediment	71.3961172	-70.3125178	699.05
2021/08/02 03:11:43	Disko Fan BC 2	Surface sediment	67.8814868	-59.3869860	962.06
2021/08/02 02:20:39	Disko Fan BC	Surface sediment	67.8823220	-59.3822658	950.17
2021/07/31 17:26:48	SF-6.2b BC	Surface sediment	66.7525707	-62.3114907	38
2021/07/31 17:08:33	SF-6.2a BC	Surface sediment	66.7512722	-62.3123452	38
2021/07/29 00:46:12	Davis Strait BC 3	Surface sediment	63.4013148	-58.5350900	1083.77
2021/07/28 23:35:19	Davis Strait BC 2	Surface sediment	63.4017390	-58.5347097	1085.28
2021/07/27 20:11:29	Hatton Sill BC 3	Surface sediment	61.4448762	-60.5692765	923.91
2021/07/27 10:39:37	Hatton Sill BC 2	Surface sediment	61.4331100	-60.7272343	546.19
2021/07/27 07:43:41	Hatton Sill BC	Surface sediment	61.4461515	-60.5768608	900
2021/07/23 13:22:50	Kelp 2021 BC	Surface sediment	58.7005587	-62.5303540	149.67
2021/07/22 14:44:21	NAI-8.5B BC	Surface sediment	56.6932163	-60.2846948	473.14
2021/07/22 09:24:36	NAI-8.5A BC	Surface sediment	56.5985642	-60.8115817	129.99
2021/07/20 06:59:57	Makkovik BC	Surface sediment	55.5401402	-58.9506460	759.29
2021/07/19 01:04:18	652 BC	Surface sediment	55.6554813	-55.5536193	2442.65
2021/07/18 12:19:47	644 BC 2	Surface sediment	54.8208152	-53.2250925	951
2021/07/18 11:16:10	644 BC	Surface sediment	54.8197778	-53.2237060	947

Table 35-4: Phytoplankton net stations for Leg 2. Samples archived at Université du Québec à Rimouski

Time (UTC)	Station ID	Latitude	Longitude	Depth (m)
2021/07/28 19:57:35	Davis Strait	63.3576500	-58.2701945	1273.43
2021/07/26 22:33:51	Hatton Sill	61.4410160	-60.6697350	598
2021/07/24 23:20:18	SaglekBank	60.5262807	-61.2571840	550.58
2021/07/20 00:23:26	Makkovik	55.5357617	-58.9519118	765.61
2021/07/18 20:55:39	652	55.6502035	-55.5416823	2441.62
2021/07/18 08:24:05	644	54.8153600	-53.2198057	924.44



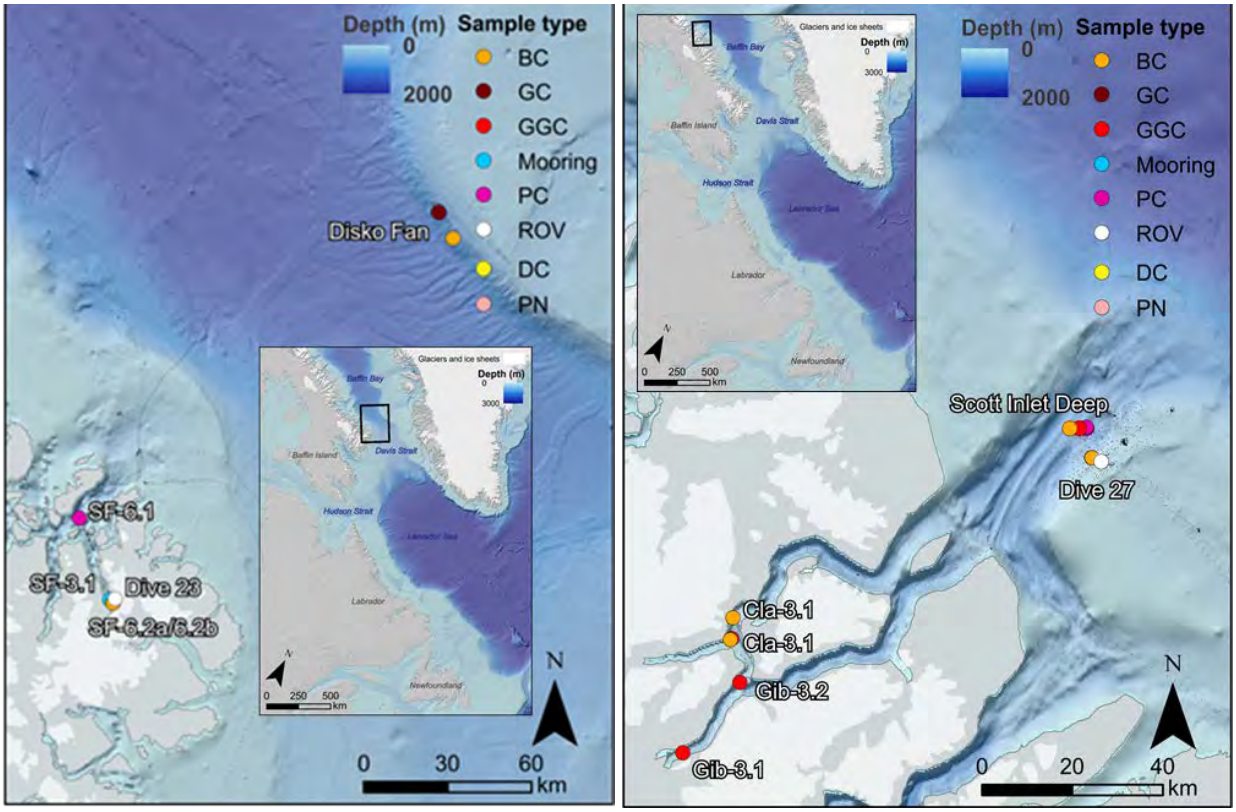


Figure 35-13 Map of stations in the area of Makkovik, Hatton Sill& Davis Strait, Southwind Fjord & Disko Fan and Scott Inlet.

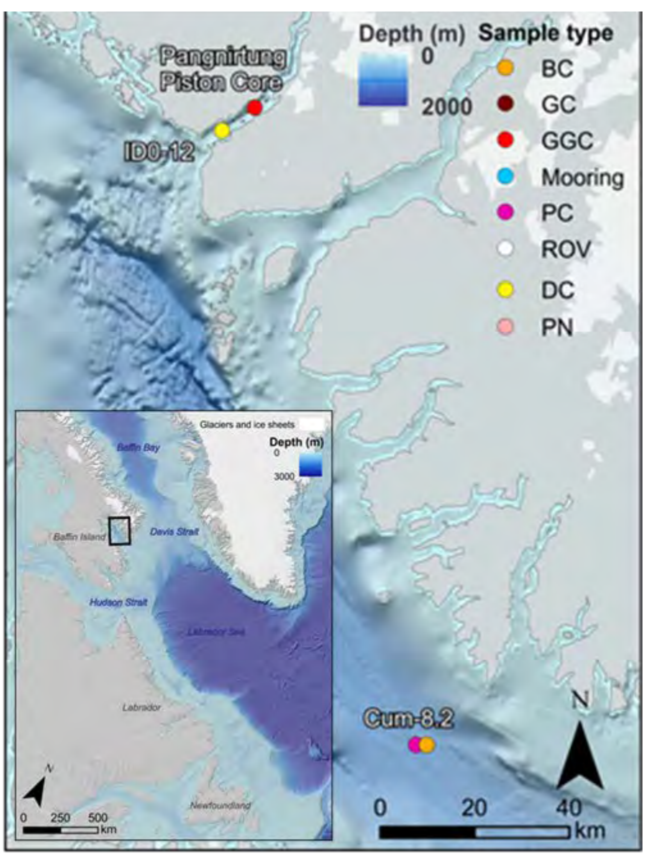


Figure 35-14. Stations in the Cumberland Sound area

Figure 35-15: Map of the stations sampled during Leg 4. Yellow dots are sites with box coring operations, green dot is gravity core sampling, red dot is giant gravity core sampling while blue dots are rivers that were sampled through the CAA river project.

Table 35-5: Summary of core stations during Leg 4. BC = Box Core (including sequentially lettered push cores from the box core); GC = Gravity Core; GCC = Giant Gravity Core; PC = Piston Core; TWC = Trigger Weight Core; Surface = surface samples from the box core or van veen grab

Station number	AMD21 03 - ID	Date (y/m/d)	Location	Time (24h, local)	Latitude (°N)	Longitude (°W)	Water depth (m)	Length (cm)	Comments	Surface sample
310E	01BC	12/09/21	Northwest Passage	05:20	71.29163	-97.70281	129	A=27 B=25 C=25		x
312	02BC	12/09/21	Northwest Passage	21:56	69.17017	-100.70233	67	A=36		x
QMG5-Y4	03BC	13/09/21	Northwest Passage	18:09	68.48478	-103.43078	69	A=39		
314	04BC	14/09/21	Northwest Passage	22 :02	68.97109	-105.47591	77	A=44		
316	05BC	15/09/21	Northwest Passage	20:04	68.38928	-112.12004	172	A=37.5 B=37		
403	06BC	16/09/21	Amundsen Gulf	23:56	70.09979	-120.11199	411	A=43 B=44		x

Station number	AMD2103 - ID	Date (y/m/d)	Location	Time (24h, local)	Latitude (°N)	Longitude (°W)	Water depth (m)	Length (cm)	Comments	Surface sample
405-C015	07BC	16/09/21	Amundsen Gulf	10:55	70.66402	-122.6325	574	A=43 B=43.5		x
407	08BC	18/09/21	Amundsen Gulf	04:52	71.00178	-126.0777	496	A=45		x
414	09BC	18/09/21	Beaufort Sea	04:16	71.42176	-127.3662	306	A=40		
420	10BC	18/09/21	Beaufort Sea	14:36	71.05037	-128.5099	42	A=32		
434	11BC	22/09/21	Beaufort Sea	20:45	70.17921	-133.5542	46	A=44 B=43.5 C=45		x
434	01GC	22/09/21	Beaufort Sea	21:07	70.17959	-133.5540	46	AB=149.5 BC=66	Total = 215.5 cm	
435	12BC	23/09/21	Beaufort Sea	15:19	71.07827	-133.7765	303	A=43		
482	13BC	27/09/21	Beaufort Sea	01:13	70.52437	-139.3798	825	A=44		
518	01GGC	03/10/21	McClure Strait	07:19	74.67983	-121.4524	524	Ao-Bo=29 A-B=149.5 B-C=146 C-D=20	Total = 344 cm	
518	14BC	03/10/21	McClure Strait	08:45	74.68118	-121.4490	526	A=39 B=39		x
516	15BC	03/10/21	McClure Strait	10:59	74.84506	-121.3895	492	A=36cm		

35.3 Preliminary Results

Many sediment cores were recovered from submarine landslides and turbidity current systems on the continental slope, the shelf and the fjords of Baffin Island and Labrador. Submarine landslides and turbidity currents are usually formed by river floods and earthquakes. One system in Scott Inlet is peculiar as it is located offshore, far from a modern source of sediment. The ROV dive and a box core collected on the system suggest it might have been active relatively recently (Figure 35-12). Therefore, other mechanisms might be at play in triggering turbidity currents. Following the cruise, we will investigate whether the nearby seep and icebergs might be responsible for the presence of this system in Scott Inlet.

Sixteen stations were sampled during Leg 4 as part of this project. At 15 stations, we were able to retrieve sediment from the seafloor. At one station (station 514), we failed to retrieve a BC because cold weather which most likely froze the trigger mechanism from the BC. The various projects simultaneously running on Leg4 were highly integrated. In particular, the ArcticNet Seafloor mapping and marine geology project and the Permafrost Carbon on the Beaufort Shelf (PECABEAU) project had similar stations and were integrated in time on the ship. The coring operations were often shared. A total of 28 samples were retrieved:

- 15 box cores,
- 1 gravity cores,
- 1 giant gravity core
- 3 river samples

The mission was successful with the collection of sediment (BC, GC, GGC). All of these samples and data expand sediment core and mapping coverage through the western Canadian Arctic. Sediment from the Beaufort Sea and Amundsen Gulf were typically very clay-rich with dropstones in a few locations. As we transited to the western Arctic, the sediment composition reflected the increasing influence of the McKenzie delta and the high sediment and organic matter load. MSCL measurements confirmed this observational interpretation.

All of sediment samples collected during Leg 3 and 4 will be analyzed in detail in the laboratory at ISMER-UQAR to achieve the objectives of our project. Briefly, sediment samples will be studied for their mineralogical, geochemical (elemental and isotopic), microfossil (benthic and planktonic foraminifera), palynological (dinoflagellate cysts), magnetic, and siliciclastic grain-size signatures. Such studies will to provide foundational information to improving our understanding on the past and present seafloor sediment composition

From an HQP-training perspective, the expedition was a unique opportunity for Maria-Emilia Rodriguez-Cuicas (ISMER-UQAR), In addition, as part of this project Maxime Dubeau and Rachelle Robitaille from Environment and Climate Change Canada received hands-on training on ship-based coring operations.

35.4 Recommendations

Below are recommendations for future operations.

1) There should be no paint on the barrels where the couplings and cutter attach as they should be able to easily slide the couplings up and down the barrels to see where the barrels meet. There are times that we cannot extract the liner from the barrels so we then have to remove the couplings in order to separate the barrels.
2) The platforms for the bottle jacks have 2” wood material underneath them for elevation and support. We would recommend that there is a double 2” by 6” material under the platforms for more stability and higher elevation. It would be better if we can elevate the core string higher to make it more level when extracting the liner.
3) The bottle jacks are too small. Every year they get broken from the heavy weight of the core string. We would recommend more heavy duty bottle jacks, this would also

mean a bigger bottle jack which would also help with the elevation of the core string. The bottom plate which is attached to the bottle jacks should be fastened with better quality screws. Two of these aluminum plates broke off during this leg of the operations. Also for the bottle jacks it would be a great help if some cans of Rust Check were onboard board to keep them lubricated and protected from the salt water.

4) The lifting straps for the core head and assembled core string are getting old. New, certified lifting straps would be preferable and could prevent a serious accident.

35.5 Acknowledgments

The ArcticNet ASM team acknowledges the crew of the CCGS *Amundsen* for their help and professionalism during the mission. We particularly thank Chief Scientist Maxime Geoffroy and Commanding Officer Alain Gariépy, as well as the entire ship's crew who allowed us to attain 150% of our science objectives for Leg 2.

We gratefully thank the Leg 4 Chief Scientist Martine Lizotte, the Captain Alain Gariépy, the officers and crew of the CCGS *Amundsen* for their support, their help, and friendship throughout this leg of the 2021 ArcticNet cruise. We also acknowledge Matt O`Regan and Ahmadreza Alleosfour for the support with the sub-bottom surveys and Daniel Rudback and Matt O`Regan for support with MSCL. We thank everyone who contributed to making it a successful campaign.

36 Seabed Mapping & Sub-bottom Profiling

Project leaders: Alexandre Forest[1] (alexandre.forest@as.ulaval.ca)

Cruise participants – Leg 1: Reilly MacKay[2]

Cruise participants – Leg 2: Reilly MacKay[2]

Cruise participants – Leg 3: Daniel Amirault[1], Alexis Belko[3]

Cruise participants – Leg 4: Ahmadreza Alleosfour[4]

[1] Amundsen Science, Université Laval, Quebec City, QC.
[2]Memorial University of Newfoundland, St. John's, NL
[3]Department of geology, Université Laval, Quebec City, QC.
[4]Department of Geodesy and Geomatics Engineering, University of New Brunswick, Fredericton, NB

36.1 Introduction

During the five Legs of the Expedition, Amundsen Science acquired multibeam echo sounder and sub-bottom profiler data. A multibeam operator was present during Legs 1 to 4, and this report covers the operations conducted during Leg 2 and 3.

From July 16th to August 12th, Amundsen Science acquired multibeam echo sounder and sub-bottom profiler data in support of Amundsen Science`s goals. Acquisition was done during transit, which took place: throughout areas on and in close proximity to Canada's continental shelf. Nighttime mapping operations were planned in accordance with the Chief Scientist, and opportunistic mapping was done during transit between sites. In total, seabed mapping covered a distance of 3432 nm for a duration between 26-28 days (see Figure 36-1).

Leg 3 of the 2021 Amundsen expedition started from Iqaluit on 12th August and finished at Resolute Bay on 9th September. Amundsen Science acquired multibeam echo sounder and sub-bottom profiler data in Baffin Bay's troughs (Broughton and Merchants), Smith Bay and Bowles Bay. In addition, transit data were acquired during throughout the leg (Figure 36-2). The mapping team conducted special mapping operations using the Amundsen barge along Mittie glacier within three hours of operation time

36.2 Methodology

Kongsberg EM302 Multibeam Sonar

The Amundsen is equipped with an EM302 multibeam echosounder (MBES) operated through Kongsberg Maritime's proprietary acquisition software, *Seafloor Information System* (SIS). Attitude is given by an *Applanix POS-MV* receiving RTCM corrections from a *CNAV 3050* GPS receiver. Position accuracies in planimetry and altimetry were approximatively < 0.6m and < 0.9m respectively. An *AML* probe is used for beam forming at the transducer head.

Knudsen 3260 CHIRP Sub-bottom Profiler

Since May 2016, a Knudsen 3260 deck unit has been installed onboard the Amundsen. It was acquired to replace the old 320-BR system showing signs of high degradation at the end of the 2015 field season. The new system now operates using a USB connector instead of a SCSII communication port. The Knudsen 3260 acquired sub-bottom profiles along transits at a frequency of 3.5 kHz to image sub-bottom stratigraphy of the seafloor. The dedicated HP Elite Desk computer was used for acquisition and processing.

Figure 36-1: Shiptrack of Amundsen 2021 Expedition – Leg 2

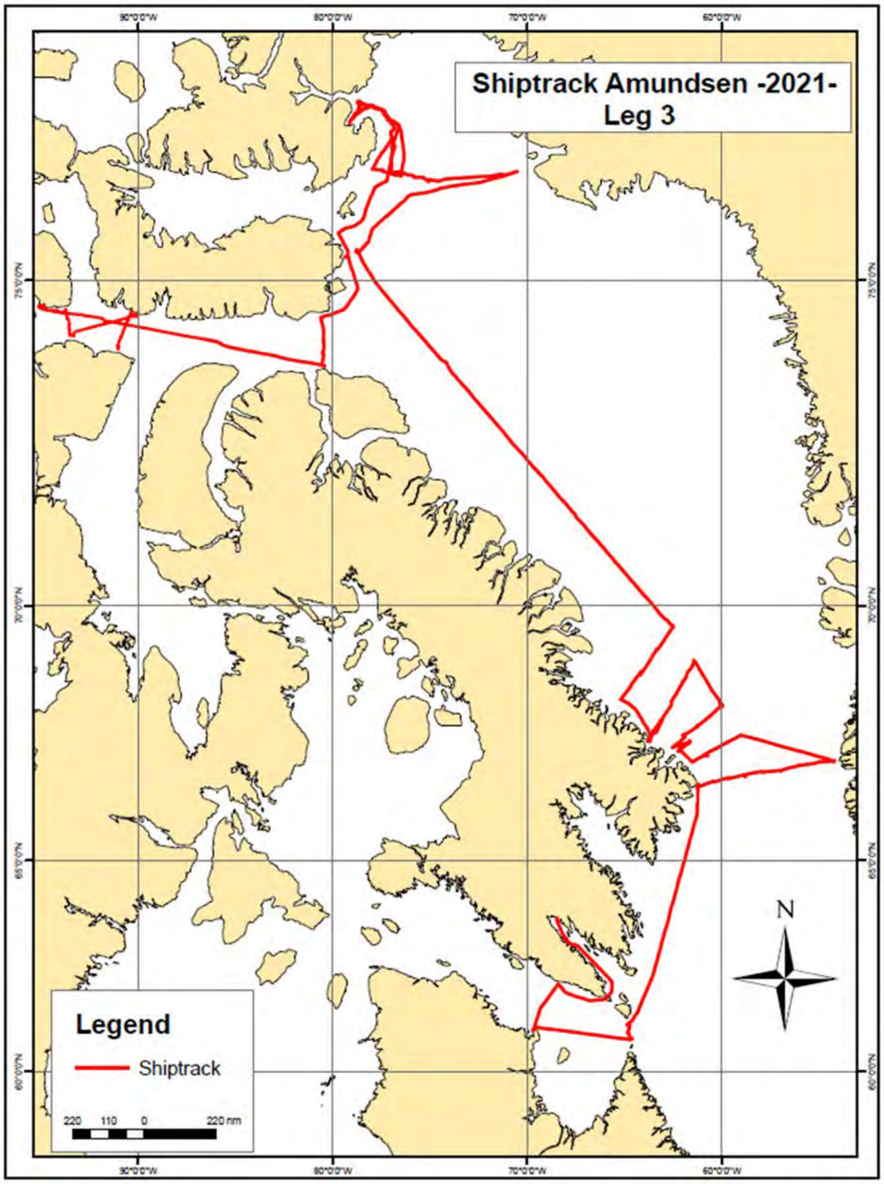


Figure 36-2: Shiptrack of Amundsen 2021 Expedition – Leg 3 (WGS84 World Mercator)

36.3 Preliminary Results

All the data acquired during the cruise is post-processed in real-time using the *CARIS HIPS&SIPS 11.1* software. This post-processing phase is essential to rapid detection of any anomalies in the data collection. 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).

36.3.1 *Opportunistic data acquisition*

The EM302 MBES and Knudsen 3260 CHIRP Sub-bottom profiler acquired data throughout the entirety of Leg 3 in order extend the spatial coverage of Amundsen Science's Arctic bathymetric database. 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.

36.3.2 *Dedicated Mapping Operations*

Between the densely packed day-to-day operations and the long transits of Leg 2, dedicated mapping was performed during any downtime, usually during the nights. Mapping was performed at a multitude of locations, which will be outlined in this section. Below is a table, which shows the distance mapped and time spent at each specific mapping site.

Table 36-1: dedicated mapping of Leg 2

Station Name	Distance(km)	Distance(nm)	Time(hh:mm:ss)
Makkovik	295.73048	159.6816847	59:49.5
Nain	72.2526	39.01328294	29:46.7
Saglek Bank	218.38347	117.9176404	49:28.0
Hatton Sill	104.76868	56.57056156	52:38.2
Davis Strait	169.49461	91.51976782	55:21.7

Makkovik survey: The surveying in Makkovik took place from the 19th to the 21st. While the whole time was not *dedicated* surveying, the MBES, SBP, and SBES systems were always running, with the exception of operations that required the use of the HiPAP system, as the various bathymetric devices would cause interference, lowering the accuracy of said system.

Nain survey: The surveying in Nain took place on the 22nd. While the whole time was not *dedicated* surveying, the MBES, SBP, and SBES systems were always running, with the exception of operations that required the use of the HiPAP system. Due to operator error during the time of survey, there are noticeable gaps in usable data collected in this area.

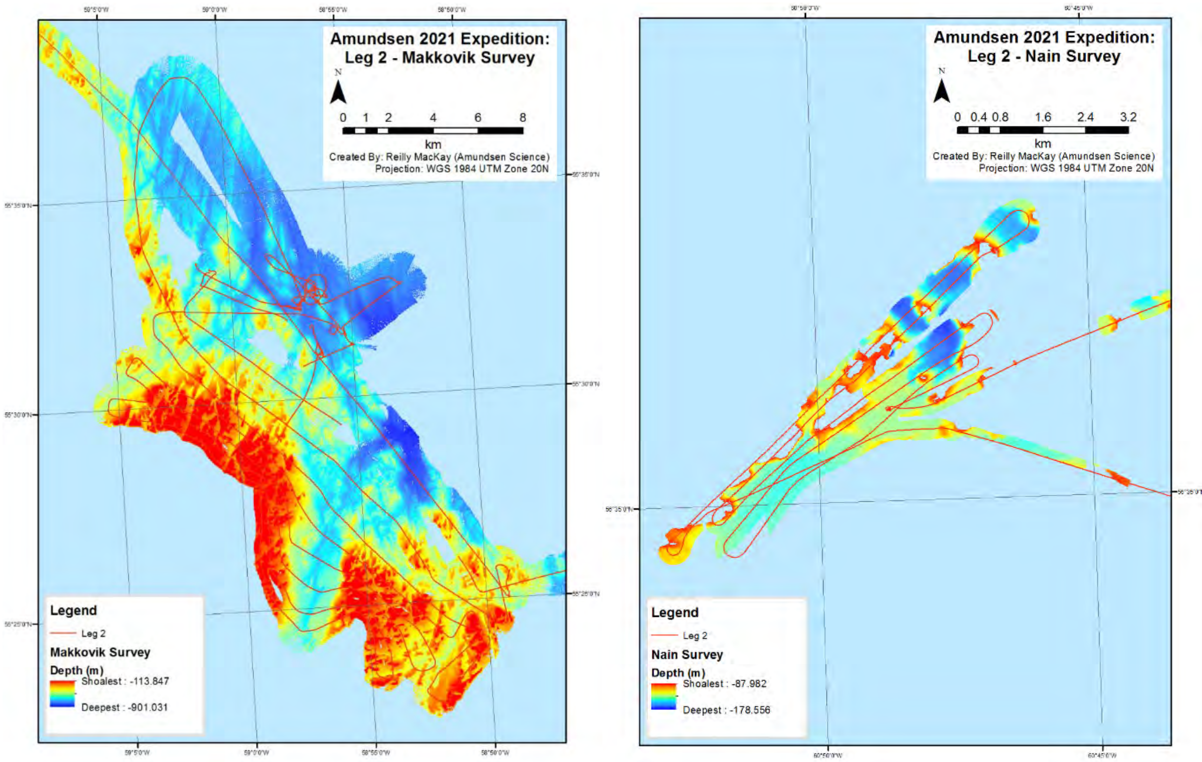


Figure 36-3: Makkovik Survey (left) and Makkovik survey (right), Leg 2 2021

Saglek Bank survey: The surveying in Saglek Bank took place from the 24th to the 26th. While the whole time was not *dedicated* surveying, the MBES, SBP, and SBES systems were always running, with the exception of operations that required the use of the HiPAP system.

Hatton Sill survey: The surveying in Hatton Sill took place from the 26th to the 27th. While the whole time was not *dedicated* surveying, the MBES, SBP, and SBES systems were always running, with the exception of operations that required the use of the HiPAP system.

Davis Strait survey: The surveying in Davis Strait took place from the 28th to the 29th. While the whole time was not *dedicated* surveying, the MBES, SBP, and SBES systems were always running, with the exception of operations that required the use of the HiPAP system.

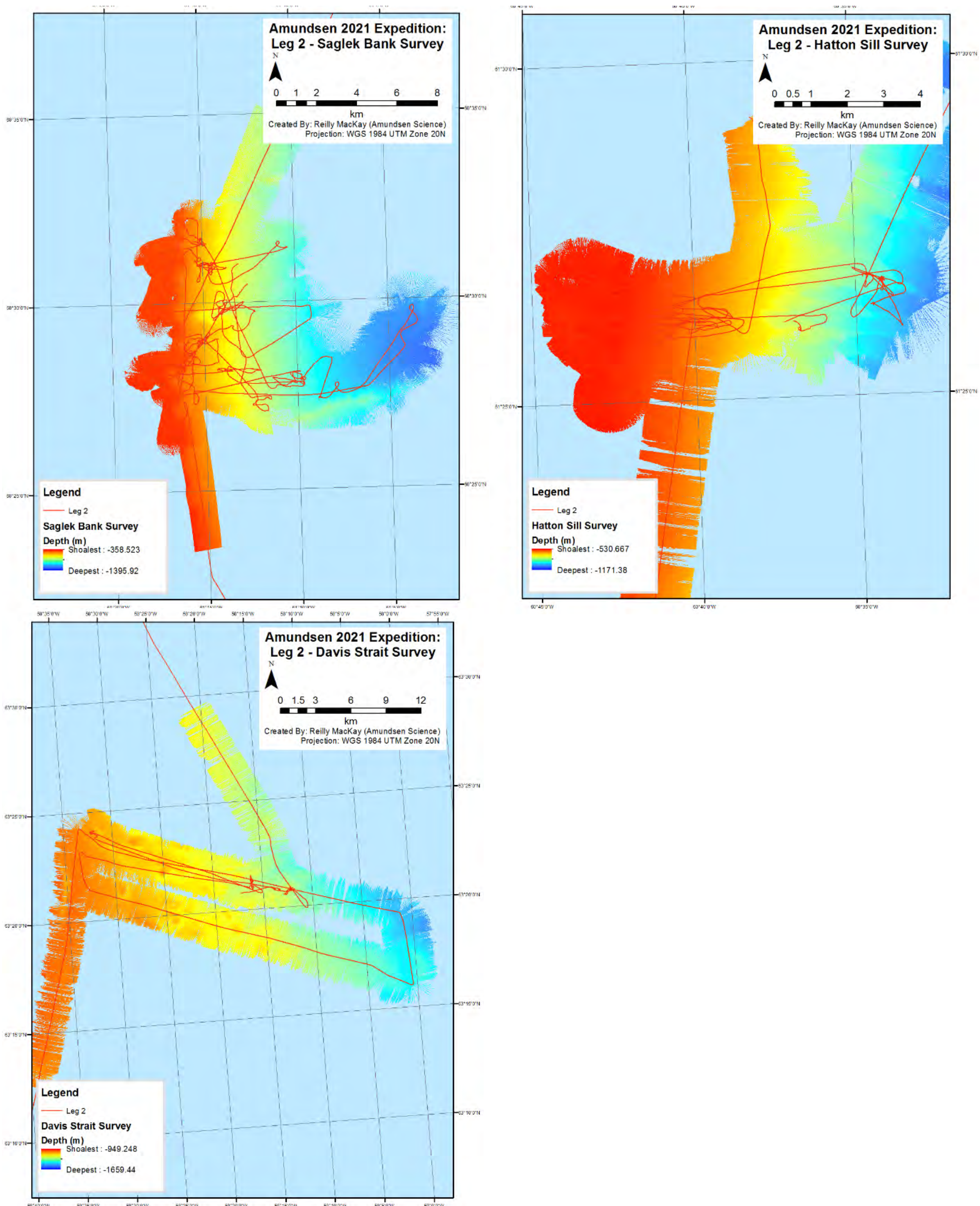


Figure 36-4: Saglek Bank Survey (top left), Hatton Sill survey (top right) and Davis Strait survey (bottom), Leg 2 2021

Dedicated mapping operations of Leg 3 took place in 2 separate zones, seen in Figure 36-5. The main objective of the dedicated mapping in Merchants and Broughton trough (Figure 36-5, Figure 36-6) was to identify glacier geometry, especially meltwater geometry. Amundsen Science utilized line plans as a general reference for navigation; however, priority was placed on obtaining 20% overlap with previous coverage. Survey speeds averaged 8 knots to ensure feasible along-track coverage and to remain outside high-noise ranges of the vessel's propeller speeds.

Some dedicated mapping operation were conducted in Smith Bay with the Amundsen (Figure 36-7) while the barge supported operations in Mittie glacier for ArcticNet project lead by Jean-Carlos Montero (Figure 36-8).

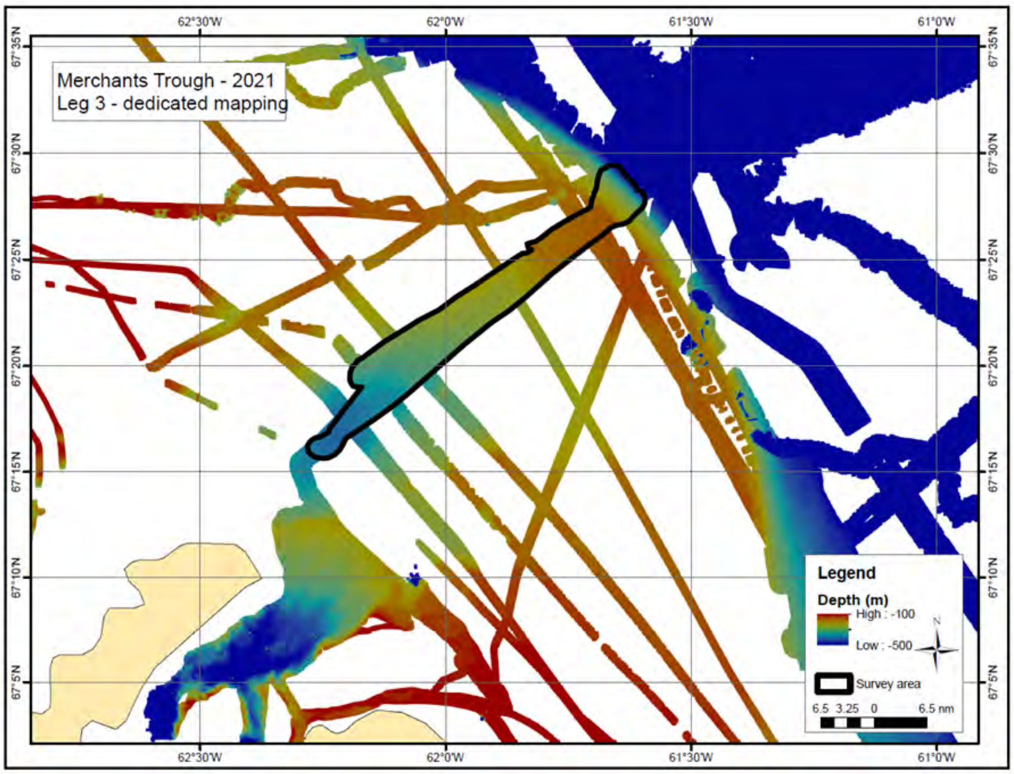


Figure 36-5: Dedicated Mapping of Merchants trough (WGS84 UTM zone 20N)

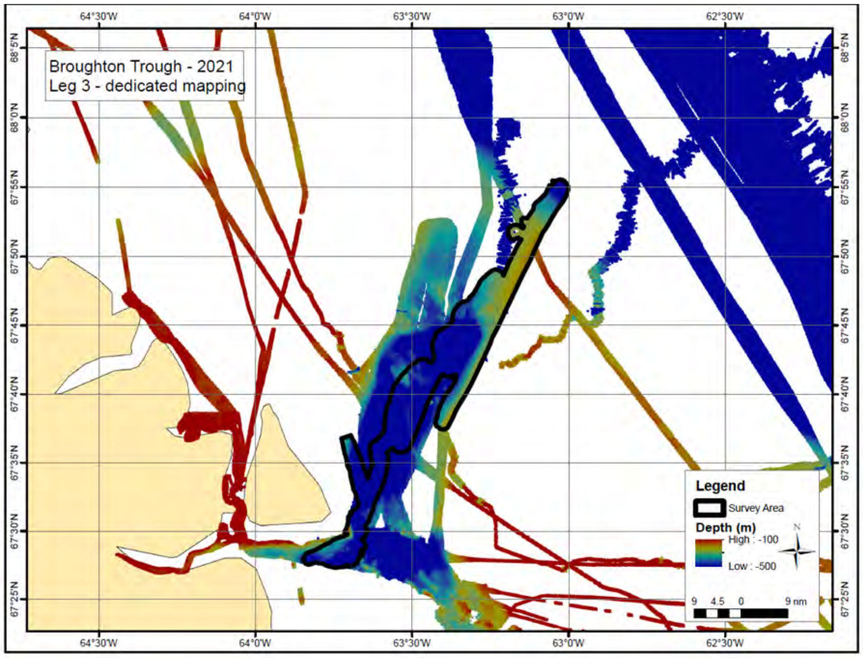


Figure 36-6: Dedicated Mapping of Broughton trough (WGS84 UTM zone 20N)

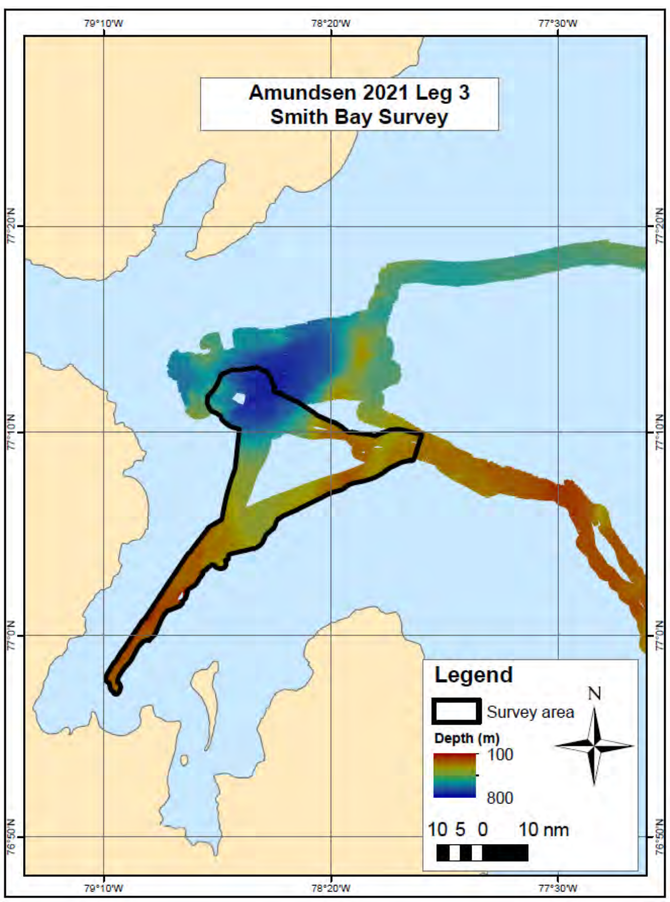


Figure 36-7: Dedicated Mapping of Smith Bay (WGS84 Mercator)

36.3.3 *Barge – Mapping Operations*

The Amundsen Leg 3 Expedition plan allotted 12 hours of bathymetric data acquisition along the terminus of Mittie Glacier, in Smith Bay and 12 hours of mapping in Croker Bay. Prior to the 2021 expedition, the barge onboard the Amundsen was equipped with an array of mapping equipment including:

- Kongsberg EM2040 Multibeam Echosounder
  - 200-400kHz frequency, 130 degree swath, maximum 500m depth
- Knudsen 3.5 kHz Sub-bottom Profiler
  - 3.5kHz frequency, Frequency Modulated Pulse (Chirp)
- POSMV V5 Position and Orientation
  - GNSS – IMU Integration

Due to major alterations of the mission plan and unforeseen technical issues (seen in Incidents), only the EM2040 was operational in Smith Bay during a total of 1 hour of data acquisition, covering 3 square kilometres was completed. The team was successfully able to map the terminus of the glacier (seen in Figure 36-9).

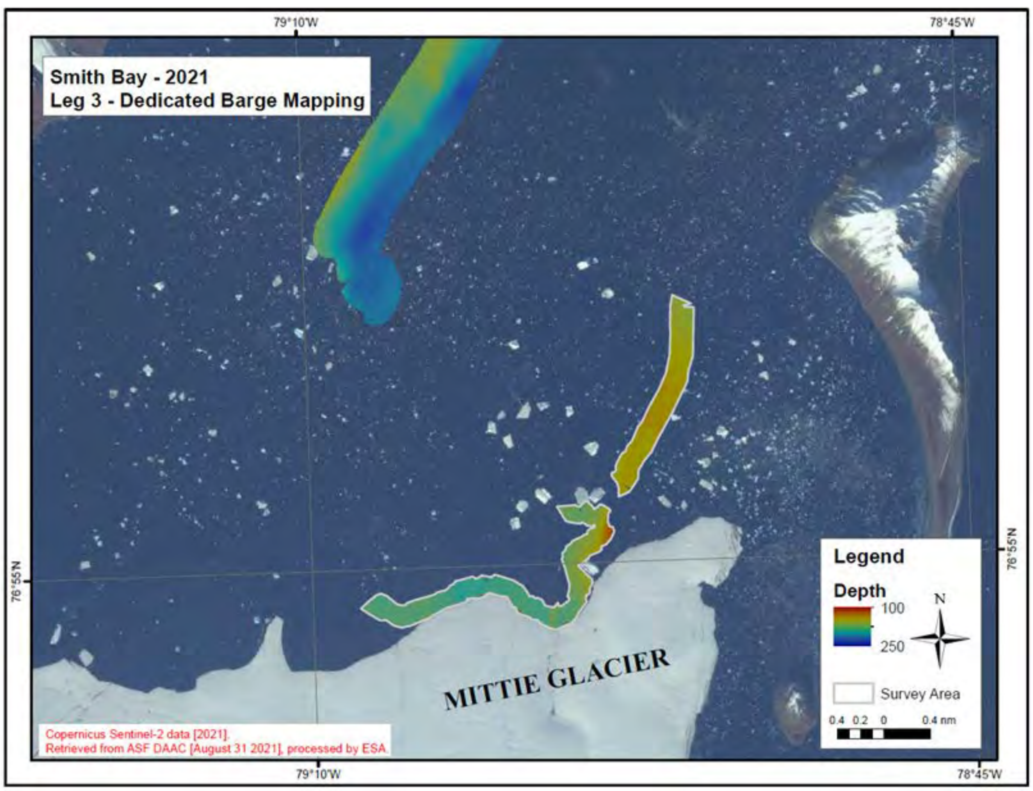


Figure 36-8: Barge Dedicated Mapping of Mittie Glacier (WGS84 UTM zone 17N)

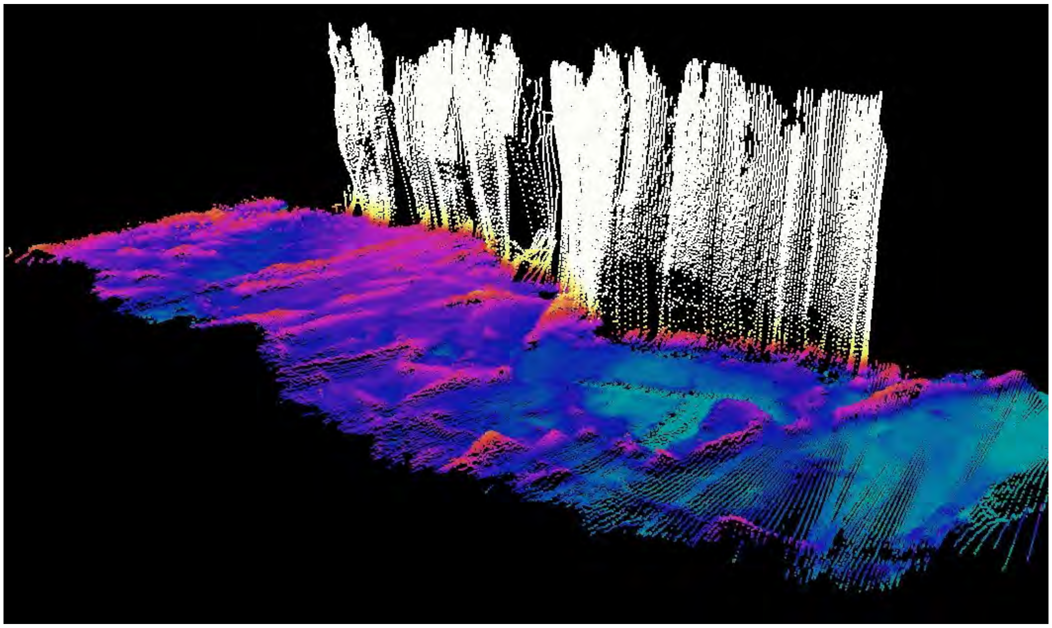


Figure 36-9: Mittie Glacier Terminus seen in Mulitbeam data

Supportive Sub-bottom Operations - BoxCore / PistonCore /GravityCore

Stations with a planned box core Piston core or Gravity core required a general knowledge of seabed composition before deploying equipment. Some stations, located in areas of particularly unknown bottom type, profited from brief sub-bottom profile assessments to predict the nature of the seafloor. Dedicated mapping in Merchants and Broughton trough supported Piston core operations.

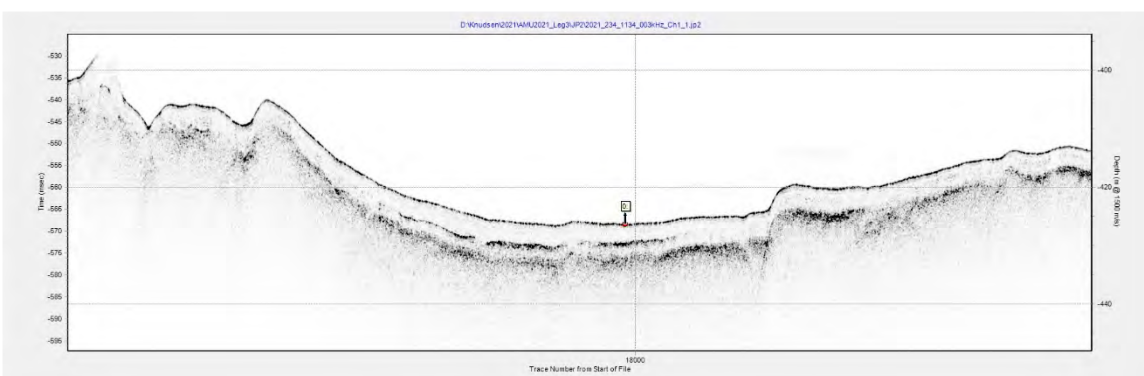


Figure 36-10: Chosen Coring Site Location - Merchants Trough

36.4 Incidents

36.4.1 *Leg 2*

Nain MBES Survey: During the multibeam echo sounder survey of stations NAI-8.5A and NAI-8.5B, or Nain, the multibeam began to falsely record data due to an issue with the set min depth of 100m. Surveying began while the hydrographer was asleep, and therefore unable to resolve the issue. This resulted in any collected data above 100m being erroneous, which resulted in large portions of the surveyed area being unusable.

MBES Shutdowns: At multiple points in the voyage, the MBES system would stop pinging either due to crashes in SIS, or due to hardware issues. The wonderful Simon and Marcia, the box, typically solved this via a shutoff of the transducer box in the scientific locker for roughly 5 minutes, however upon later inspection and filters were filled with dust. After a quick clean, the system stopped having issues.

NMEA Logger Shutoff / Tide Creation Errors: At an unspecified point in time, COMCAP4 (which supplies the NMEA strings for tide file creation) was turned off. This resulted in a large swath of data being missed (roughly 9-10 days). Another issue that surfaced is that the code utilized to create shiptracks for webtide ceased to function with all NMEA logs starting on 31/07/2021 onward. The next hydrographer who is familiar with this program has been alerted, and will hopefully find a solution.

POSMV Logging Issues: For reasons that have not been identified, the POSMV Ethernet logging will cease. Typical reasons such as limited storage have been checked, however that has had no effect. The software is currently writing a file without breaks, unknown if this is a cause for concern.

36.4.2 *Leg 3*

Barge Survey

POSView: Despite successful tests of the POSMV V5 installation while the barge was onboard the Amundsen, an unknown error occurred after deploying the barge to escort the Amundsen into Smith Bay. Before the problem was resolved, the barge was called back to the Amundsen for a rescue operation.

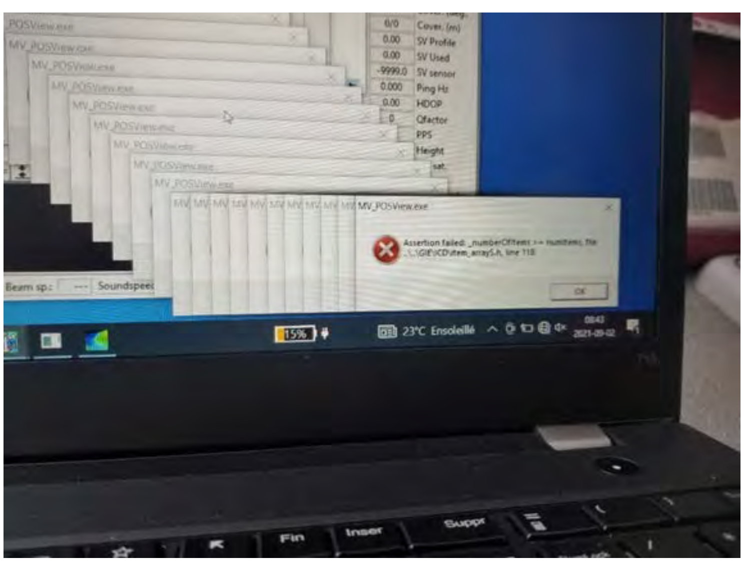


Figure 36-11: error message shown on the POSView sorfware

An Applandix employee was contacted, revealing the the acquisition laptop's POSView software version (4.34) was too old. Even though the software version was changed, the issue worsened, leaving the POSView software unusable on the acquisition laptop. The issue was resolved using a backup acquisition laptop with the newer version of the POSView software (9.21).

Ethernet: the mapping team experienced problems related to communication between surveying equipment (POSMV, EM302, acquisition laptop) during the survey operations in Smith Bay. The main issue stemmed from the Cisco Switch, responsible for managing communication by Ethernet. At continuous intervals of approximately five seconds, all communication ceased for 2-3 seconds then restarted. As a result, the Multibeam stopped receiving data from the POSMV and both systems would stop communicating with the acquisition laptop. The team replaced the switch yet the problem seemed to persist; therefore, the power source was changed from the UPS to the barges inverter. This worked after many configuration attempts. The source of the issue is believed to be the available power from the UPS; however, an insufficient amount of evidence was gathered to confirm this was the true problem.

Time Constraints: Leg 3 planned 24 hours of mapping onboard the barge. Due to major changes in allotted time of operations, the given survey time in Croker Bay was cancelled and Mittie Glacier barge operations were only given a total of 3 hours. This operational time included barge deployment, transits to the survey site, and the preparation of systems. This short amount of allotted operational time creates many difficulties towards assessing and implementing barge-mapping operations and should be further discussed the next year if barge mapping is requested.

AML Base X CTD: During the Barge mapping operations, the AML Base X CTD profiler malfunctioned causing the team to be uncertain of its state. Usually its indication light will shine green when powered on and start flashing green when collecting data. The first attempt to deploy the probe indicated there was an internal issue within the CTD. The indication light on the CTD flashed green for 3 seconds and turn off, yet the Seacast application showed the instrument was still above half battery capacity.

After reviewing the manual, this type of error indicates the instrument should be returned to the manufacturer for further review.

Appendix 1 - List of stations sampled during the 2021 Amundsen Expedition

Leg	Station ID	Station Type	UTC Date	UTC Time	Latitude (N)	Longitude (W)	Depth (m)
Leg 1							
1	MSP21-15	Camera	2021-07-09	21:32	50,4555657	-49,4588892	
1	MSP21-30	Coring	2021-07-11	11:06	51,2230463	-49,8370522	963
1	MSP21-32	Coring	2021-07-11	13:39	51,2729862	-50,0016932	715
1	MSP21-31	Coring	2021-07-11	18:58	51,3073595	-49,9348145	1084
1	MSP21-10	Camera	2021-07-12	13:00	51,2681505	-50,0187598	669
1	MSP21-09	Camera	2021-07-12	18:51	51,1181375	-49,9137205	744
1	MSP21-13	Camera	2021-07-12	21:54	51,3712623	-49,7518748	1863
Leg 2							
2	ROV trial	Practive	2021-07-16	19:07	47,7769472	-53,0547678	
2	Rosette1_leg2	Practive	2021-07-17	12:56	50,9120952	-52,753538	358,7
2	644	ArcticNet	2021-07-18	8:20	54,8169742	-53,2220512	929,72
2	652	ArcticNet	2021-07-18	20:52	55,650669	-55,5427533	2439,9
2	Makkovik	ROV/Benthic	2021-07-19	12:49	55,5524983	-59,0165302	676,71
2	NAI-8.5A	Coring	2021-07-22	9:20	56,598427	-60,8115527	133,36
2	NAI-8.5B	Coring	2021-07-22	14:34	56,6943937	-60,2863583	473,67
2	Kelp2021	Benthic	2021-07-23	5:40	58,66862	-62,6054933	119,73
2	SagBank-21	Mooring	2021-07-23	21:00	59,3755017	-60,3098503	450,25
2	SagBank-21CROM	Mooring	2021-07-23	22:13	59,385637	-60,326814	420,28
2	HiBioA-20	Mooring	2021-07-24	7:29	60,4530627	-61,2686567	477,5
2	HiBioC-20	Mooring	2021-07-24	10:49	60,4641523	-61,1703875	969,25
2	SaglekBank	ROV/Benthic	2021-07-24	12:08	60,5276168	-61,2520642	580,1
2	HiBio-A-21	Mooring	2021-07-25	9:49	60,4684143	-61,2814895	440,44
2	HiBio-C	Mooring	2021-07-26	1:29	60,4621178	-61,1648287	997,05
2	HiBio-A-21-CROM	Mooring	2021-07-26	14:18	60,4832417	-61,2494753	593,11
2	Hatton Sill	ROV/Benthic	2021-07-26	20:22	61,4365833	-60,670868	596,85
2	Davis Strait	ROV/Benthic	2021-07-28	16:33	63,3506092	-58,2726628	1282,6
2	SF-3.1	ArcticNet/SouthWir	2021-07-31	11:29	66,7618233	-62,3396277	
2	SF-ROV	ArcticNet/SouthWir	2021-07-31	13:38	66,7515957	-62,3159732	66,67
2	SF-6.2a	ArcticNet/SouthWir	2021-07-31	17:07	66,7512543	-62,3124923	
2	SF-6.2b	ArcticNet/SouthWir	2021-07-31	17:25	66,752578	-62,3115828	
2	SF-6.1	Coring	2021-07-31	23:10	67,0255487	-62,5801485	805,6
2	CSF4.4	ArcticNet/SouthWir	2021-08-01	2:14	66,9233143	-62,4647698	353,76
2	CSF4.3	ArcticNet/SouthWir	2021-08-01	3:42	66,956325	-62,4969235	258,7
2	CSF4.2	ArcticNet/SouthWir	2021-08-01	5:10	66,9912217	-62,5551113	389,28
2	Disko Fan	ROV/Benthic	2021-08-02	0:19	67,8808843	-59,3753093	942,68
2	McBeth Fjord	Mooring	2021-08-03	20:48	69,911364	-66,807295	
2	Scott Inlet -ROV1	ROV/Benthic	2021-08-04	10:02	71,3792032	-70,0758108	265,33
2	Scott Inlet-ROV1	ROV/Benthic	2021-08-04	11:11	71,3798225	-70,068406	
2	0t2	ROV/Benthic	2021-08-04	21:37	71,3792827	-70,0713255	
2	SE-1K	ROV/Benthic	2021-08-04	23:11	71,3725972	-70,048885	209,9
2	NE-1K	ROV/Benthic	2021-08-04	23:31	71,3866107	-70,0552897	258,97
2	NE-5K	ROV/Benthic	2021-08-05	0:01	71,409624	-69,976387	263,45
2	Scott Inlet	ROV/Benthic	2021-08-05	1:13	71,3909877	-70,3016733	698,12
2	Scott Inlet-Deep	ROV/Benthic	2021-08-05	2:43	71,3894058	-70,3031523	697,85
2	Scott Inlet-ROV2	ROV/Benthic	2021-08-05	12:35	71,3468872	-70,1718037	
2	SE-25K (ROV3)	ROV/Benthic	2021-08-05	16:49	71,2229583	-69,549526	153,97
2	0t1	ROV/Benthic	2021-08-06	2:25	71,377131	-70,0788612	
2	Scott Inlet ROV1	ROV/Benthic	2021-08-06	3:42	71,3777585	-70,0690478	

Leg	Station ID	Station Type	UTC Date	UTC Time	Latitude (N)	Longitude (W)	Depth (m)
2	Scott Inlet ROV 3	ROV/Benthic	2021-08-06	10:25	71,4279458	-70,1398657	439,42
2	Scott Inlet ROV 4	ROV/Benthic	2021-08-06	17:57	71,3391195	-70,2605162	
2	Scott Inlet Piston Co	ROV/Benthic	2021-08-06	21:50	71,397022	-70,3179293	698,69
2	Scott Inlet Box Core	ROV/Benthic	2021-08-07	0:59	71,3389662	-70,259766	376,6
2	Scott Inlet Beam Tra	ROV/Benthic	2021-08-07	2:11	71,3310473	-70,1244147	128,93
2	Scott Inlet Beam Tra	ROV/Benthic	2021-08-07	4:09	71,4532048	-69,7971607	293,91
2	Gib-3.1	Coring	2021-08-07	13:47	70,6491142	-72,4828337	299,29
2	Gib-3.2	Coring	2021-08-07	17:27	70,8040375	-72,2018647	261,12
2	Cla-3.1	Coring	2021-08-07	19:19	70,8873982	-72,2872957	267,86
2	Cla-3.2		2021-08-07	20:33	70,9284217	-72,3015493	206,62
2	Clark Fjord CTD	CTD	2021-08-07	23:41	71,0491357	-71,5880715	680,35
2	Scott Inlet Mooring	Mooring	2021-08-08	1:49	71,1358298	-70,8016795	152,38
2	padloping		2021-08-09	1:58	67,354176	-62,2484637	234,28
2	Cum-8.2	Coring	2021-08-09	20:55	64,9743893	-64,8493822	797,86
2	ID-12	DropCam	2021-08-10	6:39	66,187072	-65,6788312	82,515
2	ID-14	DropCam	2021-08-10	7:40	66,1751023	-65,665754	110,98
2	ID-11	DropCam	2021-08-10	8:39	66,174537	-65,7219862	95,68
2	ID-13	DropCam	2021-08-10	9:30	66,1638307	-65,6974798	94,31
2	ID-10	DropCam	2021-08-10	11:07	66,1636548	-65,7226133	152,88
2	ID-9	DropCam	2021-08-10	12:50	66,153011	-65,7532407	148,48
2	Pangnirtung Piston C	Coring	2021-08-10	13:57	66,164013	-65,7200005	150,4
2	ID-2	DropCam	2021-08-10	14:54	66,1355087	-65,7750063	116,02
2	ID-1	DropCam	2021-08-10	15:46	66,1378727	-65,8166835	95,83
2	ID-8	DropCam	2021-08-10	16:46	66,1236553	-65,8661422	69,2
2	ID-0	DropCam	2021-08-10	17:47	66,1143428	-65,8671253	
2	ID-6	DropCam	2021-08-10	18:44	66,1188108	-65,909473	
2	ID-7	DropCam	2021-08-10	19:45	66,0905415	-65,9765793	
2	ID-4	DropCam	2021-08-10	20:21	66,109472	-65,9208145	
Leg 3							
3	Basic Q3	Basic	2021-08-14	18:46	61,0481585	-69,6664385	132
3	Nutrient Q4	Nutrient	2021-08-14	22:07	61,03085	-69,6919245	154
3	Nutrient Q6	Nutrient	2021-08-15	0:38	61,050376	-69,7146487	299
3	Nutrient Q2	Nutrient	2021-08-15	3:04	61,0730827	-69,6397943	218
3	Nutrient 356	Nutrient	2021-08-15	18:16	60,8065025	-64,7254018	197
3	Nutrient 354	Nutrient	2021-08-16	0:55	60,9701762	-64,7876257	235
3	Nutrient 352	Nutrient	2021-08-16	4:13	61,1724205	-64,7723888	267
3	Full A1	Full	2021-08-17	11:16	66,5480997	-61,2363023	93
3	Basic A2	Basic	2021-08-17	19:23	66,669212	-60,4618278	164
3	Full A3	Full	2021-08-18	3:50	66,736284	-59,629497	128
3	Basic A4	Basic	2021-08-18	14:06	66,8018388	-58,7581137	789
3	Full A5	Full	2021-08-19	0:20	66,8665325	-57,9712707	758
3	Nutrient 195	Nutrient	2021-08-19	10:30	66,891681	-56,9145075	227
3	Basic 196	Basic	2021-08-19	16:21	66,9839257	-56,062584	355
3	Basic 196	Basic	2021-08-19	18:23	66,984144	-56,0644777	395
3	Nutrient 197	Nutrient	2021-08-19	22:14	67,0490943	-55,0833313	349
3	Full 198	Full	2021-08-20	0:53	67,0851148	-54,2140697	758
3	Full 198	Full	2021-08-20	5:01	67,0776323	-54,3259687	336
3	Full B5	Full	2021-08-20	16:01	67,5867605	-59,0092362	322
3	Basic B4	Basic	2021-08-21	0:34	67,4615618	-59,6507078	448
3	Full B3	Full	2021-08-21	7:50	67,3294362	-60,2746515	449

Leg	Station ID	Station Type	UTC Date	UTC Time	Latitude (N)	Longitude (W)	Depth (m)
3	Basic B2	Basic	2021-08-21	16:59	67,1973557	-60,8940403	532
3	Full B1	Full	2021-08-22	3:39	67,0626375	-61,5006428	663
3	Merchants Trough		2021-08-22	10:54	67,3049105	-62,1725243	660
3	Full C1	Full	2021-08-23	2:56	67,350487	-62,522607	139
3	Basic C2	Full	2021-08-23	7:33	67,5518005	-61,9008537	1975
3	Full C3	Full	2021-08-23	15:14	67,7526663	-61,2778615	1977
3	Basic C4	Full	2021-08-24	2:13	67,9536578	-60,6316797	1300
3	Full C5	Full	2021-08-24	7:44	68,1473558	-59,9648677	1323
3	Full D5	Full	2021-08-24	22:53	68,9996847	-61,407271	489
3	Basic D4	Full	2021-08-25	7:53	68,6299245	-61,9779142	444
3	Full D3	Full	2021-08-25	12:12	68,2429867	-62,592713	443
3	Basic D2	Basic	2021-08-25	21:56	67,8583115	-63,147579	443
3	Bro-6.3	Piston	2021-08-26	18:00	67,5999703	-63,6070667	584
3	Full D1	Full	2021-08-26	20:20	67,4675457	-63,8198317	583
3	Full E1	Full	2021-08-27	12:00	68,2785075	-65,137824	263
3	Basic E2	Basic	2021-08-27	21:25	68,53786	-64,6580107	1845
3	Full E3	Full	2021-08-28	1:45	68,800214	-64,1629613	1401
3	Basic E4	Basic	2021-08-28	16:16	69,2148245	-63,3474882	1565
3	Full E5	Full	2021-08-28	22:11	69,6043737	-62,537967	1565
3	Nutrient 116	Nutrient	2021-08-31	9:10	76,3803058	-70,5191022	142
3	Full 115	Full	2021-08-31	12:55	76,3334495	-71,2006322	388
3	Full 115	Full	2021-08-31	19:10	76,3321903	-71,1972532	115
3	CTD 114		2021-08-31	21:57	76,3262508	-71,7860342	647
3	Nutrient 113	Nutrient	2021-08-31	23:08	76,3207797	-72,2170023	641
3	CTD 112		2021-09-01	0:58	76,3156297	-72,7020455	702
3	Basic 111	Basic	2021-09-01	2:16	76,3071548	-73,2166245	644
3	Nutrient 110	Nutrient	2021-09-01	5:35	76,2993543	-73,6364085	641
3	CTD 109		2021-09-01	7:30	76,2910603	-74,1154078	1091
3	Full 108	Full	2021-09-01	8:38	76,265576	-74,6097057	1095
3	Nutrient 107	Nutrient	2021-09-01	16:31	76,2836512	-75,0036302	1198
3	CTD 106		2021-09-01	19:16	76,3101052	-75,3487062	1196
3	Basic 105	Basic	2021-09-01	20:25	76,3189143	-75,7643568	1192
3	Basic 105	Basic	2021-09-01	22:14	76,3175537	-75,7398733	1187
3	CTD 104		2021-09-02	0:06	76,3509105	-76,2038908	84
3	Nutrient 103	Nutrient	2021-09-02	0:53	76,3673582	-76,5427652	86
3	CTD 102		2021-09-02	2:09	76,3736662	-76,9752013	72
3	Smith Bay		2021-09-02	7:42	77,1600313	-77,9798148	77
3	Full 101	Full	2021-09-02	20:37	76,3851765	-77,4001532	72
3	Nutrient 100	Nutrient	2021-09-03	3:09	76,4107928	-77,9511857	656
3	100A		2021-09-03	6:21	76,4592587	-77,825166	816
3	SB1	Nutrient	2021-09-03	16:28	76,963387	-79,1385173	816
3	East 5	Coring	2021-09-04	21:36	75,3126048	-79,2250085	919
3	Basic 322	Basic	2021-09-05	4:17	74,4955437	-80,5263175	908
3	Nutrient 300	Nutrient	2021-09-05	7:01	74,3160492	-80,4630477	911
3	Nutrient 323	Nutrient	2021-09-05	9:15	74,1553637	-80,4718652	905
3	Nutrient 324	Nutrient	2021-09-05	11:42	73,985848	-80,4723727	856
3	Basic 325	Basic	2021-09-05	14:01	73,8174633	-80,4964867	873
3	Basic 305D	Basic	2021-09-07	1:23	74,6020853	-93,7293617	875
3	Nutrient 305C	Nutrient	2021-09-07	4:20	74,484453	-93,637271	523
3	Nutrient 305B	Nutrient	2021-09-07	8:34	74,3564867	-93,5603615	523

Leg	Station ID	Station Type	UTC Date	UTC Time	Latitude (N)	Longitude (W)	Depth (m)
3	Nutrient 305A	Nutrient	2021-09-07	10:18	74,343908	-93,5530365	525
3	Basic S10	Basic	2021-09-07	20:21	74,5432485	-90,4062458	94
3	CTD S11		2021-09-07	23:03	74,5733052	-90,3636532	95
3	S9		2021-09-08	0:23	74,4628052	-90,529493	461
3	Box core site	Basic	2021-09-08	2:41	74,5170683	-90,4424385	570
3	Basic S8	Basic	2021-09-08	4:05	74,4015637	-90,621925	339
3	CTD S7		2021-09-08	6:30	74,3440905	-90,7124033	94
3	Nutrient S6	Nutrient	2021-09-08	7:16	74,2803152	-90,805319	90
3	Basic S5	Basic	2021-09-08	8:40	74,2187828	-90,9009275	96
3	Basic S3	Basic	2021-09-08	12:20	74,0981775	-91,0754358	53
3	Nutrient S1	Nutrient	2021-09-08	15:20	74,0584043	-91,0290778	40
3	Nutrient S4	Nutrient	2021-09-08	16:49	74,144368	-91,0103003	48
3	Basic S5	Basic	2021-09-08	18:14	74,2175172	-90,9038825	46
3	Coring radstock bay	Coring	2021-09-08	22:37	74,6949242	-91,1440715	47
3	Coring		2021-09-08	23:17	74,6960065	-91,1441662	118
Leg 4							
4	Nutrient C002	Nutrient	2021-09-10	21:45	73,9605817	-88,8162883	
4	C002	Nutrient	2021-09-10	23:50	73,963065	-88,8073067	
4	Nutrient C003	Nutrient	2021-09-11	12:31	72,364664	-91,3998058	390
4	C004 (427m)	Nutrient	2021-09-11	21:15	71,9559095	-95,835113	431
4	Basic 310E (124m)	Basic	2021-09-12	5:48	71,2872392	-97,68769	130
4	Nutrient C009 (203r	Nutrient	2021-09-12	13:50	70,7053297	-98,9665368	202
4	312	Basic	2021-09-12	23:21	69,1721345	-100,68904	65
4	C010	Basic	2021-09-13	8:36	68,24797	-101,646724	111
4	QMG4-Y3	Basic	2021-09-13	19:07	68,485663	-103,432076	70
4	QMW	Nutrient	2021-09-14	2:02	68,7086905	-104,667245	85
4	314	Basic	2021-09-14	23:27	68,9748672	-105,479417	80
4	C011	Nutrient	2021-09-15	4:40	69,0179022	-106,618906	112
4	C012	Nutrient	2021-09-15	13:53	68,328798	-110,271512	296
4	316	Basic	2021-09-15	19:48	68,3886993	-112,124747	176
4	CG13	Nutrient	2021-09-16	3:20	68,3855787	-113,160352	173
4	400-C013	Nutrient	2021-09-16	8:48	69,0555455	-114,784292	93
4	MCTL	Coring	2021-09-16	10:39	69,1141813	-115,047192	171
4	C014	Nutrient	2021-09-16	18:02	69,6187973	-118,603038	519
4	403	Basic	2021-09-16	23:24	70,1076643	-120,124572	412
4	405-C015	Basic	2021-09-17	10:34	70,6623205	-122,61654	567
4	PCB-01	PCB Basic	2021-09-18	0:29	71,2328753	-125,598447	411
4	407	Basic	2021-09-18	5:37	71,0103068	-126,076245	390
4	409	Basic	2021-09-18	17:27	71,8735458	-125,903968	112
4	410	Nutrient	2021-09-18	23:43	71,6987875	-126,487051	405
4	411	CTD	2021-09-19	1:20	71,6296748	-126,710118	436
4	412	Nutrient	2021-09-19	2:30	71,5646225	-126,918917	420
4	413	CTD	2021-09-19	4:17	71,4953697	-127,141616	373
4	414	Basic	2021-09-19	5:30	71,4235965	-127,374262	305
4	415	CTD	2021-09-19	11:07	71,3629647	-127,548159	249
4	416	Nutrient	2021-09-19	12:15	71,2921557	-127,769555	158
4	417	CTD	2021-09-19	13:39	71,2245015	-127,970356	85
4	418	Nutrient	2021-09-19	14:40	71,1631053	-128,167263	66
4	419	CTD	2021-09-19	15:58	71,106456	-128,344677	57
4	420	Basic	2021-09-19	17:29	71,0541255	-128,533702	43

Leg	Station ID	Station Type	UTC Date	UTC Time	Latitude (N)	Longitude (W)	Depth (m)
4	JET1	Nutrient	2021-09-19	23:27	70,913703	-127,764106	118
4	JET2	CTD	2021-09-20	0:41	70,9152408	-128,052599	88
4	JET3	CTD	2021-09-20	1:33	70,9158305	-128,343105	50
4	JET4	CTD	2021-09-20	2:24	70,9139233	-128,629105	42
4	JET5	Nutrient	2021-09-20	3:18	70,9141758	-128,921061	36
4	JET6	Nutrient	2021-09-20	5:00	71,0519957	-129,461372	41
4	JET7	Nutrient	2021-09-20	6:57	71,0531397	-130,400257	46
4	PCB-05	PCB Basic	2021-09-20	9:38	71,2029417	-131,351892	75
4	PCB-04	PCB Full	2021-09-20	13:18	71,4510997	-131,294204	531
4	PCB-02	PCB Basic	2021-09-21	1:35	71,6219965	-128,105989	314
4	PCB-03	PCB Full	2021-09-21	13:22	72,1118265	-131,04685	1044
4	PCB-06	PCB Full	2021-09-22	7:17	70,7618287	-131,429856	50
4	PCB-07	PCB Basic	2021-09-22	14:22	70,534833	-131,495279	52
4	434	Basic	2021-09-22	23:29	70,1726145	-133,539992	46
4	433	CTD	2021-09-23	3:37	70,288021	-133,575729	55
4	432	Nutrient	2021-09-23	4:33	70,3943362	-133,607332	63
4	431/PCB-8	PCB Basic	2021-09-23	6:11	70,524856	-133,613482	69
4	430	Nutrient	2021-09-23	9:06	70,598214	-133,641786	71
4	429	CTD	2021-09-23	10:44	70,6961023	-133,672242	69
4	428	Nutrient	2021-09-23	11:54	70,7895818	-133,698717	75
4	427	CTD	2021-09-23	13:06	70,879471	-133,720249	81
4	426	Nutrient	2021-09-23	14:01	70,9764062	-133,744968	95
4	435	Basic	2021-09-23	15:10	71,077105	-133,775866	303
4	424	Nutrient	2021-09-23	23:15	71,1754957	-133,82445	584
4	423	CTD	2021-09-24	1:11	71,2708245	-133,853537	798
4	422	Nutrient	2021-09-24	2:39	71,3802723	-133,892608	1103
4	421	Basic	2021-09-24	4:39	71,4680262	-133,898267	1133
4	546	Nutrient	2021-09-24	14:40	71,74243	-133,947437	1612
4	PCB-09	PCB Full	2021-09-24	23:48	71,1022105	-135,142989	674
4	PCB-21	PCB Full	2021-09-25	12:09	70,3402392	-140,02577	442
4	PCB-22	PCB Full	2021-09-25	21:38	70,1227675	-140,245773	48
4	PCB-23	PCB Basic	2021-09-26	4:22	69,8103258	-140,548515	33
4	2121	GSC coring	2021-09-26	11:29	69,7686622	-139,646387	36
4	PCB-20	PCB Basic	2021-09-26	17:22	70,5499128	-139,820381	783
4	482	Basic	2021-09-26	23:25	70,5207852	-139,370806	825
4	PCB-16	PCB Full	2021-09-27	9:13	70,5035005	-138,831075	795
4	480	Nutrient	2021-09-27	17:15	70,3344708	-139,150148	560
4	476/PCB-18	Full	2021-09-27	21:07	69,9841968	-138,665016	267
4	478/PCB-19	PCB Basic	2021-09-28	10:22	70,166343	-138,901381	375
4	474	Nutrient	2021-09-28	17:30	69,7985268	-138,433038	173
4	472	Nutrient	2021-09-28	20:14	69,6097535	-138,221304	125
4	470/PCB-17	PCB Full	2021-09-28	23:57	69,4290052	-138,000758	54
4	PCB-17A	PCB Basic	2021-09-29	8:58	69,2878232	-137,279269	
4	PCB-11	PCB Full	2021-09-29	21:12	70,5474777	-136,009515	74
4	PCB-13	PCB Full	2021-09-30	9:23	69,9916265	-135,445774	32
4	PCB-12	PCB Basic	2021-09-30	16:29	70,2798583	-135,775621	57
4	PCB-10	PCB Basic	2021-10-01	0:06	70,9095063	-136,282126	955
4	PCB-14	PCB Basic	2021-10-01	8:28	70,2387003	-137,181052	57
4	516	Basic	2021-10-03	4:26	74,8405442	-121,461111	509
4	518N	Coring	2021-10-03	12:11	74,679869	-121,451775	525

Leg	Station ID	Station Type	UTC Date	UTC Time	Latitude (N)	Longitude (W)	Depth (m)
4	515	Nutrient	2021-10-04	0:02	75,0255692	-121,35572	476
4	518	Nutrient	2021-10-04	14:02	74,5951968	-121,469305	420
4	PKC_UluBluff-21	Mooring	2021-10-06	9:24	70,7083173	-117,8754	118
Leg 5							
5	DE110	Open water	2021-10-12	14:43	76,0608588	-77,1256327	314
5	DE120	Sea Ice	2021-10-13	16:22	76,26983	-78,902566	105
5	DE130	Sea Ice	2021-10-14	13:03	76,3868822	-78,2395397	147
5	DE210		2021-10-15	13:48	76,7668187	-75,0580377	466
5	DE310	Open water	2021-10-16	12:51	78,2402227	-74,051472	620
5	DE320	Sea Ice	2021-10-17	12:10	78,2048982	-74,551687	575
5	DE400		2021-10-20	0:01	76,001293	-81,7827572	707
5	DE410		2021-10-20	10:19	75,9618067	-85,5946955	616
5	DE420		2021-10-21	10:15	75,962682	-85,5944275	615
5	DE430		2021-10-22	12:03	76,2251848	-81,736267	
5	DE440		2021-10-23	0:36	76,2262515	-81,731481	274
5	BB2		2021-10-25	18:03	72,7493115	-67,0016382	2370

Appendix 2 - CTD Logbook for the 2021 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	CTD_Test	2021-07-05	20:11:00	49.30462	-64.32268	365	383
Leg 1	002	CTD_Test2	2021-07-06	19:48:00	46.79864	-57.28866	180	200
Leg 1	003	MSP21-15	2021-07-09	21:44:00	50.4555	-49.45736	1691	1701
Leg 1	004	MSP21-32	2021-07-11	13:44:00	51.27284	-50.0002	728	734
Leg 2								
Leg 2	001	Test-labrador	2021-07-17	12:56:00	50.9121	-52.75352	99	359
Leg 2	002	Test-labrador	2021-07-17	13:34:00	50.91544	-52.75092	99	364
Leg 2	003	Test-labrador	2021-07-17	14:11:00	50.91738	-52.74726	101	360
Leg 2	004	644	2021-07-18	08:52:00	54.82266	-53.21846	976	984
Leg 2	005	652	2021-07-18	21:22:00	55.65058	-55.54234	2394	2411
Leg 2	006	Makkovik	2021-07-19	23:03:00	55.53556	-58.95164	757	780
Leg 2	007	Makkovik	2021-07-20	10:56:00	55.427433	-58.8159833	445	453
Leg 2	008	Makkovik	2021-07-21	11:18:00	55.5176	-58.94244	631	644
Leg 2	009	Kelp2021	2021-07-23	05:42:00	58.66856	-62.60524	131	143
Leg 2	010	Sagbank-21CROM	2021-07-23	23:21:00	59.38164	-60.3326	400	412
Leg 2	011	HiBioA-20	2021-07-24	07:31:00	60.4526	-61.26832	456	461
Leg 2	012	SaglekBank	2021-07-24	12:08:00	60.52764	-61.25206	555	565
Leg 2	013	SaglekBank	2021-07-24	22:20:00	60.51758	-61.27464	411	421
Leg 2	014	HiBio-A-21	2021-07-25	09:49:00	60.4684	-61.28174	389	399
Leg 2	015	HIBIO-C	2021-07-26	01:30:00	60.46214	-61.16572	962	970
Leg 2	016	SaglekBank	2021-07-26	08:58:00	60.50234	-61.23074	771	778
Leg 2	017	Hatton Sill	2021-07-26	20:23:00	61.4364	-60.67124	587	596
Leg 2	018	Hatton Sill	2021-07-27	04:57:00	61.43948	-60.65972	630	641
Leg 2	019	Hatton Sill	2021-07-27	11:53:00	61.43592	-60.6672	587	594
Leg 2	020	Davis Strait	2021-07-28	16:33:00	63.3506	-58.27266	1277	1288
Leg 2	021	Davis Strait	2021-07-29	01:58:00	63.39846	-58.5255	1090	1099
Leg 2	022	Davis Strait	2021-07-29	09:13:00	63.34714	-58.19752	1284	1293
Leg 2	023	SF3.1	2021-07-31	18:39:00	66.76082	-62.33444	107	117
Leg 2	024	Disko Fan	2021-08-02	00:51:00	67.88084	-59.37168	921	929
Leg 2	025	Disko Fan	2021-08-02	09:49:00	67.8848	-59.36988	907	916
Leg 2	026	Scott Inlet	2021-08-04	10:02:00	71.3792	-70.0758	256	265
Leg 2	027	Scott Inlet	2021-08-04	21:38:00	71.37926	-70.07136	246	260
Leg 2	028	SE-1K	2021-08-04	23:11:00	71.3726	-70.0489	2	12
Leg 2	029	NE-1K	2021-08-04	23:31:00	71.3866	-70.05528	3	259
Leg 2	030	NE-5K	2021-08-05	00:00:00	71.40964	-69.97634	2	264
Leg 2	031	Scott Inlet	2021-08-05	01:18:00	71.39108	-70.30102	686	695
Leg 2	032	Stn0t1	2021-08-06	02:25:00	71.37714	-70.07888	253	262
Leg 2	033	Gib-3.1	2021-08-07	13:49:00	70.6491	-72.48339	2	262
Leg 2	034	Clark Fjord CTD	2021-08-07	23:41:00	71.04914	-71.58804	668	678
Leg 2	035	Ice-station	2021-08-09	03:11:00	67.36072	-62.23364	227	236
Leg 3								
Leg 3	001	MVP	2021-08-14	04:55:00	62.17766	-68.41176	94	103
Leg 3	002	Q3	2021-08-14	20:23:00	61.04918	-69.66698	41	50
Leg 3	003	Q4	2021-08-14	22:12:00	61.0323	-69.69044	39	48
Leg 3	004	Q6	2021-08-15	00:44:00	61.05062	-69.7137	91	98
Leg 3	005	Q2	2021-08-15	03:08:00	61.07428	-69.63908	79	87
Leg 3	006	356	2021-08-15	21:57:00	60.80752	-64.70674	339	346
Leg 3	007	354	2021-08-16	01:05:00	60.96822	-64.79154	567	577
Leg 3	008	352	2021-08-16	04:13:00	61.1724	-64.77262	358	374
Leg 3	009	A1	2021-08-17	13:25:00	66.60536	-61.19406	93	102
Leg 3	010	A2	2021-08-17	19:22:00	66.66922	-60.46172	517	525
Leg 3	011	A3	2021-08-18	04:32:00	66.734	-59.61186	864	874

Leg	Cast #	Station	Start date UTC	Time UTC	Latitude (N)	Longitude (W)	Cast depth (m)	Bottom depth (m)
Leg 3	012	A4	2021-08-18	14:53:00	66.80262	-58.77082	902	910
Leg 3	013	A5	2021-08-19	01:02:00	66.86974	-57.95128	808	817
Leg 3	014	195	2021-08-19	10:35:00	66.8917	-56.91582	650	658
Leg 3	015	196	2021-08-19	17:05:00	66.98206	-56.06826	123	131
Leg 3	016	197	2021-08-19	21:53:00	67.04334	-55.08514	60	70
Leg 3	017	198	2021-08-20	01:38:00	67.08424	-54.20104	65	74
Leg 3	018	B5	2021-08-20	16:50:00	67.589	-59.02044	1179	1189
Leg 3	019	B4	2021-08-21	00:40:00	67.46194	-59.6476	1445	1453
Leg 3	020	B3	2021-08-21	08:35:00	67.33084	-60.27806	1076	1086
Leg 3	021	B2	2021-08-21	19:05:00	67.19822	-60.89922	628	636
Leg 3	022	B1	2021-08-22	05:04:00	67.0605	-61.51596	103	111
Leg 3	023	merchant	2021-08-22	10:59:00	67.30516	-62.17148	375	384
Leg 3	024	merchant	2021-08-22	20:28:00	67.47802	-61.6465	366	374
Leg 3	025	C1	2021-08-23	03:40:00	67.3485	-62.52316	127	136
Leg 3	026	C2	2021-08-23	08:29:00	67.55148	-61.90788	444	452
Leg 3	027	C3	2021-08-23	18:25:00	67.75304	-61.2808	1555	1564
Leg 3	028	C4	2021-08-24	04:18:00	67.9554	-60.62784	1597	1607
Leg 3	029	C5	2021-08-24	08:31:00	68.14936	-59.96764	1373	1383
Leg 3	030	C5	2021-08-24	14:33:00	68.16414	-60.01394	363	1409
Leg 3	031	D5	2021-08-24	23:43:00	68.9999	-61.40248	1827	1835
Leg 3	032	D4	2021-08-25	07:52:00	68.62994	-61.97778	1794	1804
Leg 3	033	D3	2021-08-25	13:02:00	68.2406	-62.59062	1552	1560
Leg 3	034	D2	2021-08-25	22:48:00	67.85768	-63.1491	259	269
Leg 3	035	mapping	2021-08-26	03:20:00	67.88912	-63.10074	339	349
Leg 3	036	mapping	2021-08-26	09:14:00	67.87522	-63.09648	283	289
Leg 3	037	D1	2021-08-26	21:48:00	67.47326	-63.69294	661	670
Leg 3	038	E1	2021-08-27	12:40:00	68.27712	-65.1376	439	449
Leg 3	039	E2	2021-08-27	21:24:00	68.53786	-64.65796	498	507
Leg 3	040	E3	2021-08-28	02:24:00	68.8008	-64.15976	1290	1298
Leg 3	041	E4	2021-08-28	16:16:00	69.21474	-63.34744	1844	1852
Leg 3	042	E5	2021-08-28	23:28:00	69.60428	-62.54172	1963	1972
Leg 3	043	E5	2021-08-29	05:36:00	69.60442	-62.54136	199	1975
Leg 3	044	116	2021-08-31	10:03:00	76.38016	-70.51468	128	137
Leg 3	045	115	2021-08-31	13:00:00	76.33376	-71.20078	653	664
Leg 3	046	115	2021-08-31	15:22:00	76.33138	-71.20458	637	646
Leg 3	047	114	2021-08-31	22:01:00	76.32602	-71.78564	602	611
Leg 3	048	113	2021-08-31	23:14:00	76.32048	-72.21786	541	550
Leg 3	049	112	2021-09-01	01:02:00	76.31576	-72.7023	555	564
Leg 3	050	111	2021-09-01	02:51:00	76.3069	-73.22278	581	590
Leg 3	051	110	2021-09-01	05:35:00	76.29932	-73.63642	520	529
Leg 3	052	109	2021-09-01	07:30:00	76.29102	-74.11542	444	452
Leg 3	053	108	2021-09-01	09:59:00	76.2641	-74.59804	438	447
Leg 3	054	107	2021-09-01	16:29:00	76.28346	-75.00224	425	435
Leg 3	055	106	2021-09-01	19:20:00	76.31076	-75.34912	373	382
Leg 3	056	105	2021-09-01	20:56:00	76.31676	-75.7773	321	335
Leg 3	057	104	2021-09-02	00:09:00	76.35128	-76.20756	160	168
Leg 3	058	103	2021-09-02	00:59:00	76.36862	-76.54802	145	155
Leg 3	059	102	2021-09-02	02:13:00	76.37448	-76.97844	233	243
Leg 3	060	Mittie	2021-09-02	07:47:00	77.16002	-77.9813	252	261
Leg 3	061	Mittie	2021-09-02	09:45:00	77.19322	-78.589	743	752
Leg 3	062	101	2021-09-02	21:38:00	76.38476	-77.41432	361	370
Leg 3	063	100	2021-09-03	03:46:00	76.41052	-77.95636	219	228
Leg 3	064	Mittie	2021-09-03	16:33:00	76.96308	-79.13754	204	215
Leg 3	065	322	2021-09-05	04:46:00	74.5006	-80.53338	651	659

Leg	Cast #	Station	Start date UTC	Time UTC	Latitude (N)	Longitude (W)	Cast depth (m)	Bottom depth (m)
Leg 3	066	300	2021-09-05	07:04:00	74.31652	-80.4615	691	700
Leg 3	067	323	2021-09-05	09:19:00	74.15536	-80.4707	776	785
Leg 3	068	324	2021-09-05	11:47:00	73.98624	-80.47006	759	768
Leg 3	069	325	2021-09-05	14:48:00	73.81762	-80.48216	683	692
Leg 3	070	305D	2021-09-07	02:05:00	74.6025	-93.74076	118	127
Leg 3	071	305C	2021-09-07	04:24:00	74.48416	-93.63494	161	170
Leg 3	072	305B	2021-09-07	09:30:00	74.35146	-93.5646	157	164
Leg 3	073	305A	2021-09-07	12:36:00	74.24894	-93.49722	158	166
Leg 3	074	S10	2021-09-07	21:13:00	74.54252	-90.41156	177	186
Leg 3	075	S11	2021-09-07	23:08:00	74.57316	-90.36242	82	91
Leg 3	076	S9	2021-09-08	00:27:00	74.46268	-90.52872	255	264
Leg 3	077	S8	2021-09-08	04:39:00	74.40264	-90.6231	187	196
Leg 3	078	S7	2021-09-08	06:35:00	74.3443	-90.71208	199	209
Leg 3	079	S6	2021-09-08	07:21:00	74.2804	-90.80448	206	216
Leg 3	080	S5	2021-09-08	10:01:00	74.22026	-90.9043	289	297
Leg 3	081	S3	2021-09-08	12:56:00	74.09962	-91.08406	143	152
Leg 3	082	S1	2021-09-08	15:24:00	74.05804	-91.02606	97	107
Leg 3	083	S4	2021-09-08	16:53:00	74.1443	-91.0096	204	212
Leg 4								
Leg 4	001	C002	2021-09-10	21:46:00	73.96068	-88.81604	401	419
Leg 4	002	C002	2021-09-10	23:51:00	73.96332	-88.80678	404	419
Leg 4	003	C003	2021-09-11	12:32:00	72.36456	-91.3996	373	388
Leg 4	004	C004	2021-09-11	22:01:00	71.95538	-95.8381	412	425
Leg 4	005	310E	2021-09-12	06:29:00	71.29218	-97.70124	121	130
Leg 4	006	C009	2021-09-12	13:50:00	70.70522	-98.9665	189	201
Leg 4	007	312	2021-09-13	00:56:00	69.17056	-100.7015	59	68
Leg 4	008	C010	2021-09-13	10:12:00	68.25118	-101.63036	90	105
Leg 4	009	QMG4-Y3	2021-09-13	21:01:00	68.4858	-103.44082	64	75
Leg 4	010	QMW	2021-09-14	02:03:00	68.7086	-104.66784	72	82
Leg 4	011	314	2021-09-15	00:56:00	68.9725	-105.47922	66	76
Leg 4	012	C011	2021-09-15	04:41:00	69.01794	-106.62002	103	113
Leg 4	013	C012	2021-09-15	13:53:00	68.32878	-110.27158	282	292
Leg 4	014	316	2021-09-15	21:53:00	68.3873	-112.12418	163	174
Leg 4	015	C013	2021-09-16	08:48:00	69.05562	-114.78434	82	91
Leg 4	016	C014	2021-09-16	18:03:00	69.61918	-118.60318	507	517
Leg 4	017	403	2021-09-17	00:53:00	70.09672	-120.1007	400	409
Leg 4	018	405-C015	2021-09-17	11:59:00	70.66688	-122.6227	577	586
Leg 4	019	PCB-01	2021-09-18	00:30:00	71.23292	-125.59848	405	413
Leg 4	020	PCB-01	2021-09-18	02:38:00	71.23406	-125.5904	53	412
Leg 4	021	407	2021-09-18	06:50:00	71.00402	-126.07526	380	390
Leg 4	022	409	2021-09-18	19:06:00	71.86892	-125.86752	95	105
Leg 4	023	410	2021-09-18	23:44:00	71.69882	-126.48732	396	405
Leg 4	024	411	2021-09-19	01:20:00	71.6297	-126.71012	424	432
Leg 4	025	412	2021-09-19	02:30:00	71.56462	-126.91892	403	414
Leg 4	026	413	2021-09-19	04:16:00	71.49542	-127.14154	360	368
Leg 4	027	414	2021-09-19	06:28:00	71.42364	-127.3731	294	304
Leg 4	028	415	2021-09-19	11:06:00	71.3629	-127.54866	236	245
Leg 4	029	416	2021-09-19	12:15:00	71.2921	-127.76972	146	155
Leg 4	030	417	2021-09-19	13:41:00	71.2248	-127.97002	75	84
Leg 4	031	418	2021-09-19	14:41:00	71.16332	-128.16724	55	64
Leg 4	032	419	2021-09-19	15:58:00	71.10668	-128.34488	46	55
Leg 4	033	420	2021-09-19	18:28:00	71.05172	-128.51394	30	40
Leg 4	034	JET1	2021-09-19	23:28:00	70.91364	-127.76398	107	117
Leg 4	035	JET2	2021-09-20	00:43:00	70.91526	-128.05214	78	86

Leg	Cast #	Station	Start date UTC	Time UTC	Latitude (N)	Longitude (W)	Cast depth (m)	Bottom depth (m)
Leg 4	036	JET3	2021-09-20	01:33:00	70.91584	-128.3431	43	50
Leg 4	037	JET4	2021-09-20	02:24:00	70.91392	-128.62918	32	41
Leg 4	038	JET5	2021-09-20	03:18:00	70.91416	-128.921	24	34
Leg 4	039	JET6	2021-09-20	05:01:00	71.052	-129.46122	30	39
Leg 4	040	JET7	2021-09-20	06:57:00	71.05314	-130.40014	36	45
Leg 4	041	PCB-05	2021-09-20	09:39:00	71.20298	-131.35184	65	74
Leg 4	042	PCB-04	2021-09-20	13:18:00	71.4511	-131.29428	523	532
Leg 4	043	PCB-04	2021-09-20	15:48:00	71.45102	-131.29364	199	533
Leg 4	044	PCB-02	2021-09-21	01:36:00	71.62248	-128.10596	304	311
Leg 4	045	PCB-02	2021-09-21	03:11:00	71.62092	-128.09706	21	312
Leg 4	046	PCB-03	2021-09-21	13:23:00	72.1118	-131.04664	1030	1040
Leg 4	047	PCB-03	2021-09-21	16:07:00	72.11308	-131.04674	1032	1041
Leg 4	048	PCB-06	2021-09-22	07:18:00	70.76182	-131.42958	40	50
Leg 4	049	PCB-06	2021-09-22	09:05:00	70.76252	-131.4303	41	49
Leg 4	050	PCB-07	2021-09-22	14:23:00	70.53484	-131.49526	41	51
Leg 4	051	PCB-07	2021-09-22	16:36:00	70.53494	-131.49474	42	51
Leg 4	052	434	2021-09-23	00:09:00	70.17648	-133.5551	36	45
Leg 4	053	433	2021-09-23	03:36:00	70.28794	-133.57572	46	54
Leg 4	054	432	2021-09-23	04:34:00	70.39426	-133.60718	52	61
Leg 4	055	431	2021-09-23	06:10:00	70.52488	-133.61374	58	67
Leg 4	056	431	2021-09-23	07:43:00	70.52488	-133.61374	4	64
Leg 4	057	430	2021-09-23	09:06:00	70.59822	-133.6417	61	69
Leg 4	058	429	2021-09-23	10:47:00	70.6959	-133.67098	59	67
Leg 4	059	428	2021-09-23	11:53:00	70.78962	-133.69836	63	73
Leg 4	060	427	2021-09-23	13:06:00	70.87946	-133.72032	70	79
Leg 4	061	426	2021-09-23	14:01:00	70.9764	-133.74496	83	93
Leg 4	062	435	2021-09-23	17:41:00	71.07806	-133.7768	291	301
Leg 4	063	424	2021-09-23	23:16:00	71.17554	-133.82442	574	584
Leg 4	064	423	2021-09-24	01:10:00	71.27088	-133.8537	786	796
Leg 4	065	422	2021-09-24	02:40:00	71.38032	-133.89252	1090	1099
Leg 4	066	421	2021-09-24	05:49:00	71.4697	-133.9095	1164	1174
Leg 4	067	546	2021-09-24	14:41:00	71.74238	-133.94744	1596	1606
Leg 4	068	546	2021-09-24	17:25:00	71.74166	-133.94918	1592	1602
Leg 4	069	PCB-21	2021-09-25	14:09:00	70.35478	-139.98298	448	457
Leg 4	070	PCB-21	2021-09-25	16:21:00	70.35394	-139.98446	161	458
Leg 4	071	PCB-22	2021-09-25	21:39:00	70.12276	-140.24566	44	47
Leg 4	072	PCB-22	2021-09-25	23:17:00	70.12136	-140.24494	38	47
Leg 4	073	PCB-23	2021-09-26	04:23:00	69.81032	-140.54854	30	32
Leg 4	074	PCB-20	2021-09-26	17:22:00	70.54988	-139.82032	766	776
Leg 4	075	PCB-20	2021-09-26	19:45:00	70.54916	-139.81986	60	781
Leg 4	076	482	2021-09-27	00:35:00	70.52438	-139.38086	811	820
Leg 4	077	PCB-16	2021-09-27	09:14:00	70.50344	-138.8311	781	788
Leg 4	078	PCB-16	2021-09-27	11:19:00	70.50458	-138.83226	70	800
Leg 4	079	480	2021-09-27	17:15:00	70.33438	-139.15024	548	555
Leg 4	080	476-PCB-18	2021-09-28	01:11:00	69.99844	-138.62892	261	270
Leg 4	081	476-PCB-18	2021-09-28	02:50:00	69.99836	-138.62828	22	271
Leg 4	082	476-PCB-18	2021-09-28	05:05:00	69.99868	-138.62894	261	270
Leg 4	083	478-PCB-19	2021-09-28	10:22:00	70.16624	-138.90132	364	373
Leg 4	084	478-PCB-19	2021-09-28	12:27:00	70.16372	-138.90796	25	372
Leg 4	085	474	2021-09-28	17:31:00	69.7985	-138.433	163	172
Leg 4	086	472	2021-09-28	20:15:00	69.60964	-138.22128	114	123
Leg 4	087	470/PCB-17	2021-09-29	02:13:00	69.43114	-137.99888	49	53
Leg 4	088	PCB-17A	2021-09-29	08:54:00	69.2878	-137.28	10	18
Leg 4	089	PCB-11	2021-09-29	21:12:00	70.54748	-136.00952	63	72

Leg	Cast #	Station	Start date UTC	Time UTC	Latitude (N)	Longitude (W)	Cast depth (m)	Bottom depth (m)
Leg 4	090	PCB-11	2021-09-29	23:05:00	70.5497	-136.0084	2	75
Leg 4	091	PCB-13	2021-09-30	09:24:00	69.9921	-135.4466	25	33
Leg 4	092	PCB-12	2021-09-30	16:29:00	70.27986	-135.77566	45	55
Leg 4	093	PCB-12	2021-09-30	18:16:00	70.27726	-135.77548	44	54
Leg 4	094	PCB-10	2021-10-01	00:06:00	70.9095	-136.28222	941	951
Leg 4	095	PCB-10	2021-10-01	02:27:00	70.91066	-136.27864	199	957
Leg 4	096	PCB-14	2021-10-01	08:28:00	70.23862	-137.18106	49	56
Leg 4	097	546	2021-10-01	19:03:00	71.74208	-133.94866	1598	1607
Leg 4	098	516	2021-10-03	05:15:00	74.84284	-121.38946	487	497
Leg 4	099	516	2021-10-03	08:56:00	74.84516	-121.41236	484	493
Leg 4	100	515	2021-10-04	05:42:00	75.0113	-121.36156	476	484
Leg 4	101	515	2021-10-04	07:32:00	75.00756	-121.3891	478	488
Leg 4	102	518	2021-10-04	14:03:00	74.59516	-121.46986	409	419
Leg 4	103	518	2021-10-04	17:22:00	74.59922	-121.45224	425	435
Leg 4	104	PKC	2021-10-06	09:23:00	70.70832	-117.8754	108	118
Leg 5								
Leg 5	001	DE110	2021-10-12	14:48:00	76.05976	-77.13048	302	307
Leg 5	002	DE110	2021-10-12	17:17:00	76.0356	-77.2371	260	279
Leg 5	003	DE110	2021-10-13	04:22:00	76.03676	-77.23108	273	283
Leg 5	004	DE120	2021-10-13	16:25:00	76.2689	-78.90492	85	104
Leg 5	005	DE120	2021-10-13	18:16:00	76.23404	-78.94972	112	131
Leg 5	006	DE120	2021-10-14	04:26:00	76.42184	-78.66346	204	213
Leg 5	007	DE130	2021-10-14	16:37:00	76.35706	-78.27702	133	154
Leg 5	008	DE210	2021-10-15	13:50:00	76.76558	-75.06064	445	459
Leg 5	009	DE310	2021-10-16	14:01:00	78.21016	-74.15422	622	639
Leg 5	010	DE310	2021-10-16	18:08:00	78.12826	-74.36608	660	679
Leg 5	011	DE310	2021-10-17	04:31:00	78.17242	-74.37376	685	694
Leg 5	012	DE320	2021-10-17	13:09:00	78.20078	-74.58944	583	602
Leg 5	013	DE320	2021-10-17	16:17:00	78.16722	-74.82546	576	595
Leg 5	014	DE320	2021-10-18	02:07:00	78.02586	-75.1448	610	621
Leg 5	015	DE320	2021-10-18	03:31:00	78.02906	-75.08874	200	633
Leg 5	016	DE320	2021-10-18	03:31:00	78.02906	-75.08874	200	633
Leg 5	017	DE400	2021-10-20	00:05:00	76.00098	-81.78544	690	699
Leg 5	018	DE410	2021-10-20	10:28:00	75.96378	-85.59172	600	608
Leg 5	019	DE410	2021-10-20	12:58:00	75.96392	-85.597	588	606
Leg 5	020	DE410	2021-10-20	16:10:00	75.96112	-85.58794	600	618
Leg 5	021	DE410	2021-10-20	19:00:00	75.9593	-85.59386	600	619
Leg 5	022	DE410	2021-10-20	22:02:00	75.96242	-85.59306	593	612
Leg 5	023	DE410	2021-10-21	01:10:00	75.95974	-85.58226	613	622
Leg 5	024	DE410	2021-10-21	04:08:00	75.96188	-85.58916	608	617
Leg 5	025	DE420	2021-10-21	10:18:00	75.96306	-85.59516	602	609
Leg 5	026	DE420	2021-10-21	13:05:00	75.96158	-85.60402	591	609
Leg 5	027	DE420	2021-10-21	16:02:00	75.97174	-85.682	540	559
Leg 5	028	DE420	2021-10-21	19:08:00	75.96236	-85.59012	595	615
Leg 5	029	DE420	2021-10-21	22:29:00	75.96232	-85.59476	593	612
Leg 5	030	DE430	2021-10-22	12:06:00	76.22528	-81.7358	252	271
Leg 5	031	DE430	2021-10-22	16:39:00	76.2276	-81.67914	185	201
Leg 5	032	DE430	2021-10-23	00:39:00	76.2265	-81.73046	270	278
Leg 5	033	DE430	2021-10-23	01:47:00	76.22502	-81.73166	230	237
Leg 5	034	DE430	2021-10-23	03:25:00	76.22736	-81.73744	230	296
Leg 5	035	DE440	2021-10-23	13:17:00	76.225	-81.73042	259	275
Leg 5	036	DE440	2021-10-24	01:49:00	76.18166	-81.81634	150	227
Leg 5	037	DE440	2021-10-24	02:43:00	76.1848	-81.82508	150	227
Leg 5	038	DE440	2021-10-24	03:33:00	76.18964	-81.79522	149	227

Leg	Cast #	Station	Start date UTC	Time UTC	Latitude (N)	Longitude (W)	Cast depth (m)	Bottom depth (m)
Leg 5	039	DE440	2021-10-24	05:08:00	76.18114	-81.83062	219	229
Leg 5	040	BB2	2021-10-25	18:06:00	72.74916	-67.00114	1482	2368
Leg 5	041	DE500	2021-10-27	10:37:00	68.08046	-58.78536	252	270
Leg 5	042	C-Node	2021-11-02	16:14:00	47.92436	-69.7602133	112	nan

Appendix 3 - List of participants on the 2021 Amundsen Expedition

Leg	Name	Position	Affiliation	Network Investigator/Supervisor	Embark place	Embark date	Disembark place	Disembark date
Leg 2	Algar, Christopher	Researcher/Professor	Dalhousie University	Algar, Chris	St. John's	2021-07-15	Iqaluit	2021-08-12
Leg 4	Alleosfour, Ahmadreza	Professional	University of New Brunswick	Church, Ian	Resolute Bay	2021-09-09	Cambridge Bay	2021-10-07
Leg 1	Amirault, Daniel	Professional	Amundsen Science	Forest, Alexandre	Quebec City	2021-06-30	St. John's	2021-07-15
Leg 3	Amirault, Daniel	Professional	Amundsen Science	Forest, Alexandre	Iqaluit	2021-08-12	Resolute Bay	2021-09-09
Leg 3	Amiraux, Rémi	Research Staff	Université Laval	Tremblay, Jean-Éric	Iqaluit	2021-08-12	Resolute Bay	2021-09-09
Leg 3, 4	Anderlini, Tia	PhD student	University of Victoria	Cullen, Jay	Iqaluit	2021-08-12	Cambridge Bay	2021-10-07
Leg 5	Ardyna, Mathieu	Researcher/Professor	Takuvik	Ardyna, Mathieu	Cambridge Bay	2021-10-07	Quebec City	2021-11-03
Leg 2	Armstrong, Maria	TBD	Dalhousie University	Algar, Chris	St. John's	2021-07-15	Iqaluit	2021-08-12
Leg 3, 4	Aubry, Cyril	Research Staff	Université Laval	Archambault, Philippe/Geoffroy	Iqaluit	2021-08-12	Cambridge Bay	2021-10-07
Leg 1	Auger, Vincent	Professional	Canadian Scientific Submersible Facility	Bancroft, Douglas	Quebec City	2021-06-30	St. John's	2021-07-04
Leg 3	Baak, Julia Ellen	Wildlife/Bird Observer	ECCC - Canadian Wildlife Service	Gjerdrum, Carina	Iqaluit	2021-08-12	Resolute Bay	2021-09-09
Leg 5	Babin, Marcel	Chief Scientist	Takuvik	Babin, Marcel	Cambridge Bay	2021-10-07	Quebec City	2021-11-03
Leg 5	Bailleul, Benjamin	Research Staff	ENS (France)	Bowler, Chris	Cambridge Bay	2021-10-07	Quebec City	2021-11-03
Leg 2	Barrett, Bianca	MSc Student	Memorial University of Newfoundland	Robert, Katleen	St. John's	2021-07-15	Iqaluit	2021-08-12
Leg 3	Barrette, Ariane	MSc Student	Université Laval	Archambault, Philippe	Iqaluit	2021-08-12	Resolute Bay	2021-09-09
Leg 5	Bécu, Guislain	Research Staff	Takuvik	Babin, Marcel	Cambridge Bay	2021-10-07	Quebec City	2021-11-03
Leg 3	Belko, Alexis	PhD Student	Université Laval	Lajeunesse, Patrick	Iqaluit	2021-08-12	Resolute Bay	2021-09-09
Leg 5	Bent, Emma	PhD Student	IFREMER (France)	Sutherland, Peter	Cambridge Bay	2021-10-07	Quebec City	2021-11-03
Leg 3	Bernstein, Sarah	Research Staff	ECCC	Jantunen, Liisa	Iqaluit	2021-08-12	Resolute Bay	2021-09-09
Leg 5	Biron, Jérémie	TBD	Takuvik	Tremblay, Jean-Eric	Cambridge Bay	2021-10-07	Quebec City	2021-11-03
Leg 2	Blais, Guillaume	MSc Student	Université Laval	Archambault, Philippe	St. John's	2021-07-15	Iqaluit	2021-08-12
Leg 2	Booker, Simone	Postdoctoral Fellow	University of Alberta	Sherwood, Owen	St. John's	2021-07-15	Iqaluit	2021-08-12
Leg 4	Bossé-Demers, Thomas	Research Staff	Université Laval	Couture, Raoul-Marie	Resolute Bay	2021-09-09	Cambridge Bay	2021-10-07
Leg 5	Bowler, Chris	Researcher/Professor	ENS (France)	Bowler, Chris	Cambridge Bay	2021-10-07	Quebec City	2021-11-03
Leg 2	Brake, Barry	Professional	Canadian Scientific Submersible Facility	Bancroft, Douglas	St. John's	2021-07-15	Iqaluit	2021-08-12
Leg 4	Bröder, Lisa	Research Staff	ETH Zurich, Switzerland	Vonk, Jorien	Resolute Bay	2021-09-09	Cambridge Bay	2021-10-07
Leg 1	Broom, Laura	Research Staff	NRCan - Geological Survey of Canada	Kostylev, Vladimir	St. John's	2021-07-04	St. John's	2021-07-15
Leg 3	Brulotte, Sylvie	Research Staff	DFO - Maurice Lamontagne Institute	Roy, Virginie	Iqaluit	2021-08-12	Resolute Bay	2021-09-09
Leg 5	Bruyant, Flavienne	Research Staff	Takuvik	Babin, Marcel	Cambridge Bay	2021-10-07	Quebec City	2021-11-03
Leg 1	Campbell, Lori	Research Staff	NRCan - Geological Survey of Canada	Kostylev, Vladimir	St. John's	2021-07-04	St. John's	2021-07-15
Leg 2	Carson, Thomas	Technician	NRCan - Geological Survey of Canada	Normandeau, Alexandre	St. John's	2021-07-15	Iqaluit	2021-08-12
Leg 4	Carson, Thomas	Technician	NRCan - Geological Survey of Canada	Campbell, Calvin	Resolute Bay	2021-09-09	Cambridge Bay	2021-10-07
Leg 3	Charette, Joannie	Research Staff	DFO - Freshwater Institute	Michel, Christine	Iqaluit	2021-08-12	Resolute Bay	2021-09-09
Leg 2	Chen, Shaomin	PhD Student	Dalhousie University	Sherwood, Owen	St. John's	2021-07-15	Iqaluit	2021-08-12
Leg 3	Ciastek, Stephen	Research Staff	University of Manitoba	Kuzyk, Zou Zou	Iqaluit	2021-08-12	Resolute Bay	2021-09-09
Leg 3	Cinq-Mars, Guillaume	Research Staff	Université Laval	Tremblay, Jean-Éric	Iqaluit	2021-08-12	Resolute Bay	2021-09-09
Leg 5	Coguiec, Estelle	PhD Student	UiT (Norway)	Daase, Malin	Cambridge Bay	2021-10-07	Quebec City	2021-11-03
Leg 3	Copland, Luke	Researcher/Professor	University of Ottawa	Copland, Luke	Iqaluit	2021-08-12	Resolute Bay	2021-09-09
Leg 2	Cote, David	Researcher/Professor	DFO - NL	Cote, David	St. John's	2021-07-15	Iqaluit	2021-08-12
Leg 5	Cournoyer, Alexandra	Professional	Canadian Ice Service	Thibault, Érick	Cambridge Bay	2021-10-07	Quebec City	2021-11-03
Leg 5	Daase, Malin	Researcher/Professor	UiT (Norway)	Daase, Malin	Cambridge Bay	2021-10-07	Quebec City	2021-11-03
Leg 3	Deslongchamps, Gabrièle	Research Staff	Université Laval	Tremblay, Jean-Éric	Iqaluit	2021-08-12	Resolute Bay	2021-09-09

Leg	Name	Position	Affiliation	Network Investigator/Supervisor	Embark place	Embark date	Disembark place	Disembark date
Leg 5	Deslongchamps, Gabrièle	Research Staff	Takuvik	Tremblay, Jean-Eric	Cambridge Bay	2021-10-07	Quebec City	2021-11-03
Leg 3	Desmarais, Amélie	Professional	Amundsen Science	Forest, Alexandre	Iqaluit	2021-08-12	Resolute Bay	2021-09-09
Leg 3	Dezutter, Thibaud	Professional	Amundsen Science	Forest, Alexandre	Iqaluit	2021-08-12	Resolute Bay	2021-09-09
Leg 5	Dorrell, Richard	Research Staff	ENS (France)	Bowler, Chris	Cambridge Bay	2021-10-07	Quebec City	2021-11-03
Leg 4	Dubeau, Maxime	TBD		Jantunen, Liisa	Resolute Bay	2021-09-09	Cambridge Bay	2021-10-07
Leg 5	Duchêne, Carole	PhD Student	ENS (France)	Bowler, Chris	Cambridge Bay	2021-10-07	Quebec City	2021-11-03
Leg 5	Dumont, Dany	Researcher/Professor	Université du Québec à Rimouski - ISMER	Dumont, Dany	Cambridge Bay	2021-10-07	Quebec City	2021-11-03
Leg 2	Edinger, Evan	Researcher/Professor	Memorial University of Newfoundland	Edinger, Evan	St. John's	2021-07-15	Iqaluit	2021-08-12
Leg 3	Else, Brent	Researcher/Professor	University of Calgary	Else, Brent	Iqaluit	2021-08-12	Resolute Bay	2021-09-09
Leg 4	Eulenburg, Antje	Technician	Alfred Wegener Institute, Germany	Vonk, Jorien	Resolute Bay	2021-09-09	Cambridge Bay	2021-10-07
Leg 5	Falciatore, Angela	Research Staff	ENS (France)	Bowler, Chris	Cambridge Bay	2021-10-07	Quebec City	2021-11-03
Leg 5	Fernandes, Luiz Filipe	Professional	Amundsen Science	Forest, Alexandre	Cambridge Bay	2021-10-07	Quebec City	2021-11-03
Leg 3	Fisher, Jonathan	Researcher/Professor	Memorial University of Newfoundland	Fisher, Jonathan	Iqaluit	2021-08-12	Resolute Bay	2021-09-09
Leg 5	Forget, Marie-Helene	Research Staff	Takuvik	Babin, Marcel	Cambridge Bay	2021-10-07	Quebec City	2021-11-03
Leg 4	Fox, Aislinn	MSc Student	University of Ottawa	Walker, Brett	Resolute Bay	2021-09-09	Cambridge Bay	2021-10-07
Leg 4	Fritz, Michael	Research Staff	Alfred Wegener Institute, Germany	Vonk, Jorien	Resolute Bay	2021-09-09	Cambridge Bay	2021-10-07
Leg 4	Gagnon, Jonathan	Research Staff	Université Laval	Tremblay, Jean-Éric	Resolute Bay	2021-09-09	Cambridge Bay	2021-10-07
Leg 3	Garbo, Adam	MSc Student	University of Ottawa	Copland, Luke	Iqaluit	2021-08-12	Resolute Bay	2021-09-09
Leg 2	Geizer, Haley	TBD	Dalhousie University	Algar, Chris	St. John's	2021-07-15	Iqaluit	2021-08-12
Leg 2	Geoffroy, Maxime	Chief Scientist	Memorial University of Newfoundland	Geoffroy, Maxime	St. John's	2021-07-15	Iqaluit	2021-08-12
Leg 5	Geoffroy, Maxime	Researcher/Professor	Memorial University of Newfoundland	Geoffroy, Maxime	Cambridge Bay	2021-10-07	Quebec City	2021-11-03
Leg 1	Guillot, Pascal	Professional	Amundsen Science - Québec-Océan	Forest, Alexandre	Quebec City	2021-06-30	St. John's	2021-07-15
Leg 3	Guillot, Pascal	Professional	Amundsen Science	Forest, Alexandre	Iqaluit	2021-08-12	Resolute Bay	2021-09-09
Leg 4	Guilmette, Caroline	Research Staff	Université Laval	Tremblay, Jean-Éric	Resolute Bay	2021-09-09	Cambridge Bay	2021-10-07
Leg 5	Hatlebakk, Maja	Postdoctoral Fellow	NTNU (Norway)	Johnsen, Geir	Cambridge Bay	2021-10-07	Quebec City	2021-11-03
Leg 3, 4	Herbig, Jennifer	PhD Student	Memorial University of Newfoundland	Geoffroy, Maxime	Iqaluit	2021-08-12	Cambridge Bay	2021-10-07
Leg 2	Jacobsen, Eugenie	MSc student	Memorial University of Newfoundland	Geoffroy, Maxime	St. John's	2021-07-15	Iqaluit	2021-08-12
Leg 4	Jasperse, Liam	MSc Student	University of Ottawa	Walker, Brett	Resolute Bay	2021-09-09	Cambridge Bay	2021-10-07
Leg 2	Ji, Meng	MSc Student	University of Calgary	Hubert, Casey	St. John's	2021-07-15	Iqaluit	2021-08-12
Leg 5	Joli, Natalie	Postdoctoral Fellow	ENS (France)	Bowler, Chris	Cambridge Bay	2021-10-07	Quebec City	2021-11-03
Leg 4	Juhls, Bennet	Research Staff	Alfred Wegener Institute, Germany	Vonk, Jorien	Resolute Bay	2021-09-09	Cambridge Bay	2021-10-07
Leg 5	Katlein, Christian	Researcher/Professor	AWI (Germany)	Babin, Marcel	Cambridge Bay	2021-10-07	Quebec City	2021-11-03
Leg 3	Koerner, Kelsey	PhD Student	Université du Québec à Rimouski - ISMER	Rochon, André / Limoges, Audr	Iqaluit	2021-08-12	Resolute Bay	2021-09-09
Leg 1	Kostylev, Vladimir	Chief Scientist	NRCan - Geological Survey of Canada	Kostylev, Vladimir	St. John's	2021-07-04	St. John's	2021-07-15
Leg 1, 2	Langevin, Cécile	Professional	Amundsen Science	Forest, Alexandre	Quebec City	2021-06-30	Iqaluit	2021-08-12
Leg 4	Lattaud, Julie	Research Staff	ETH Zurich, Switzerland	Vonk, Jorien	Resolute Bay	2021-09-09	Cambridge Bay	2021-10-07
Leg 5	Leymarie, Edouard	Research Staff	LOV (France)	Babin, Marcel	Cambridge Bay	2021-10-07	Quebec City	2021-11-03
Leg 4	Lizotte, Martine	Chief Scientist	Amundsen Science	Forest, Alexandre	Resolute Bay	2021-09-09	Cambridge Bay	2021-10-07
Leg 2	Lockhart, Peter	Professional	Canadian Scientific Submersible Facility	Bancroft, Douglas	St. John's	2021-07-15	Iqaluit	2021-08-12
Leg 1, 2	Ludkin, Derek Owen (Rick)	Wildlife/Bird Observer	ECCC - Canadian Wildlife Service	Gjerdrum, Carina	Quebec City	2021-06-30	Iqaluit	2021-08-12
Leg 1, 2	Mackay, Reilly	BSc Student	Memorial University of Newfoundland	Forest, Alexandre	St. John's	2021-07-04	Iqaluit	2021-08-12
Leg 1	MacKillop, Kevin	Professional	NRCan - Geological Survey of Canada	Kostylev, Vladimir	St. John's	2021-07-04	St. John's	2021-07-15
Leg 3	Marcil, Catherine	Research Staff	DFO - Freshwater Institute	Hedges, Kevin	Iqaluit	2021-08-12	Resolute Bay	2021-09-09

Leg	Name	Position	Affiliation	Network Investigator/Superviso	Embark place	Embark date	Disembark place	isembark dat
Leg 5	Marec, Claudie	Research Staff	Takuvik	Babin, Marcel	Cambridge Bay	2021-10-07	Quebec City	2021-11-03
Leg 4	Matsuoka, Atsushi	Researcher/Professor	University of New Hampshire, USA	Vonk, Jorien	Resolute Bay	2021-09-09	Cambridge Bay	2021-10-07
Leg 5	Matthes, Lisa	Postdoctoral Fellow	Takuvik	Babin, Marcel	Cambridge Bay	2021-10-07	Quebec City	2021-11-03
Leg 4	McKee, Kayla	MSc Student	University of Ottawa	Walker, Brett	Resolute Bay	2021-09-09	Cambridge Bay	2021-10-07
Leg 2	Meredyk, Shawn	Professional	Amundsen Science	Forest, Alexandre	St. John's	2021-07-15	Iqaluit	2021-08-12
Leg 1	Merzouk, Anissa	Professional	Amundsen Science	Forest, Alexandre	Quebec City	2021-06-30	St. John's	2021-07-15
Leg 5	Mével, Gaëlle	BSc Student	Takuvik	Babin, Marcel	Cambridge Bay	2021-10-07	Quebec City	2021-11-03
Leg 1	Michaud, Luc	Professional	Amundsen Science	Forest, Alexandre	Quebec City	2021-06-30	St. John's	2021-07-15
Leg 4	Michaud, Luc	Professional	Amundsen Science	Forest, Alexandre	Resolute Bay	2021-09-09	Cambridge Bay	2021-10-07
Leg 3	Montero-Serrano, Jean-Carlos	Researcher/Professor	Université du Québec à Rimouski - ISMER	Montero-Serrano, Jean-Carlos	Iqaluit	2021-08-12	Resolute Bay	2021-09-09
Leg 2	Morisset, Simon	Professional	Amundsen Science	Forest, Alexandre	St. John's	2021-07-15	Iqaluit	2021-08-12
Leg 2	Morrissey, Christopher	Professional	Amundsen Science	Forest, Alexandre	St. John's	2021-07-15	Iqaluit	2021-08-12
Leg 5	Morrissey, Christopher	Professional	Amundsen Science	Forest, Alexandre	Cambridge Bay	2021-10-07	Quebec City	2021-11-03
Leg 2	Murray, Kathryn	MSc Student	Memorial University of Newfoundland	Mercier, Annie	St. John's	2021-07-15	Iqaluit	2021-08-12
Leg 2	Neves, Barbara	Researcher/Professor	DFO - NL	Neves, Barbara	St. John's	2021-07-15	Iqaluit	2021-08-12
Leg 3, 4	Nickoloff, Gina	MSc Student	University of Calgary	Else, Brent	Iqaluit	2021-08-12	Cambridge Bay	2021-10-07
Leg 5	Nicot, Paul	Research Staff	Université du Québec à Rimouski - ISMER	Dumont, Dany	Cambridge Bay	2021-10-07	Quebec City	2021-11-03
Leg 2	Normandeau, Alexandre	Researcher/Professor	NRCan - Geological Survey of Canada	Normandeau, Alexandre	St. John's	15-07-2021	Iqaluit	12-08-2021
Leg 4	O'Regan, Matt	Research Staff	Stockholm University, Sweden	Vonk, Jorien	Resolute Bay	2021-09-09	Cambridge Bay	2021-10-07
Leg 2	Ostiguy, Josiane	TBD	Memorial University of Newfoundland	Zedel, Len	St. John's	15-07-2021	Iqaluit	12-08-2021
Leg 1	Patton, Eric	Research Staff	NRCan - Geological Survey of Canada	Kostylev, Vladimir	St. John's	2021-07-04	St. John's	2021-07-15
Leg 1, 2	Pearson, Marcia	Professional	Amundsen Science	Forest, Alexandre	Quebec City	2021-06-30	Iqaluit	2021-08-12
Leg 4	Pearson, Marcia	Professional	Amundsen Science	Forest, Alexandre	Resolute Bay	2021-09-09	Cambridge Bay	2021-10-07
Leg 4	Pellerin, André	Researcher/Professor	Université du Québec à Rimouski - ISMER	Montero-Serrano, Jean-Carlos	Resolute Bay	2021-09-09	Cambridge Bay	2021-10-07
Leg 5	Pelletier, Eloise	MSc Student	Université du Québec à Rimouski - ISMER	Dumont, Dany	Cambridge Bay	2021-10-07	Quebec City	2021-11-03
Leg 4	Perron, Christophe	PhD Student	Université Laval	Forest, Alexandre	Resolute Bay	2021-09-09	Cambridge Bay	2021-10-07
Leg 2	Piccirillo, Laura	MSc Student	Memorial University of Newfoundland	Edinger, Evan	St. John's	15-07-2021	Iqaluit	12-08-2021
Leg 4	Poirier-Turcot, Audréanne	Professional	Canadian Ice Service	Thibault, Érick	Resolute Bay	2021-09-09	Cambridge Bay	2021-10-07
Leg 4	Priest, Taylor	Research Staff	Max Planck Insitute, Germany	Vonk, Jorien	Resolute Bay	2021-09-09	Cambridge Bay	2021-10-07
Leg 5	Priou, Pierre	PhD Student	Memorial University	Geoffroy, Maxime	Cambridge Bay	2021-10-07	Quebec City	2021-11-03
Leg 3	Pucko, Monika	Research Staff	DFO - Freshwater Institute	Michel, Christine	Iqaluit	2021-08-12	Resolute Bay	2021-09-09
Leg 5	Randelhoff, Achim	Research Staff	Takuvik	Babin, Marcel	Cambridge Bay	2021-10-07	Quebec City	2021-11-03
Leg 5	Raulier, Bastian	MSc Student	Takuvik	Babin, Marcel	Cambridge Bay	2021-10-07	Quebec City	2021-11-03
Leg 1	Robertson, Angus	Research Staff	NRCan - Geological Survey of Canada	Kostylev, Vladimir	St. John's	2021-07-04	St. John's	2021-07-15
Leg 4	Robitaille, Rachelle	Research Staff	ECCC	Jantunen, Liisa	Resolute Bay	2021-09-09	Cambridge Bay	2021-10-07
Leg 4	Rodriguez-Cuicas, Maria-Emilia	MSc Student	Université du Québec à Rimouski - ISMER	Montero-Serrano, Jean-Carlos	Resolute Bay	2021-09-09	Cambridge Bay	2021-10-07
Leg 2	Roul, Sheena	Professional	DFO - NL	Cote, David	St. John's	15-07-2021	Iqaluit	12-08-2021
Leg 1, 2	Roux, Dylan	Professional	Amundsen Science	Forest, Alexandre	Quebec City	2021-06-30	Iqaluit	2021-08-12
Leg 4, 5	Roux, Dylan	Professional	Amundsen Science	Forest, Alexandre	Resolute Bay	2021-09-09	Quebec City	2021-11-03
Leg 3	Roy, Cameron	Professional	Canadian Ice Service	Thibault, Érick	Iqaluit	2021-08-12	Resolute Bay	2021-09-09
Leg 4	Rudbäck, Daniel	Research Staff	Stockholm University, Sweden	Vonk, Jorien	Resolute Bay	2021-09-09	Cambridge Bay	2021-10-07
Leg 3	Salant, Carlissa	PhD student	Memorial University of Newfoundland	Parrish, Chris	Iqaluit	2021-08-12	Resolute Bay	2021-09-09
Leg 3	Scholz, Daniel	Professional	Amundsen Science	Forest, Alexandre	Iqaluit	2021-08-12	Resolute Bay	2021-09-09

Leg	Name	Position	Affiliation	Network Investigator/Superviso	Embark place	Embark date	Disembark place	isembark dat
Leg 5	Scholz, Daniel	Professional	Amundsen Science	Forest, Alexandre	Cambridge Bay	2021-10-07	Quebec City	2021-11-03
Leg 3	Schuler, Katrina	PhD Student	University of British Columbia	Tortell, Philippe	Iqaluit	2021-08-12	Resolute Bay	2021-09-09
Leg 1	Seiden, Jennica	Research Staff	DFO - NL	Cote, David	St. John's	2021-07-04	St. John's	2021-07-15
Leg 5	Sellet, Hugo	Professional	IFREMER (France)	Sutherland, Peter	Cambridge Bay	2021-10-07	Quebec City	2021-11-03
Leg 3	Sezginer, Yayla	MSc Student	University of British Columbia	Tortell, Philippe	Iqaluit	2021-08-12	Resolute Bay	2021-09-09
Leg 2	Sharpe, Hannah	MSc Student	University of New Brunswick	Limoges, Audrey	St. John's	15-07-2021	Iqaluit	12-08-2021
Leg 5	Sivaram, Sneha	MSc Student	Takuvik	Babin, Marcel	Cambridge Bay	2021-10-07	Quebec City	2021-11-03
Leg 4	Soetaert, Grayson	BSc Student	University of Victoria	Tremblay, Jean-Éric / Cullen, Ja	Resolute Bay	2021-09-09	Cambridge Bay	2021-10-07
Leg 3	St-Denis, Bruno	Research Staff	DFO - Maurice Lamontagne Institute	Roy, Virginie	Iqaluit	2021-08-12	Resolute Bay	2021-09-09
Leg 5	Stray, Jørgen Dalsmo	Technician	Kongsberg	Babin, Marcel	Cambridge Bay	2021-10-07	Quebec City	2021-11-03
Leg 5	Sutherland, Peter	Researcher/Professor	IFREMER (France)	Sutherland, Peter	Cambridge Bay	2021-10-07	Quebec City	2021-11-03
Leg 2	Sutton, Jordan	MSc student	Memorial University	Geoffroy, Maxime	St. John's	15-07-2021	Iqaluit	12-08-2021
Leg 5	Taillandier, Vincent	Research Staff	LOV (France)	Babin, Marcel	Cambridge Bay	2021-10-07	Quebec City	2021-11-03
Leg 2	Tamburri, Keith	Professional	Canadian Scientific Submersible Facility	Bancroft, Douglas	St. John's	15-07-2021	Iqaluit	12-08-2021
Leg 3	Tremblay, Jean-Éric	Chief Scientist	Université Laval	Tremblay, Jean-Éric	Iqaluit	2021-08-12	Resolute Bay	2021-09-09
Leg 3	Tremblay, Pascal	Research Staff	DFO - Freshwater Institute	Michel, Christine	Iqaluit	2021-08-12	Resolute Bay	2021-09-09
Leg 4	Tremblay-Gagnon, Félix	MSc student	Université du Québec à Rimouski	Robert, Dominique	Resolute Bay	2021-09-09	Cambridge Bay	2021-10-07
Leg 3	Vandenbyllaardt, Lenore	Research Staff	DFO - Freshwater Institute	Hedges, Kevin	Iqaluit	2021-08-12	Resolute Bay	2021-09-09
Leg 4	Veenaas, Cathrin	Postdoctoral Fellow	University of Manitoba	Stern, Gary	Resolute Bay	2021-09-09	Cambridge Bay	2021-10-07
Leg 5	Vilgrain, Laure	PhD Student	Takuvik & LOV	Maps, Frédéric	Cambridge Bay	2021-10-07	Quebec City	2021-11-03
Leg 3	Villeneuve, Vincent	Research Staff	DFO - Freshwater Institute	Michel, Christine	Iqaluit	2021-08-12	Resolute Bay	2021-09-09
Leg 2	Vogt, Judith	PhD Student	St. Francis Xavier University	Sherwood, Owen	St. John's	15-07-2021	Iqaluit	12-08-2021
Leg 4	Whalen, Dustin	Professional	NRCan - Geological Survey of Canada	Campbell, Calvin	Resolute Bay	2021-09-09	Cambridge Bay	2021-10-07
Leg 2	Williams, Thomas	PhD Student	University of Southampton, UK	Solan, Martin / Archambault, P	St. John's	15-07-2021	Iqaluit	12-08-2021
Leg 2	Wolvin, Sophie	MSc Student	Memorial University of Newfoundland	Mercier, Annie	St. John's	15-07-2021	Iqaluit	12-08-2021

Appendix 4 - Scientific log of science activities conducted during the 2021 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		Test	2021-07-05	20:08	49,3053645	-64,3229002	Net tow			298	5,5	15,3	12,00	30,10	1007,10	84	
1		Test	2021-07-05	20:10	49,304906	-64,3228458	CTD Rosette	Deployment		287	5,9	15,2	12,76	30,11	1007,15	84	
1		Test	2021-07-05	20:26	49,3036107	-64,3204628	CTD Rosette	Bottom	383	278	5,1	15,4	13,98	29,77	1007,01	84	
1		Test	2021-07-05	20:45	49,302124	-64,3195885	CTD Rosette	Recovery	383	301	5,5	15,5	11,07	30,39	1007,01	83	
1		Test	2021-07-06	19:43	46,7975385	-57,2884127	CTD Rosette	Deployment	198	233	20,8	13	11,08	31,70	1009,09	87	
1		Test	2021-07-06	19:56	46,7999682	-57,2891507	CTD Rosette	Bottom	200	231	20,6	12,9	11,15	31,70	1009,21	89	
1		Test	2021-07-06	20:01	46,8007917	-57,289282	CTD Rosette	Recovery	201	221	16,9	13	11,11	31,70	1009,01	90	
1	MSP21-15	Camera	2021-07-09	21:32	50,4555657	-49,4588892	CTD Rosette	Deployment		186	14,9	9,1			1024,99	81	
1	MSP21-15	Camera	2021-07-09	22:17	50,4554227	-49,4532395	CTD Rosette	Bottom		172	13,1	12,5			1024,73	68	
1	MSP21-15	Camera	2021-07-09	22:58	50,4563508	-49,446671	CTD Rosette	Recovery	1716	177	12,8	11,9			1025,09	71	
1	MSP21-30	Coring	2021-07-11	11:06	51,2230463	-49,8370522	Box Core	Deployment	963	233	10,7	7,7	7,94	33,85	1016,33	96	
1	MSP21-30	Coring	2021-07-11	11:26	51,2246927	-49,831026	Box Core	Bottom	980	226	11,2	7,8	7,97	33,86	1016,51	97	
1	MSP21-30	Coring	2021-07-11	11:52	51,2243862	-49,8320887	Box Core	Recovery	976	243	11	8,5	7,95	33,85	1016,60	94	
1	MSP21-32	Coring	2021-07-11	13:39	51,2729862	-50,0016932	CTD Rosette	Deployment	715	218	10,9	8,8	8,12	33,85	1016,75	94	
1	MSP21-32	Coring	2021-07-11	14:00	51,2705443	-49,9975042	CTD Rosette	Bottom	735	212	13,1	8,7	8,26	33,84	1016,71	94	
1	MSP21-32	Coring	2021-07-11	14:32	51,2674717	-49,988592	CTD Rosette	Recovery	733	206	11,6	9,1	8,33	33,84	1016,79	94	
1	MSP21-31	Coring	2021-07-11	18:58	51,3073595	-49,9348145	Piston Core	Deployment	1084	209	3,4	10,1	8,81	33,96	1017,67	94	
1	MSP21-31	Coring	2021-07-11	19:23	51,3044497	-49,9270305	Piston Core	Bottom	1109	241	10,1	10,3	8,77	33,96	1017,65	93	
1	MSP21-31	Coring	2021-07-11	19:51	51,3028852	-49,9217397	Piston Core	Recovery	1112	223	12,2	9,9	8,91	33,97	1017,75	91	
1		Coring	2021-07-12	12:14	51,2704813	-50,0147203	Piston Core	Deployment	689				6,80	33,31			
1		Coring	2021-07-12	12:31	51,2705657	-50,0134792	Piston Core	Bottom	689	154	16,9	8,6	6,80	33,35	1014,40	99	
1		Coring	2021-07-12	12:59	51,2681672	-50,018708	Piston Core	Recovery	670	160	18,8	8,7	6,65	33,32	1014,31	99	
1	MSP21-10	Camera	2021-07-12	13:00	51,2681505	-50,0187598	Camera		669	162	17,3	8,7	6,71	33,31	1014,30	99	
1	MSP21-10	Camera	2021-07-12	17:07	51,1135527	-49,935797	Camera	Deployment	756	145	19,6	9	8,25	33,77	1012,15	99	
1	MSP21-10	Camera	2021-07-12	17:22	51,1134678	-49,9356997	Camera	Bottom	758	149	22,1	9,2	8,28	33,76	1011,68	99	
1	MSP21-10	Camera	2021-07-12	18:04	51,113821	-49,9375247	Camera	Recovery	755	157	15,2	9,1	8,22	33,74	1011,82	99	
1	MSP21-09	Camera	2021-07-12	18:51	51,1181375	-49,9137205	Camera	Deployment	744	134	16	8,9	7,95	33,70	1011,20	99	
1	MSP21-09	Camera	2021-07-12	19:05	51,1184557	-49,914339	Camera	Bottom	742	132	16,8	8,8	7,94	33,69	1010,97	99	
1	MSP21-09	Camera	2021-07-12	19:52	51,1181495	-49,9183585	Camera	Recovery	743	141	18,1	8,8	7,91	33,67	1010,42	99	
1	MSP21-13	Camera	2021-07-12	21:54	51,3712623	-49,7518748	Camera	Deployment	1863	140	12,9	9	8,67	34,12	1010,27	99	
1	MSP21-13	Camera	2021-07-12	22:48	51,3705892	-49,7521577	Camera	Bottom	1863	145	12,4	8,9	8,69	34,12	1009,65	99	
1	MSP21-13	Camera	2021-07-13	0:02	51,3699035	-49,7516545	Camera	Recovery	1861	126	10,9	8,8	8,78	34,14	1009,46	99	
Leg 2																	
2	ROV trial	Practive	2021-07-16	19:07	47,7769472	-53,0547678	ROV	Deployment		193	15,8	18,1	11,30	31,81	1018,12	80	
2	ROV trial	Practive	2021-07-16	19:47	47,7814803	-53,0543687	ROV	Bottom		196	14,9	16,2	11,25	31,81	1017,78	86	
2	ROV trial	Practive	2021-07-16	20:05	47,7821283	-53,0524448	ROV	Recovery		194	16,4	16,4	11,07	31,81	1017,60	85	
2	Rosette1_leg2	Practive	2021-07-17	12:56	50,9120952	-52,753538	CTD Rosette	Deployment	359	183	20,2	11,1	8,32	32,11	1009,36	98	0
2	Rosette1_leg2	Practive	2021-07-17	13:00	50,9123928	-52,7531087	CTD Rosette	Bottom	359	185	21,5	10,9	8,32	32,11	1009,21	99	0
2	Rosette1_leg2	Practive	2021-07-17	13:08	50,9128773	-52,7525307	CTD Rosette	Recovery	359	188	19,8	10,9	8,31	32,12	1009,16	99	0
2	Rosette1_leg2	Practive	2021-07-17	13:33	50,9154123	-52,7509088	CTD Rosette	Deployment	362	177	17,3	10,6	8,35	32,12	1008,90	99	0
2	Rosette1_leg2	Practive	2021-07-17	13:37	50,915654	-52,7509217	CTD Rosette	Bottom	364	184	18,7	10,8	8,35	32,13	1009,03	99	0
2	Rosette1_leg2	Practive	2021-07-17	13:43	50,9158982	-52,7504192	CTD Rosette	Recovery	362	183	18,7	10,9	8,36	32,12	1009,10	99	0
2	Rosette1_leg2	Practive	2021-07-17	14:10	50,917303	-52,7473283	CTD Rosette	Deployment					8,37	32,12			0
2	Rosette1_leg2	Practive	2021-07-17	14:18	50,9176727	-52,746929	CTD Rosette	Bottom					8,39	32,12			0
2	Rosette1_leg2	Practive	2021-07-17	14:22	50,9180367	-52,7467493	CTD Rosette	Recovery		181	19,8	10,8	8,38	32,13	1008,71	99	0
2	644	ArcticNet	2021-07-18	8:20	54,8169742	-53,2220512	Phytoplankton Net	Deployment	930				3,18	32,34			0
2	644	ArcticNet	2021-07-18	8:24	54,81536	-53,2198057	Phytoplankton Net	Bottom	925	203	8,6	7	2,37	32,51	1006,11	99	0
2	644	ArcticNet	2021-07-18	8:26	54,8146488	-53,218754	Phytoplankton Net	Recovery	926	204	8,2	6,9	4,37	32,29	1006,11	99	0
2	644	ArcticNet	2021-07-18	8:51	54,8226937	-53,2185825	CTD Rosette	Deployment	981	219	7,2	7,7	5,29	32,28	1005,91	99	0
2	644	ArcticNet	2021-07-18	9:10	54,8191488	-53,2101193	CTD Rosette	Bottom	979	237	1,7	8,4	4,00	32,27	1005,83	99	0
2	644	ArcticNet	2021-07-18	10:03	54,8087527	-53,1876673	CTD Rosette	Recovery	946	194	7,8	7,8	5,43	32,25	1005,89	99	0
2	644	ArcticNet	2021-07-18	10:46	54,8209265	-53,2291005	Box Core	Deployment	946	193	6,9	6,8	5,57	32,16	1006,00	99	0
2	644	ArcticNet	2021-07-18	11:16	54,8197778	-53,223706	Box Core	Bottom	947	221	9,5	6,8	5,74	32,15	1006,40	99	0
2	644	ArcticNet	2021-07-18	11:35	54,8174497	-53,2173102	Box Core	Recovery	946	230	8,8	6,8	5,94	32,20	1006,38	99	0
2	644	ArcticNet	2021-07-18	11:57	54,823374	-53,2304005	Box Core	Deployment	962	235	11,2	7	6,12	32,17	1006,36	99	0
2	644	ArcticNet	2021-07-18	12:19	54,8208152	-53,2250925	Box Core	Bottom	951	241	10,5	7	6,68	32,19	1006,31	99	0
2	644	ArcticNet	2021-07-18	12:38	54,8173807	-53,2184122	Box Core	Recovery	943	229	8,6	7	6,89	32,21	1006,54	99	0
2	652	ArcticNet	2021-07-18	20:52	55,650669	-55,5427533	Phytoplankton Net	Deployment	2440	295	14,5	9,5	8,84	34,49	1008,16	92	0
2	652	ArcticNet	2021-07-18	20:55	55,6502035	-55,5416823	Phytoplankton Net	Bottom	2437	300	15,2	9,5	8,83	34,49	1008,14	91	0
2	652	ArcticNet	2021-07-18	20:57	55,6498197	-55,5408185	Phytoplankton Net	Recovery		302	15	9,5	8,81	34,49	1008,20	91	0
2	652	ArcticNet	2021-07-18	21:21	55,6505687	-55,5426147	CTD Rosette	Deployment	2439	316	17,1	9,7	8,72	34,49	1008,45	89	0
2	652	ArcticNet	2021-07-18	22:06	55,6491728	-55,5360972	CTD Rosette	Bottom	2410	328	15,8	9,2	8,81	34,49	1009,13	89	0
2	652	ArcticNet	2021-07-18	23:51	55,6438432	-55,518312	CTD Rosette	Recovery	2432	346	12,2	7,7	8,72	34,49	1010,67	96	0
2	652	ArcticNet	2021-07-19	0:20	55,6625337	-55,56318	Box Core	Deployment	2434	351	12,2	8,1	8,68	34,49	1011,19	95	0
2	652	ArcticNet	2021-07-19	1:04	55,6554813	-55,5536193	Box Core	Bottom	2438	342	9,3	8,3	8,69	34,49	1011,77	95	0
2	652	ArcticNet	2021-07-19	1:45	55,6524578	-55,5405278	Box Core	Recovery	2443	308	11,2	8,3	8,70	34,49	1012,27	95	0
2	Makkovik	ROV/Benthic	2021-07-19	12:49	55,5524983	-59,0165302	Baited camera	Deployment	677	181	8	7,9	5,60	31,52	1014,39	92	0
2	Makkovik	ROV/Benthic	2021-07-19	13:11	55,551751	-59,0183433	Baited camera	Bottom	689	168	6,1	7,4	5,75	31,49	1014,06	92	0
2	Makkovik	ROV/Benthic	2021-07-19	14:25	55,5315297	-58,9603433	ROV	Deployment					5,60	31,60			0
2	Makkovik	ROV/Benthic	2021-07-19	17:38	55,5320958	-58,9587312	ROV	Bottom		140	13,7	7,3	6,22	31,63	1012,77	91	0

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						
2	Makkovik	ROV/Benthic	2021-07-19	20:59	55,5311162	-58,962961	ROV	Recovery		146	13,3	7,2	6,23	31,62	1011,49	94	0
2	Makkovik	ROV/Benthic	2021-07-19	22:28	55,5564978	-59,0240212	Baited camera	Recovery	618	145	13,3	7,5	6,16	31,65	1010,82	94	0
2	Makkovik	ROV/Benthic	2021-07-19	23:03	55,5355458	-58,951655	CTD Rosette	Deployment	761	138	13,1	7,2	5,80	31,69	1010,69	97	0
2	Makkovik	ROV/Benthic	2021-07-19	23:18	55,535899	-58,9533218	CTD Rosette	Bottom	776	139	12,9	7,3	5,64	31,68	1010,51	97	0
2	Makkovik	ROV/Benthic	2021-07-20	0:03	55,5377403	-58,9609208	CTD Rosette	Recovery	795	131	11,8	7,4	5,95	31,66	1010,27	97	0
2	Makkovik	ROV/Benthic	2021-07-20	0:20	55,5358812	-58,9519662	Phytoplankton Net	Deployment	764	131	10,7	7,3	6,41	31,65	1010,47	97	0
2	Makkovik	ROV/Benthic	2021-07-20	0:23	55,5357617	-58,9519118	Phytoplankton Net	Bottom	761	131	10,5	7,3	6,42	31,65	1010,47	97	0
2	Makkovik	ROV/Benthic	2021-07-20	0:25	55,5357128	-58,9521407	Phytoplankton Net	Recovery	763	137	10,7	7,4	5,47	31,66	1010,54	97	0
2	Makkovik	ROV/Benthic	2021-07-20	1:18	55,5390953	-58,9511307	Hydrobios	Deployment	760	142	11,6	7,3	5,67	31,64	1009,97	98	0
2	Makkovik	ROV/Benthic	2021-07-20	1:40	55,5382247	-58,9523572	Hydrobios	Bottom	774	144	13,9	7,4	6,03	31,68	1009,73	98	0
2	Makkovik	ROV/Benthic	2021-07-20	2:06	55,5375225	-58,9537333	Hydrobios	Recovery	787	149	14,1	7,6	6,19	31,67	1009,71	97	0
2	Makkovik	ROV/Benthic	2021-07-20	2:35	55,5390543	-58,9505575	Hydrobios	Deployment	759	150	14,5	7,4	3,65	31,72	1009,16	98	0
2	Makkovik	ROV/Benthic	2021-07-20	2:53	55,5387983	-58,9522035	Hydrobios	Bottom	764	146	11,4	7,4	5,78	31,65	1008,88	98	0
2	Makkovik	ROV/Benthic	2021-07-20	3:18	55,5377025	-58,9529765	Hydrobios	Recovery	787	152	12,6	7,7	4,98	31,67	1008,63	98	0
2	Makkovik	ROV/Benthic	2021-07-20	5:02	55,5414815	-58,9344128	IKMT	Deployment	720	179	10,3	9,3	4,48	31,72	1007,63	93	0
2	Makkovik	ROV/Benthic	2021-07-20	5:27	55,538056	-58,9468933	IKMT	Bottom	757	169	13,3	9,3	6,04	31,61	1007,30	95	0
2	Makkovik	ROV/Benthic	2021-07-20	6:18	55,5467503	-58,9467152	IKMT	Recovery	788	174	10,9	9,3	5,83	31,59	1006,79	94	0
2	Makkovik	ROV/Benthic	2021-07-20	6:44	55,539535	-58,9507148	Box Core	Deployment	757	179	12,8	9,5	5,36	31,62	1006,40	94	0
2	Makkovik	ROV/Benthic	2021-07-20	6:59	55,5401402	-58,950646	Box Core	Bottom	759	170	12	9,1	5,80	31,58	1006,25	94	0
2	Makkovik	ROV/Benthic	2021-07-20	7:13	55,5406538	-58,9512405	Box Core	Recovery	767	205	10,5	10,1	5,72	31,59	1006,37	92	0
2	Makkovik	ROV/Benthic	2021-07-20	10:55	55,4273773	-58,816014	CTD Rosette	Deployment	448	180	12,9	10,4	5,71	31,68	1006,25	92	0
2	Makkovik	ROV/Benthic	2021-07-20	11:04	55,4274322	-58,8160458	CTD Rosette	Bottom	448	182	12,9	10,4	5,93	31,61	1006,17	93	0
2	Makkovik	ROV/Benthic	2021-07-20	11:15	55,4270393	-58,81631	CTD Rosette	Recovery	440	181	10,9	9,9	6,03	31,58	1006,14	94	0
2	Makkovik	ROV/Benthic	2021-07-20	11:54	55,4189712	-58,8176598	Mooring	Recovery	476	188	10,3	9,3	6,14	31,51	1006,47	96	0
2	Makkovik	ROV/Benthic	2021-07-20	13:36	55,5174673	-58,9428875	ROV	Deployment		292	3,2	12,5	6,27	31,60	1006,78	86	0
2	Makkovik	ROV/Benthic	2021-07-20	14:29	55,5173425	-58,943046	ROV	Bottom		8	11,6	15,4	6,40	31,59	1006,94	66	0
2	Makkovik	ROV/Benthic	2021-07-20	16:49	55,5173757	-58,9495038	ROV	Recovery		302	0,8	9,8	6,23	31,57	1007,58	80	0
2	Makkovik	ROV/Benthic	2021-07-20	18:28	55,5208502	-58,9156067	Baited Camera	Deployment	666	15	6,5	8,6	6,34	31,53	1008,36	83	0
2	Makkovik	ROV/Benthic	2021-07-20	18:45	55,5211782	-58,9172903	Baited Camera	Bottom	667	16	4,2	8,6	4,20	31,68	1008,38	84	0
2	Makkovik	ROV/Benthic	2021-07-20	20:04	55,5441642	-58,8806755	Piston Core	Deployment	780	63	2,9	9,2	5,78	31,58	1008,75	80	0
2	Makkovik	ROV/Benthic	2021-07-20	20:21	55,5444733	-58,880805	Piston Core	Bottom	779	55	4,6	9,6	5,86	31,62	1008,76	78	0
2	Makkovik	ROV/Benthic	2021-07-20	20:36	55,5443707	-58,8808198	Piston Core	Recovery	778	48	4,8	10	5,26	31,62	1008,71	76	0
2	Makkovik	ROV/Benthic	2021-07-20	21:24	55,53769167	-58,93754	Drop Camera	Deployment					4,73	31,66			0
2	Makkovik	ROV/Benthic	2021-07-20	21:37	55,53808167	-58,9385567	Drop Camera	Bottom					5,50	31,62			0
2	Makkovik	ROV/Benthic	2021-07-20	22:17	55,5405412	-58,9424812	Drop Camera	Recovery	762	180	0,8	10,6	6,31	31,59	1009,24	80	0
2	Makkovik	ROV/Benthic	2021-07-20	22:37	55,5546873	-58,9715113	Drop Camera	Deployment	703	220	2,3	10,3	4,65	31,81	1009,19	82	0
2	Makkovik	ROV/Benthic	2021-07-20	22:50	55,555608	-58,9726823	Drop Camera	Bottom	773	193	6,5	10,2	5,69	31,55	1009,37	83	0
2	Makkovik	ROV/Benthic	2021-07-20	23:26	55,5583082	-58,9744983	Drop Camera	Recovery	773	198	4	10,5	6,68	31,58	1009,50	77	0
2	Makkovik	ROV/Benthic	2021-07-21	0:40	55,524731	-58,922229	Baited Camera	Recovery	728	202	6,5	9,6	6,97	31,56	1009,92	79	0
2	Makkovik	ROV/Benthic	2021-07-21	1:29	55,5264083	-58,9263767	Tucker Net	Deployment	754				5,84	31,57			0
2	Makkovik	ROV/Benthic	2021-07-21	1:33	55,5280343	-58,9291293	Tucker Net	Bottom	786	239	8	9,7	6,91	31,56	1010,06	85	0
2	Makkovik	ROV/Benthic	2021-07-21	1:40	55,52595	-58,9321013	Tucker Net	Recovery	787	221	9,1	10,1	7,37	31,57	1010,02	83	0
2	Makkovik	ROV/Benthic	2021-07-21	11:18	55,5175997	-58,942431	CTD Rosette	Deployment	679	269	1,7	7,3	6,67	31,51	1013,09	92	0
2	Makkovik	ROV/Benthic	2021-07-21	11:36	55,518819	-58,9428975	CTD Rosette	Bottom	660	54	0	8,8	5,82	31,57	1012,90	82	0
2	Makkovik	ROV/Benthic	2021-07-21	12:03	55,5214567	-58,9419217	CTD Rosette	Recovery	689	317	2,5	8,4	6,84	31,50	1013,42	92	0
2	Makkovik	ROV/Benthic	2021-07-21	14:06	55,517171	-58,9418478	ROV	Deployment		290	1	8,9	6,11	31,54	1014,11	88	0
2	Makkovik	ROV/Benthic	2021-07-21	14:06	55,5171813	-58,941875	ROV	Deployment					5,97	31,56			0
2	Makkovik	ROV/Benthic	2021-07-21	15:26	55,5162888	-58,9406632	ROV	Bottom		320	2,3	8,8	6,97	31,54	1013,78	83	0
2	Makkovik	ROV/Benthic	2021-07-21	15:26	55,5162917	-58,9406598	ROV	Bottom		319	2,5	8,7	6,97	31,55	1013,79	83	0
2	Makkovik	ROV/Benthic	2021-07-21	20:03	55,523605	-58,9453237	ROV	Recovery		157	6,5	10,4	7,10	31,56	1013,00	84	0
2	Makkovik	ROV/Benthic	2021-07-21	21:08	55,5166828	-58,9379768	Box Core	Deployment	692	133	10,7	8,9	8,12	31,56	1012,74	86	0
2	Makkovik	ROV/Benthic	2021-07-21	21:19	55,5175607	-58,9381982	Box Core	Bottom	694	142	11	8,9	5,49	31,61	1012,71	88	0
2	Makkovik	ROV/Benthic	2021-07-21	21:35	55,519504	-58,939469	Box Core	Recovery	693	146	12	8,8	5,68	31,60	1013,00	90	0
2	NAI-8.5A	Coring	2021-07-22	9:20	56,598427	-60,8115527	Box Core	Deployment	133	239	8,2	13,6	7,06	30,41	1009,95	71	0
2	NAI-8.5A	Coring	2021-07-22	9:24	56,5985642	-60,8115817	Box Core	Bottom	133	243	7,8	14,5	7,22	30,54	1009,96	67	0
2	NAI-8.5A	Coring	2021-07-22	9:28	56,5986465	-60,8114618	Box Core	Recovery	133	245	7,8	14,4	7,05	30,56	1009,99	68	0
2	NAI-8.5A	Coring	2021-07-22	10:32	56,5986497	-60,8125565	Piston Core	Deployment	133	249	7	12,6	7,37	30,44	1010,20	75	0
2	NAI-8.5A	Coring	2021-07-22	10:37	56,5985917	-60,8123483	Piston Core	Bottom	133	254	8	12,6	7,50	30,43	1010,19	76	0
2	NAI-8.5A	Coring	2021-07-22	10:49	56,5985957	-60,8123268	Piston Core	Recovery	134	264	9,9	13,1	7,65	30,40	1010,20	73	0
2	NAI-8.5B	Coring	2021-07-22	14:34	56,6943937	-60,2863583	Box Core	Deployment	474	294	3	13	6,14	31,50	1010,66	76	0
2	NAI-8.5B	Coring	2021-07-22	14:44	56,6932163	-60,2846948	Box Core	Bottom	473	275	4	12,8	5,26	31,61	1010,60	75	0
2	NAI-8.5B	Coring	2021-07-22	14:55	56,6918285	-60,2846293	Box Core	Recovery	475	332	5	12,5	6,81	31,48	1010,48	79	0
2	NAI-8.5B	Coring	2021-07-22	15:47	56,6921628	-60,2844393	Piston Core	Deployment	473	81	2,9	13,6	5,86	31,51	1010,51	70	0
2	NAI-8.5B	Coring	2021-07-22	15:55	56,6917988	-60,2848382	Piston Core	Bottom	473				5,89	31,49			0
2	NAI-8.5B	Coring	2021-07-22	16:05	56,691056	-60,2847202	Piston Core	Recovery	473	60	4,4	13	5,94	31,48	1010,50	73	0
2	Kelp2021	Benthic	2021-07-23	5:40	58,66862	-62,6054933	CTD Rosette	Deployment	120	178	5,1	7,2	5,25	30,99	1013,93	84	
2	Kelp2021	Benthic	2021-07-23	5:46	58,6681938	-62,604115	CTD Rosette	Bottom	140	167	3,8	7,2	5,15	31,03	1013,98	85	
2	Kelp2021	Benthic	2021-07-23	5:58	58,6665978	-62,6013818	CTD Rosette	Recovery	148	172	6,3	7,3	3,94	31,12	1013,79	82	
2	Kelp2021	Benthic	2021-07-23	6:43	58,6599205	-62,5918242	Baited Camera	Deployment	129	194	8,2	9,6	3,99	31,08	1013,64	69	
2	Kelp2021	Benthic	2021-07-23	6:49	58,6594938	-62,5904983	Baited Camera	Bottom	125	182	6,3	9,6	3,84	31,08	1013,71	71	
2	Kelp2021	Benthic	2021-07-23	7:42	58,669045	-62,6072275	Drop camera	Deployment	104	204	16,4	9,9	4,04	31,02	1013,11	65	

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						
2	Kelp2021	Benthic	2021-07-23	7:45	58,6690982	-62,607188	Drop camera	Bottom	104	204	15,6	10,4	4,57	30,65	1012,86	64	
2	Kelp2021	Benthic	2021-07-23	8:17	58,6679332	-62,6025087	Drop camera	Recovery	148	212	13,5	9,9	4,62	30,62	1013,71	68	
2	Kelp2021	Benthic	2021-07-23	8:44	58,6684305	-62,6042572	Hydrobios	Deployment	138	219	17,1	9,7	4,36	30,69	1013,63	68	
2	Kelp2021	Benthic	2021-07-23	8:48	58,6685008	-62,6035083	Hydrobios	Bottom	141	210	16,4	10,2	4,28	30,73	1013,56	65	
2	Kelp2021	Benthic	2021-07-23	8:55	58,6689255	-62,6027182	Hydrobios	Recovery	147	217	16,9	10,6	4,18	30,80	1013,66	62	
2	Kelp2021	Benthic	2021-07-23	9:13	58,6670368	-62,6034482	Hydrobios	Deployment	147	214	13,7	10,4	2,66	31,34	1013,81	66	
2	Kelp2021	Benthic	2021-07-23	9:17	58,6663777	-62,603737	Hydrobios	Bottom	146	211	12,4	10	3,83	31,14	1013,84	68	
2	Kelp2021	Benthic	2021-07-23	9:23	58,6658735	-62,6042317	Hydrobios	Recovery	146	201	10,9	9,4	2,56	31,25	1013,66	71	
2	Kelp2021	Benthic	2021-07-23	9:56	58,6717838	-62,5912847	Tucker Net	Deployment	157	223	13,5	10,4	4,68	30,69	1014,01	64	
2	Kelp2021	Benthic	2021-07-23	10:02	58,6741838	-62,5889172	Tucker Net	Bottom	150	221	13,7	10,4	4,64	30,71	1013,84	65	
2	Kelp2021	Benthic	2021-07-23	10:09	58,6764963	-62,5923552	Tucker Net	Recovery	146	224	12,9	10,5	4,29	30,73	1014,07	65	
2	Kelp2021	Benthic	2021-07-23	10:44	58,6681067	-62,6089305	Beam trawl	Deployment	113	226	6,5	11,3	4,55	30,73	1013,84	72	
2	Kelp2021	Benthic	2021-07-23	10:57	58,6726932	-62,6056723	Beam trawl	Bottom	149	222	16,2	10,3	4,41	30,75	1013,81	73	
2	Kelp2021	Benthic	2021-07-23	11:23	58,6775998	-62,6299323	Beam trawl	Recovery	111	224	20,6	11,6	3,90	30,96	1013,87	71	
2	Kelp2021	Benthic	2021-07-23	12:55	58,6591435	-62,5918922	Baited Camera	Recovery	127	183	10,9	15,7	2,92	31,28	1013,80	60	
2	Kelp2021	Benthic	2021-07-23	13:19	58,70035	-62,5308045	Box Core	Deployment	149	218	14,7	14	5,70	31,21	1013,80	64	
2	Kelp2021	Benthic	2021-07-23	13:22	58,7005587	-62,530354	Box Core	Bottom	150	216	14,5	14,2	5,17	31,40	1013,82	63	
2	Kelp2021	Benthic	2021-07-23	13:27	58,7005385	-62,530346	Box Core	Recovery	149	221	13,7	14,4	4,47	31,55	1013,86	62	
2	SagBank-21	Mooring	2021-07-23	21:00	59,3755017	-60,3098503	Mooring	Deployment	450				3,79	33,10			
2	SagBank-21CROM	Mooring	2021-07-23	22:13	59,385637	-60,326814	Mooring	Deployment	420	227	7,8	6,1	4,03	33,13	1011,53	88	
2	SagBank-21CROM	Mooring	2021-07-23	22:49	59,3837272	-60,3186075	Mooring	Bottom		255	6,7	6,2	4,02	33,14	1011,67	88	
2	SagBank-21CROM	Mooring	2021-07-23	23:21	59,3816932	-60,3326157	CTD Rosette	Deployment	413	307	7,2	6,5	3,80	33,10	1011,84	89	
2	SagBank-21CROM	Mooring	2021-07-23	23:32	59,3801405	-60,3332523	CTD Rosette	Bottom	414	281	7	6,4	3,84	33,08	1011,69	89	
2	SagBank-21CROM	Mooring	2021-07-23	23:44	59,3788195	-60,3328658	CTD Rosette	Recovery	414	296	7,6	7,1	3,76	33,06	1011,70	87	
2	HiBioA-20	Mooring	2021-07-24	7:29	60,4530627	-61,2686567	CTD Rosette	Deployment	478	250	10,9	6	3,69	32,56	1008,58	92	
2	HiBioA-20	Mooring	2021-07-24	7:40	60,4501882	-61,2690325	CTD Rosette	Bottom	460				3,70	32,56			
2	HiBioA-20	Mooring	2021-07-24	8:15	60,4428577	-61,2738587	CTD Rosette	Recovery	398	228	9,9	5,4	3,70	32,56	1008,38	93	
2	HiBioC-20	Mooring	2021-07-24	10:49	60,4641523	-61,1703875	Mooring	Recovery	969	239	7,2	7,1	4,14	33,25	1008,52	87	
2	SaglekBank	ROV/Benthic	2021-07-24	12:08	60,5276168	-61,2520642	CTD Rosette	Deployment	580	201	9,3	6,9	4,23	33,22	1008,13	89	
2	SaglekBank	ROV/Benthic	2021-07-24	12:23	60,528413	-61,252136	CTD Rosette	Bottom	573	190	9,5	6,9	4,23	33,22	1008,13	89	
2	SaglekBank	ROV/Benthic	2021-07-24	12:45	60,5282942	-61,2507668	CTD Rosette	Recovery	584	174	8,8	7,1	4,03	33,20	1007,82	89	
2	SaglekBank	ROV/Benthic	2021-07-24	13:39	60,5243367	-61,2631462	ROV	Deployment		180	3,4	7,2	4,21	33,03	1007,82	88	
2	SaglekBank	ROV/Benthic	2021-07-24	14:33	60,5242315	-61,2445415	ROV	Bottom		157	10,3	6,4	4,16	33,06	1007,49	91	
2	SaglekBank	ROV/Benthic	2021-07-24	16:13	60,5209853	-61,2323597	ROV	Recovery		278	0,4	6,8	4,64	32,95	1006,94	87	
2	SaglekBank	ROV/Benthic	2021-07-24	18:18	60,5253362	-61,2539808	ROV	Deployment		201	5,9	6,6	4,19	32,58	1006,92	87	
2	SaglekBank	ROV/Benthic	2021-07-24	19:06	60,5194542	-61,2439523	ROV	Bottom		221	8,8	6,4	4,31	32,59	1006,84	88	
2	SaglekBank	ROV/Benthic	2021-07-24	21:47	60,5187942	-61,2498208	ROV	Recovery		156	6,5	7,1	4,44	32,91	1005,92	85	
2	SaglekBank	ROV/Benthic	2021-07-24	22:18	60,5176125	-61,2738062	CTD Rosette	Deployment	426				5,13	32,89			
2	SaglekBank	ROV/Benthic	2021-07-24	22:33	60,517109	-61,2826407	CTD Rosette	Bottom	421	146	9,5	6,9	4,62	32,90	1005,59	86	
2	SaglekBank	ROV/Benthic	2021-07-24	22:55	60,5180502	-61,2947667	CTD Rosette	Recovery	420	145	7,6	9,1	4,93	32,90	1005,66	81	
2	SaglekBank	ROV/Benthic	2021-07-24	23:17	60,5260112	-61,254491	Phytoplankton Net	Deployment	564	139	4,6	7,4	4,91	33,07	1005,52	87	
2	SaglekBank	ROV/Benthic	2021-07-24	23:20	60,5262807	-61,257184	Phytoplankton Net	Bottom	549	181	6,1	7,6	5,17	33,07	1005,54	86	
2	SaglekBank	ROV/Benthic	2021-07-24	23:22	60,5265083	-61,2592298	Phytoplankton Net	Recovery	536	168	5,1	7,6	5,39	33,02	1005,51	87	
2	SaglekBank	ROV/Benthic	2021-07-24	23:53	60,527831	-61,250587	Baited Camera	Deployment	590	164	12	7,5	5,24	33,17	1005,51	87	
2	SaglekBank	ROV/Benthic	2021-07-25	0:14	60,5301708	-61,2614417	Baited Camera	Bottom	511	162	14,1	7,4	4,85	33,24	1005,36	87	
2	SaglekBank	ROV/Benthic	2021-07-25	1:12	60,517153	-61,2451887	Drop camera	Deployment	634	145	14,5	6,7	4,70	33,24	1004,90	89	
2	SaglekBank	ROV/Benthic	2021-07-25	1:21	60,5172732	-61,2471858	Drop camera	Bottom	625	157	14,3	6,6	4,77	33,23	1005,01	90	
2	SaglekBank	ROV/Benthic	2021-07-25	2:01	60,5174598	-61,2520307	Drop camera	Recovery	591	148	13,3	6,4	4,67	33,20	1004,62	90	
2	SaglekBank	ROV/Benthic	2021-07-25	2:26	60,516674	-61,2450935	Hydrobios	Deployment	632	145	13,7	6,4	4,91	33,15	1004,29	91	
2	SaglekBank	ROV/Benthic	2021-07-25	2:40	60,5169303	-61,2431822	Hydrobios	Bottom	643	143	16	6,2	5,39	33,08	1003,65	91	
2	SaglekBank	ROV/Benthic	2021-07-25	3:08	60,5176618	-61,2386998	Hydrobios	Recovery	671	143	15,4	6,3	4,99	33,14	1003,33	91	
2	SaglekBank	ROV/Benthic	2021-07-25	3:38	60,517572	-61,2501757	Hydrobios	Deployment	601	135	12,9	6,2	5,06	33,07	1003,08	92	
2	SaglekBank	ROV/Benthic	2021-07-25	4:05	60,5176482	-61,2407457	Hydrobios	Bottom	661	154	15,6	6,4	4,82	33,04	1002,83	92	
2	SaglekBank	ROV/Benthic	2021-07-25	4:14	60,517006	-61,2391562	Hydrobios	Recovery	667	139	13,7	6,4	4,78	33,00	1002,74	92	
2	SaglekBank	ROV/Benthic	2021-07-25	5:36	60,5149325	-61,241702	IKMT	Deployment	647	150	14,3	7,1	4,08	32,59	1002,03	91	
2	SaglekBank	ROV/Benthic	2021-07-25	5:59	60,508994	-61,2272323	IKMT	Bottom	717	150	4,8	6,8	4,14	32,56	1001,68	93	
2	SaglekBank	ROV/Benthic	2021-07-25	6:39	60,5263195	-61,1822997	IKMT	Recovery	929	157	19,2	7,3	4,46	32,80	1001,15	91	
2	SaglekBank	ROV/Benthic	2021-07-25	7:16	60,5164432	-61,2517192	Van Veen Grab	Deployment	595	147	16,4	5,9	3,70	32,54	1001,00	94	
2	SaglekBank	ROV/Benthic	2021-07-25	7:33	60,5138842	-61,2519263	Van Veen Grab	Bottom	590	152	17,3	5,6	3,80	32,54	1000,58	94	
2	SaglekBank	ROV/Benthic	2021-07-25	7:49	60,5098505	-61,252883	Van Veen Grab	Recovery	573	152	16	5,5	3,82	32,55	1000,47	94	
2	SaglekBank	ROV/Benthic	2021-07-25	9:06	60,5215902	-61,267392	Baited Camera	Recovery	461	152	16,8	8,8	3,66	32,57	999,60	87	
2	HiBio-A-21	Mooring	2021-07-25	9:49	60,4684143	-61,2814895	CTD Rosette	Deployment	440	146	17,1	6	3,88	32,55	998,93	90	
2	HiBio-A-21	Mooring	2021-07-25	10:01	60,4671182	-61,290139	CTD Rosette	Bottom	400	145	17,5	6,3	3,88	32,55	998,85	89	
2	HiBio-A-21	Mooring	2021-07-25	10:19	60,465888	-61,3040208	CTD Rosette	Recovery	401	27	11,4	9	3,86	32,55	998,77	73	
2	HiBio-A-21	Mooring	2021-07-25	11:58	60,4738365	-61,2633933	Mooring	Deployment	495	156	14,7	7,2	4,18	32,69	998,56	85	
2	SaglekBank	ROV/Benthic	2021-07-25	12:40	60,4973598	-61,2097587	ROV	Deployment		157	15,2	6,9	4,10	33,12	998,68	87	
2	SaglekBank	ROV/Benthic	2021-07-25	13:34	60,4968655	-61,2325585	ROV	Bottom		158	14,3	7,1	3,66	33,24	998,65	87	
2	SaglekBank	ROV/Benthic	2021-07-25	15:46	60,5046963	-61,2163288	ROV	Recovery		161	11,8	8,2	4,25	33,12	998,45	83	
2	SaglekBank	ROV/Benthic	2021-07-25	17:28	60,5052513	-61,2419995	ROV	Deployment		179	16,2	9,1	4,00	32,55	998,96	79	
2	SaglekBank	ROV/Benthic	2021-07-25	18:36	60,4980452	-61,2286622	ROV	Bottom		267	2,5	9,1	4,31	32,55	999,78	79	
2	SaglekBank	ROV/Benthic	2021-07-25	21:51	60,4953947	-61,2396625	ROV	Recovery		145	5,3	9,5	4,68	32,61	999,90	81	

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						
2	SaglekBank	ROV/Benthic	2021-07-26	0:16	60,4698525	-61,1994042	Baited Camera	Deployment	853	157	16,2	7,8	4,93	32,77	999,85	87	
2	SaglekBank	ROV/Benthic	2021-07-26	0:40	60,468656	-61,2112648	Baited Camera	Bottom	795				4,91	32,80			
2	HiBio-C	Mooring	2021-07-26	1:29	60,4621178	-61,1648287	CTD Rosette	Deployment	997	144	17,1	9	3,72	33,30	999,44	81	
2	HiBio-C	Mooring	2021-07-26	1:47	60,4623425	-61,1725207	CTD Rosette	Bottom	967	140	17,7	8,6	3,66	33,32	999,44	83	
2	HiBio-C	Mooring	2021-07-26	2:41	60,4657215	-61,1877363	CTD Rosette	Recovery	908	131	16,6	7,8	3,32	33,38	998,78	87	
2	HiBio-C	Mooring	2021-07-26	3:04	60,4636198	-61,1604072	Hydrobios	Deployment	1010	131	17,9	8,5	4,17	33,19	998,56	86	
2	HiBio-C	Mooring	2021-07-26	3:09	60,4645818	-61,161113	Hydrobios	Bottom	1007	134	16,6	8,2	4,18	33,19	998,58	87	
2	HiBio-C	Mooring	2021-07-26	3:17	60,4649657	-61,1630695	Hydrobios	Recovery	999	139	16,2	8,2	4,17	33,21	998,51	87	
2	HiBio-C	Mooring	2021-07-26	3:44	60,4664712	-61,162675	Tucker Net	Deployment	999	141	18,3	7,8	4,25	33,21	998,02	87	
2	HiBio-C	Mooring	2021-07-26	3:49	60,4678425	-61,16576	Tucker Net	Bottom	994	141	16,8	8,1	4,31	33,19	997,97	86	
2	HiBio-C	Mooring	2021-07-26	4:06	60,4655927	-61,1671363	Tucker Net	Recovery	986	146	20,8	8,3	4,19	33,11	997,95	86	
2	HiBio-C	Mooring	2021-07-26	5:06	60,4602173	-61,1333687	IKMT	Deployment	1079	118	9,7	14,4	4,35	32,72	997,81	61	
2	HiBio-C	Mooring	2021-07-26	5:32	60,460661	-61,1115098	IKMT	Bottom	1097	139	11	8,4	4,46	32,70	998,06	84	
2	HiBio-C	Mooring	2021-07-26	6:29	60,4963188	-61,0633063	IKMT	Recovery	1172	162	17,3	8,6	3,98	33,29	998,10	82	
2	SaglekBank	ROV/Benthic	2021-07-26	8:57	60,5025192	-61,2306263	CTD Rosette	Deployment	712	168	17,7	8,7	4,17	32,55	997,61	77	
2	SaglekBank	ROV/Benthic	2021-07-26	9:20	60,4981848	-61,2308545	CTD Rosette	Bottom		170	18,7	8,4	4,03	32,56	997,62	80	
2	SaglekBank	ROV/Benthic	2021-07-26	9:49	60,4933102	-61,238497	CTD Rosette	Recovery	748	164	10,1	15,4	4,24	32,57	997,70	58	
2	SaglekBank	ROV/Benthic	2021-07-26	10:16	60,4978783	-61,2186358	Drop Camera	Deployment	850	65	3,8	7,6	4,27	32,59	997,67	84	
2	SaglekBank	ROV/Benthic	2021-07-26	10:27	60,4965192	-61,2228543	Drop Camera	Bottom	830	193	11	8	4,24	32,59	997,46	84	
2	SaglekBank	ROV/Benthic	2021-07-26	11:08	60,4968142	-61,2320312	Drop Camera	Recovery	796	156	17,5	7,4	4,31	32,64	997,65	87	
2	SaglekBank	ROV/Benthic	2021-07-26	13:14	60,4544545	-61,2062263	Baited Camera	Recovery	778	165	23,2	7,3	5,05	32,99	997,51	88	
2	HiBio-A-21-CRON	Mooring	2021-07-26	14:18	60,4832417	-61,2494753	Mooring	Deployment	593	163	16,9	7,6	4,86	33,15	997,72	86	
2	HiBio-A-21-CRON	Mooring	2021-07-26	14:41	60,4848967	-61,2630503	Mooring	Bottom	507	167	13,7	7,9	5,17	32,92	998,12	86	
2	Hatton Sill	ROV/Benthic	2021-07-26	20:22	61,4365833	-60,670868	CTD Rosette	Deployment	597	173	10,3	9,4	6,07	32,38	1000,56	93	
2	Hatton Sill	ROV/Benthic	2021-07-26	20:35	61,4351272	-60,6760807	CTD Rosette	Bottom	590	158	10,7	10	6,10	32,38	1000,31	87	
2	Hatton Sill	ROV/Benthic	2021-07-26	21:10	61,4310887	-60,6861782	CTD Rosette	Recovery	571	155	18,1	8,7	6,05	32,42	1000,23	90	
2	Hatton Sill	ROV/Benthic	2021-07-26	21:39	61,4452175	-60,7206178	Baited Camera	Deployment	543	175	16	8,7	5,70	32,47	1000,38	92	
2	Hatton Sill	ROV/Benthic	2021-07-26	21:51	61,4434758	-60,728102	Baited Camera	Bottom	543	173	15	8,4	5,62	32,54	1000,46	93	
2	Hatton Sill	ROV/Benthic	2021-07-26	22:31	61,4413267	-60,6676405	Phytoplankton Net	Deployment	604	175	14,7	8	5,22	32,74	1000,96	95	
2	Hatton Sill	ROV/Benthic	2021-07-26	22:33	61,441016	-60,669735	Phytoplankton Net	Bottom	598	175	14,3	8	4,10	33,37	1000,93	95	
2	Hatton Sill	ROV/Benthic	2021-07-26	22:35	61,440673	-60,671329	Phytoplankton Net	Recovery	593	178	14,9	8,1	3,91	33,58	1000,94	95	
2	Hatton Sill	ROV/Benthic	2021-07-26	22:58	61,4369792	-60,6558377	Hydrobios	Deployment	643	179	14,3	7,9	6,11	32,83	1001,15	96	
2	Hatton Sill	ROV/Benthic	2021-07-26	23:06	61,436464	-60,6608053	Hydrobios	Bottom	631	180	16,2	8	6,09	32,84	1000,74	96	
2	Hatton Sill	ROV/Benthic	2021-07-26	23:13	61,4365605	-60,6647508	Hydrobios	Recovery	622	180	15,6	7,9	6,32	32,71	1001,16	96	
2	Hatton Sill	ROV/Benthic	2021-07-26	23:37	61,4346973	-60,654121	Hydrobios	Deployment	655	188	15	7,8	5,63	33,17	1001,33	96	
2	Hatton Sill	ROV/Benthic	2021-07-26	23:51	61,4340203	-60,6629483	Hydrobios	Bottom	632	191	13,3	7,7	6,11	32,98	1001,44	96	
2	Hatton Sill	ROV/Benthic	2021-07-27	0:12	61,4355625	-60,6809798	Hydrobios	Recovery	579	190	12,6	7,4	5,54	33,42	1001,59	96	
2	Hatton Sill	ROV/Benthic	2021-07-27	0:45	61,4379563	-60,6797787	Tucker Net	Deployment	576	175	8,6	7,1	6,27	33,02	1001,77	97	
2	Hatton Sill	ROV/Benthic	2021-07-27	0:54	61,437564	-60,6972913	Tucker Net	Bottom	548	181	9,1	7,1	6,33	32,96	1001,63	97	
2	Hatton Sill	ROV/Benthic	2021-07-27	1:04	61,4376633	-60,7162417	Tucker Net	Recovery	543	183	7,2	7	6,19	33,03	1001,61	97	
2	Hatton Sill	ROV/Benthic	2021-07-27	1:40	61,4329992	-60,653059	IKMT	Deployment	657	186	10,5	7,4	5,64	33,25	1001,89	98	
2	Hatton Sill	ROV/Benthic	2021-07-27	1:57	61,4321097	-60,6804597	IKMT	Bottom	581	187	10,5	7,3	5,75	33,22	1001,94	98	
2	Hatton Sill	ROV/Benthic	2021-07-27	2:44	61,4210407	-60,7048287	IKMT	Recovery	549	159	2,1	7,1	6,05	33,06	1002,23	98	
2	Hatton Sill	ROV/Benthic	2021-07-27	3:07	61,4360255	-60,6725748	IKMT	Deployment	595	193	9,3	7	5,64	33,28	1002,57	99	
2	Hatton Sill	ROV/Benthic	2021-07-27	3:28	61,4465803	-60,6624408	IKMT	Bottom		213	4,2	6,5	5,81	33,25	1002,62	99	
2	Hatton Sill	ROV/Benthic	2021-07-27	3:59	61,4702693	-60,6480135	IKMT	Recovery		272	3,8	6,2	5,57	33,25	1002,56	99	
2	Hatton Sill	ROV/Benthic	2021-07-27	4:56	61,4394833	-60,6598277	CTD Rosette	Deployment	628	332	6,3	6,2	6,12	32,78	1002,60	99	
2	Hatton Sill	ROV/Benthic	2021-07-27	5:09	61,4383532	-60,6543907	CTD Rosette	Bottom	643	224	1,3	6,3	6,11	32,76	1002,77	99	
2	Hatton Sill	ROV/Benthic	2021-07-27	5:27	61,4369088	-60,6476507	CTD Rosette	Recovery	664	7	6,3	6,3	6,07	32,77	1002,75	99	
2	Hatton Sill	ROV/Benthic	2021-07-27	6:10	61,4479652	-60,5847808	Drop Camera	Deployment	871	29	3	6,2	6,08	32,94	1002,87	99	
2	Hatton Sill	ROV/Benthic	2021-07-27	6:24	61,4467203	-60,5792662	Drop Camera	Bottom	892	24	2,7	6,4	6,09	32,92	1003,05	99	
2	Hatton Sill	ROV/Benthic	2021-07-27	7:06	61,4408922	-60,5636773	Drop Camera	Recovery	985	355	3,4	6,6	6,03	32,92	1003,19	99	
2	Hatton Sill	ROV/Benthic	2021-07-27	7:25	61,4463375	-60,5784937	Box Core	Deployment	895	353	4,4	6,5	6,09	32,91	1003,19	99	
2	Hatton Sill	ROV/Benthic	2021-07-27	7:43	61,4461515	-60,5768608	Box Core	Bottom	901	3	5,3	6,6	6,12	32,89	1003,34	98	
2	Hatton Sill	ROV/Benthic	2021-07-27	8:00	61,4445663	-60,5777502	Box Core	Recovery	907	347	3	6,4	6,11	32,87	1003,57	98	
2	Hatton Sill	ROV/Benthic	2021-07-27	10:08	61,4387138	-60,735962	Baited Camera	Recovery	546	296	8	5,9	6,17	32,39	1004,11	96	
2	Hatton Sill	ROV/Benthic	2021-07-27	10:31	61,4330802	-60,7261237	Box Core	Deployment	545	316	8,6	5,9	6,18	32,44	1004,44	96	
2	Hatton Sill	ROV/Benthic	2021-07-27	10:39	61,43311	-60,7272343	Box Core	Bottom	544	308	7,8	6,2	6,06	32,45	1004,34	96	
2	Hatton Sill	ROV/Benthic	2021-07-27	10:49	61,4325158	-60,7310843	Box Core	Recovery	547	303	7,4	6,1	5,25	32,88	1004,30	96	
2	Hatton Sill	ROV/Benthic	2021-07-27	11:53	61,4359352	-60,6673325	CTD Rosette	Deployment	617	340	6,9	6,3	6,28	32,77	1004,46	97	
2	Hatton Sill	ROV/Benthic	2021-07-27	12:04	61,4365972	-60,6735422	CTD Rosette	Bottom	596	3	6,5	6,4	6,29	32,79	1004,46	97	
2	Hatton Sill	ROV/Benthic	2021-07-27	12:19	61,4369372	-60,6813498	CTD Rosette	Recovery	577	354	7,2	6,3	6,33	32,85	1004,38	97	
2	Hatton Sill	ROV/Benthic	2021-07-27	14:06	61,4364428	-60,6331257	ROV	Deployment		338	7	7,1	5,82	33,24	1005,00	95	
2	Hatton Sill	ROV/Benthic	2021-07-27	14:45	61,4361375	-60,6446495	ROV	Bottom		319	7,6	7	5,75	33,29	1005,03	95	
2	Hatton Sill	ROV/Benthic	2021-07-27	17:47	61,4347047	-60,6283338	ROV	Recovery		311	2,1	6,9	6,70	33,37	1006,52	97	
2	Hatton Sill	ROV/Benthic	2021-07-27	18:52	61,4386505	-60,5744305	Piston Core	Deployment	972	316	6,9	7	6,80	33,38	1006,81	98	
2	Hatton Sill	ROV/Benthic	2021-07-27	19:06	61,4390347	-60,5741702	Piston Core	Bottom	973	306	8,2	6,8	6,17	33,15	1007,03	97	
2	Hatton Sill	ROV/Benthic	2021-07-27	19:18	61,4378677	-60,5705515	Piston Core	Recovery	987	300	8,2	6,7	6,33	33,09	1006,91	96	
2	Hatton Sill	ROV/Benthic	2021-07-27	19:58	61,4450115	-60,5709515	Box Core	Deployment	918	298	10,1	6,4	6,46	32,92	1007,01	95	
2	Hatton Sill	ROV/Benthic	2021-07-27	20:11	61,4448762	-60,5692765	Box Core	Bottom	925	305	11,8	6,3	6,51	32,84	1006,88	95	
2	Hatton Sill	ROV/Benthic	2021-07-27	20:26	61,4447985	-60,5683435	Box Core	Recovery	929	311	9,9	6,4	6,50	32,78	1007,17	94	

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						
2	Hatton Sill	ROV/Benthic	2021-07-27	21:06	61,442562	-60,5693013	Piston Core	Deployment	933	303	8,6	6,4	6,41	32,66	1007,17	95	
2	Hatton Sill	ROV/Benthic	2021-07-27	21:24	61,4448773	-60,570261	Piston Core	Bottom	923	284	4,6	6,2	6,30	32,65	1007,81	96	
2	Hatton Sill	ROV/Benthic	2021-07-27	21:39	61,441205	-60,5736882	Piston Core	Recovery	932	248	1,1	6,3	6,33	32,76	1008,15	96	
2	Davis Strait	ROV/Benthic	2021-07-28	16:33	63,3506092	-58,2726628	CTD Rosette	Deployment	1283	193	17,5	7,3	6,85	33,22	1011,11	99	
2	Davis Strait	ROV/Benthic	2021-07-28	16:58	63,3518825	-58,27171	CTD Rosette	Bottom	1288	200	15,8	7,3	6,86	33,21	1011,56	99	
2	Davis Strait	ROV/Benthic	2021-07-28	18:09	63,359353	-58,2703165	CTD Rosette	Recovery	1271	209	11,6	7,3	6,87	33,18	1012,15	99	
2	Davis Strait	ROV/Benthic	2021-07-28	18:42	63,3502038	-58,2662827	Hydrobios	Deployment	1284	208	7	7,3	7,03	33,24	1012,48	99	
2	Davis Strait	ROV/Benthic	2021-07-28	19:12	63,3529663	-58,2673457	Hydrobios	Bottom	1294	196	12,8	7,1	7,09	33,25	1012,83	99	
2	Davis Strait	ROV/Benthic	2021-07-28	19:46	63,356392	-58,2710242	Hydrobios	Recovery	1271	205	9,9	7	7,00	33,25	1013,26	99	
2	Davis Strait	ROV/Benthic	2021-07-28	19:55	63,3575318	-58,2704862	Phytoplankton Net	Deployment	1273	200	9,3	7	6,87	33,21	1013,27	99	
2	Davis Strait	ROV/Benthic	2021-07-28	19:57	63,35765	-58,2701945	Phytoplankton Net	Bottom	1273	195	9,7	6,9	6,91	33,21	1013,31	99	
2	Davis Strait	ROV/Benthic	2021-07-28	19:59	63,3576867	-58,2701445	Phytoplankton Net	Recovery	1272	192	10,1	6,9	6,89	33,21	1013,26	99	
2	Davis Strait	ROV/Benthic	2021-07-28	20:15	63,3506907	-58,268366	Hydrobios	Deployment	1286	144	3	7	7,03	33,26	1013,45	99	
2	Davis Strait	ROV/Benthic	2021-07-28	20:24	63,3513885	-58,2680047	Hydrobios	Bottom	1288	202	11	6,9	7,12	33,41	1013,52	99	
2	Davis Strait	ROV/Benthic	2021-07-28	20:44	63,3523288	-58,267074	Hydrobios	Recovery	1293	215	9,7	6,9	7,19	33,30	1013,71	99	
2	Davis Strait	ROV/Benthic	2021-07-28	21:58	63,3998803	-58,5354537	Box Core	Deployment	1083	177	8,6	6,5	6,72	33,30	1014,10	99	
2	Davis Strait	ROV/Benthic	2021-07-28	22:19	63,4015973	-58,5377355	Box Core	Bottom	1081	179	9,9	6,6	6,57	33,27	1014,28	99	
2	Davis Strait	ROV/Benthic	2021-07-28	22:54	63,4016608	-58,5371562	Box Core	Recovery	1082	206	8,2	6,6	6,58	33,22	1014,33	99	
2	Davis Strait	ROV/Benthic	2021-07-28	23:13	63,4018783	-58,533354	Box Core	Deployment	1087	152	1,1	6,6	6,51	33,19	1014,49	99	
2	Davis Strait	ROV/Benthic	2021-07-28	23:35	63,401739	-58,5347097	Box Core	Bottom	1085	202	4,8	6,6	6,33	33,16	1014,43	99	
2	Davis Strait	ROV/Benthic	2021-07-29	0:09	63,4020452	-58,5333943	Box Core	Recovery	1087	191	4,2	6,7	6,42	33,15	1014,66	99	
2	Davis Strait	ROV/Benthic	2021-07-29	0:25	63,4020725	-58,53666	Box Core	Deployment	1084	179	7,8	6,7	6,44	33,16	1014,68	99	
2	Davis Strait	ROV/Benthic	2021-07-29	0:46	63,4013148	-58,53509	Box Core	Bottom	1086	180	8	6,8	6,51	33,16	1014,66	99	
2	Davis Strait	ROV/Benthic	2021-07-29	1:21	63,3999003	-58,5302737	Box Core	Recovery	1094	206	4,6	6,9	6,66	33,18	1014,75	99	
2	Davis Strait	ROV/Benthic	2021-07-29	1:57	63,3985778	-58,5257963	CTD Rosette	Deployment	1104	162	8,9	6,8	6,75	33,20	1014,74	99	
2	Davis Strait	ROV/Benthic	2021-07-29	2:17	63,3976917	-58,527606	CTD Rosette	Bottom	1099	155	6,7	6,8	6,78	33,20	1014,87	99	
2	Davis Strait	ROV/Benthic	2021-07-29	2:39	63,3966383	-58,5306028	CTD Rosette	Recovery	1096	142	6,3	6,9	6,77	33,20	1015,00	99	
2	Davis Strait	ROV/Benthic	2021-07-29	4:06	63,3477575	-58,2226193	Drop Camera	Deployment	1282	146	14,1	7,7	7,28	33,61	1015,18	99	
2	Davis Strait	ROV/Benthic	2021-07-29	4:25	63,3477993	-58,2189618	Drop Camera	Bottom		150	12,2	7,5	7,41	33,57	1015,25	99	
2	Davis Strait	ROV/Benthic	2021-07-29	5:13	63,3415938	-58,219471	Drop Camera	Recovery		147	15,6	7,4	6,12	33,68	1015,58	99	
2	Davis Strait	ROV/Benthic	2021-07-29	5:34	63,340856	-58,2231205	Tucker Net	Deployment		144	12,2	8,6	7,57	33,58	1015,86	99	
2	Davis Strait	ROV/Benthic	2021-07-29	5:43	63,3440865	-58,2326127	Tucker Net	Bottom		136	13,3	7,2	7,54	33,57	1015,74	99	
2	Davis Strait	ROV/Benthic	2021-07-29	5:53	63,3463767	-58,2437192	Tucker Net	Recovery		126	12,2	7,1	7,55	33,57	1015,83	99	
2	Davis Strait	ROV/Benthic	2021-07-29	6:19	63,3586763	-58,2593827	IKMT	Deployment		144	13,1	7,1	7,36	33,35	1016,15	99	
2	Davis Strait	ROV/Benthic	2021-07-29	6:45	63,3558502	-58,2853687	IKMT	Bottom		146	11,6	7,2	6,96	33,22	1016,13	99	
2	Davis Strait	ROV/Benthic	2021-07-29	7:33	63,3500482	-58,2951665	IKMT	Recovery		141	15	7,3	6,92	33,21	1016,33	99	
2	Davis Strait	ROV/Benthic	2021-07-29	8:11	63,3488347	-58,2306662	Gravity Core	Deployment	1283	134	13,1	7,3	7,59	33,58	1016,57	99	
2	Davis Strait	ROV/Benthic	2021-07-29	8:31	63,3480757	-58,2294268	Gravity Core	Bottom	1280	129	12,8	7,2	7,62	33,59	1016,46	99	
2	Davis Strait	ROV/Benthic	2021-07-29	8:48	63,3493542	-58,2332198	Gravity Core	Recovery	1287	117	13,5	7,4	7,59	33,57	1016,35	99	
2	Davis Strait	ROV/Benthic	2021-07-29	9:13	63,3471487	-58,1975153	CTD Rosette	Deployment	1308	133	15	7,4	7,51	33,57	1016,43	99	
2	Davis Strait	ROV/Benthic	2021-07-29	9:37	63,347936	-58,2004705	CTD Rosette	Bottom	1296	117	14,5	7,4	7,51	33,57	1016,40	99	
2	Davis Strait	ROV/Benthic	2021-07-29	10:06	63,3482528	-58,2044407	CTD Rosette	Recovery	1291	113	13,9	7,3	7,55	33,58	1016,49	99	
2	Davis Strait	ROV/Benthic	2021-07-29	10:33	63,343959	-58,1915668	ROV	Deployment		104	13,1	7,2	7,52	33,57	1016,46	99	
2	Davis Strait	ROV/Benthic	2021-07-29	11:44	63,3466527	-58,1943592	ROV	Bottom		109	16	7	7,56	33,57	1016,47	100	
2	Davis Strait	ROV/Benthic	2021-07-29	20:36	63,348746	-58,1960335	ROV	Recovery		89	15	7,2	7,65	33,58	1014,25	100	
2	Davis Strait	ROV/Benthic	2021-07-29	22:04	63,3463627	-58,201769	Piston Core	Deployment	1299	84	18,7	7	7,39	33,52	1013,57	100	
2	Davis Strait	ROV/Benthic	2021-07-29	22:22	63,3466593	-58,2012647	Piston Core	Bottom	1300	92	21,7	7,2	7,37	33,52	1013,43	100	
2	Davis Strait	ROV/Benthic	2021-07-29	22:38	63,3463992	-58,2080657	Piston Core	Recovery	1289	83	20,6	7,2	7,44	33,53	1013,30	100	
2	Davis Strait	ROV/Benthic	2021-07-29	23:24	63,3480165	-58,2015398	Gravity Core	Deployment	1296	88	18,7	7,3	7,35	33,52	1013,32	100	
2	Davis Strait	ROV/Benthic	2021-07-29	23:42	63,3470968	-58,2033522	Gravity Core	Bottom	1298	81	21,1	7,2	7,19	33,57	1013,00	100	
2	Davis Strait	ROV/Benthic	2021-07-30	0:04	63,3466865	-58,2009507	Gravity Core	Recovery	1301	86	20,8	7,2	7,34	33,53	1013,07	100	
2		Ice	2021-07-31	0:51	67,1346307	-62,030982	Ice sample	Deployment	133	298	5,9	-0,3	0,28	29,96	1011,57	101	
2		Ice	2021-07-31	1:07	67,1328408	-62,0228508	Ice sample	Recovery	137	311	6,3	-0,2	0,12	30,02	1011,51	101	
2	SF-3.1	ArcticNet/Sout	2021-07-31	11:29	66,7618233	-62,3396277	Mooring	Recovery		339	6,5	5,2	2,31	29,04	1011,63	101	
2	SF-3.1	ArcticNet/Sout	2021-07-31	12:55	66,7609705	-62,3369797	Zodiac	Deployment		345	3,2	6	1,94	29,58	1011,32	101	
2	SF-ROV	ArcticNet/Sout	2021-07-31	13:38	66,7515957	-62,3159732	ROV	Deployment	67	338	6,3	5,5	2,24	28,90	1011,41	101	
2	SF-ROV	ArcticNet/Sout	2021-07-31	13:57	66,7515945	-62,314412	ROV	Bottom		338	7,2	5,4	1,13	29,69	1011,37	101	
2	SF-ROV	ArcticNet/Sout	2021-07-31	15:46	66,7512677	-62,3140148	ROV	Recovery					1,68	29,80			
2	SF-6.2a	ArcticNet/Sout	2021-07-31	17:07	66,7512543	-62,3124923	Box Core	Deployment		341	10,9	5,6	1,15	29,24	1011,12	101	
2	SF-6.2a	ArcticNet/Sout	2021-07-31	17:08	66,7512722	-62,3123452	Box Core	Bottom		340	10,5	5,6	1,07	29,58	1011,07	101	
2	SF-6.2a	ArcticNet/Sout	2021-07-31	17:13	66,7521952	-62,3123427	Box Core	Recovery		330	10,3	5,6	1,33	29,68	1011,04	101	
2	SF-6.2b	ArcticNet/Sout	2021-07-31	17:25	66,752578	-62,3115828	Box Core	Deployment		320	11	5,7	1,23	29,66	1010,92	101	
2	SF-6.2b	ArcticNet/Sout	2021-07-31	17:26	66,7525707	-62,3114907	Box Core	Bottom		322	11,2	5,6	1,34	29,64	1010,98	101	
2	SF-6.2b	ArcticNet/Sout	2021-07-31	17:28	66,7525998	-62,3114053	Box Core	Recovery		323	11,8	5,7	1,16	29,63	1010,93	101	
2	SF-6.2b	ArcticNet/Sout	2021-07-31	17:56	66,7527057	-62,3116983	Gravity Core	Deployment		322	9,7	5,7	1,40	29,58	1010,91	101	
2	SF-6.2b	ArcticNet/Sout	2021-07-31	18:12	66,7526412	-62,3111538	Gravity Core	Bottom		339	9,7	6,2	1,21	29,64	1010,98	101	
2	SF-6.2b	ArcticNet/Sout	2021-07-31	18:14	66,7526935	-62,3112652	Gravity Core	Recovery		334	10,3	6,2	1,24	29,66	1010,98	101	
2	SF-3.1	ArcticNet/Sout	2021-07-31	18:38	66,760831	-62,3345085	CTD Rosette	Deployment		336	14,7	5,3	1,97	29,28	1010,95	101	
2	SF-3.1	ArcticNet/Sout	2021-07-31	18:43	66,7607908	-62,3340802	CTD Rosette	Bottom		334	12,8	5,5	1,77	29,23	1011,02	101	
2	SF-3.1	ArcticNet/Sout	2021-07-31	19:02	66,7602462	-62,3321295	CTD Rosette	Recovery		338	14,1	5,5	1,86	29,25	1011,03	101	
2	SF-6.1	Coring	2021-07-31	23:10	67,0255487	-62,5801485	Piston Core	Deployment	806	8	8	0,2	-0,47	29,69	1011,30	101	2

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						
2	SF-6.1	Coring	2021-07-31	23:22	67,0256855	-62,580443	Piston Core	Bottom	805	342	6,9	-0,3	-0,42	29,39	1011,31	101	3
2	SF-6.1	Coring	2021-07-31	23:35	67,0260588	-62,581148	Piston Core	Recovery	804	1	8,4	-0,5	-0,50	29,17	1011,34	101	4
2	CSF4.4	ArcticNet/Sout	2021-08-01	2:14	66,9233143	-62,4647698	Drop Camera	Deployment	354	340	5,1	0	1,61	29,43	1010,52	101	
2	CSF4.4	ArcticNet/Sout	2021-08-01	2:21	66,9231512	-62,464896	Drop Camera	Bottom	354	335	4,4	0,1	1,25	29,59	1010,42	101	
2	CSF4.4	ArcticNet/Sout	2021-08-01	2:56	66,9216342	-62,463767	Drop Camera	Recovery	349				0,81	29,52			
2	CSF4.3	ArcticNet/Sout	2021-08-01	3:42	66,956325	-62,4969235	Drop Camera	Deployment	259				0,17	29,48			
2	CSF4.3	ArcticNet/Sout	2021-08-01	3:48	66,9563127	-62,4968248	Drop Camera	Bottom	257	335	5,3	-0,7	0,21	29,57	1009,53	101	
2	CSF4.3	ArcticNet/Sout	2021-08-01	4:23	66,9546852	-62,4985827	Drop Camera	Recovery	285	337	4,4	-0,8	0,08	30,03	1009,46	101	
2	CSF4.2	ArcticNet/Sout	2021-08-01	5:10	66,9912217	-62,5551113	Drop Camera	Deployment	389				-0,70	29,58			
2	CSF4.2	ArcticNet/Sout	2021-08-01	5:17	66,9912353	-62,554518	Drop Camera	Bottom	392	334	2,7	-1,1	-0,77	30,26	1009,08	101	
2	CSF4.2	ArcticNet/Sout	2021-08-01	5:54	66,9897045	-62,5475878	Drop Camera	Recovery	396	294	1,9	-1,2	-0,79	30,63	1008,90	101	
2	Disko Fan	ROV/Benthic	2021-08-02	0:19	67,8808843	-59,3753093	CTD Rosette	Deployment	943	322	14,9	1,3	1,04	30,24	999,98	102	
2	Disko Fan	ROV/Benthic	2021-08-02	1:00	67,8808225	-59,3713187	CTD Rosette	Bottom	932				1,32	29,93			
2	Disko Fan	ROV/Benthic	2021-08-02	1:48	67,8775548	-59,364463	CTD Rosette	Recovery	925	328	12,2	1,6	1,04	30,03	999,64	102	
2	Disko Fan	ROV/Benthic	2021-08-02	2:06	67,8831998	-59,3840628	Box Core	Deployment	953	323	13,1	1,4	-0,02	30,39	999,55	102	
2	Disko Fan	ROV/Benthic	2021-08-02	2:20	67,882322	-59,3822658	Box Core	Bottom	950	327	16,6	1,4	0,78	30,17	999,37	102	
2	Disko Fan	ROV/Benthic	2021-08-02	2:37	67,8804065	-59,3821832	Box Core	Recovery	955	323	13,1	1,3	1,30	29,95	999,35	102	
2	Disko Fan	ROV/Benthic	2021-08-02	2:55	67,882457	-59,3848362	Box Core	Deployment	958	329	14,7	1,4	0,32	30,26	999,01	102	
2	Disko Fan	ROV/Benthic	2021-08-02	3:11	67,8814868	-59,386986	Box Core	Bottom	962	332	14,1	1,4	0,90	29,91	999,04	102	
2	Disko Fan	ROV/Benthic	2021-08-02	3:42	67,8783707	-59,3865665	Box Core	Recovery	983	317	18,1	1,4	0,75	30,09	998,79	102	
2	Disko Fan	ROV/Benthic	2021-08-02	4:30	67,8832972	-59,3845165	Box Core	Deployment	952	315	15,2	1	1,05	29,91	998,88	102	
2	Disko Fan	ROV/Benthic	2021-08-02	4:44	67,8825528	-59,3834473	Box Core	Bottom	951	320	15,8	0,8	1,08	29,88	998,74	102	
2	Disko Fan	ROV/Benthic	2021-08-02	5:15	67,8809515	-59,3794905	Box Core	Recovery	949	328	15,8	0,5	0,95	30,00	998,56	102	
2	Disko Fan	ROV/Benthic	2021-08-02	5:54	67,883759	-59,3781588	Drop Camera	Deployment	933	324	20	-0,3	1,20	29,88	998,18	102	
2	Disko Fan	ROV/Benthic	2021-08-02	6:07	67,8839257	-59,3800892	Drop Camera	Bottom	939	330	18,1	-0,2	1,08	29,88	998,30	102	
2	Disko Fan	ROV/Benthic	2021-08-02	6:53	67,8799508	-59,3698763	Drop Camera	Recovery	926	306	13,7	-0,6	0,89	29,92	998,71	102	
2	Disko Fan	ROV/Benthic	2021-08-02	7:19	67,8840613	-59,3865777	Hydrobios	Deployment	953	315	13,5	-0,7	0,95	29,95	998,77	102	
2	Disko Fan	ROV/Benthic	2021-08-02	7:29	67,8835773	-59,385857	Hydrobios	Bottom	953	315	14,9	-0,7	0,86	29,95	998,67	102	
2	Disko Fan	ROV/Benthic	2021-08-02	7:46	67,8829172	-59,384892	Hydrobios	Recovery	952	314	13,9	-0,6	0,70	30,06	998,54	102	
2	Disko Fan	ROV/Benthic	2021-08-02	8:04	67,8817343	-59,3911768	Hydrobios	Deployment	977	323	11,8	-0,5	0,54	30,44	998,67	102	1
2	Disko Fan	ROV/Benthic	2021-08-02	8:29	67,8825348	-59,3980753	Hydrobios	Bottom	992	299	10,7	-0,7	0,60	30,01	998,73	102	1
2	Disko Fan	ROV/Benthic	2021-08-02	9:00	67,8848265	-59,3947965	Hydrobios	Recovery	972	317	12	-0,7	0,63	30,12	998,65	102	1
2	Disko Fan	ROV/Benthic	2021-08-02	9:48	67,8848847	-59,369898	CTD Rosette	Deployment	914	303	9,1	3,1	0,71	30,06	998,73	103	1
2	Disko Fan	ROV/Benthic	2021-08-02	10:05	67,8847368	-59,3702418	CTD Rosette	Bottom	915	315	18,1	2,2	0,84	30,50	998,86	103	1
2	Disko Fan	ROV/Benthic	2021-08-02	10:26	67,8849842	-59,3690488	CTD Rosette	Recovery		308	10,5	4,7	0,62	30,14	998,78	102	1
2	Disko Fan	ROV/Benthic	2021-08-02	13:15	67,9676262	-59,496766	ROV	Deployment		319	17,1	-0,5	0,49	29,80	999,66	103	1
2	Disko Fan	ROV/Benthic	2021-08-02	14:04	67,9659307	-59,494538	ROV	Bottom		309	13,7	-0,3	0,59	29,85	999,67	103	1
2	Disko Fan	ROV/Benthic	2021-08-02	21:25	67,9705117	-59,4924935	ROV	Recovery		271	6,5	-0,2	0,98	29,91	1001,78	103	1
2	Disko Fan	ROV/Benthic	2021-08-02	22:39	67,9682002	-59,4901457	Piston Core	Deployment	868	295	6,1	-0,4	0,88	29,92	1002,02	103	0
2	Disko Fan	ROV/Benthic	2021-08-02	22:56	67,9682355	-59,4898547	Piston Core	Bottom	868	280	5,1	-0,6	0,86	29,94	1002,01	103	0
2	Disko Fan	ROV/Benthic	2021-08-02	23:12	67,9687075	-59,4902545	Piston Core	Recovery	868	250	2,9	-0,6	0,88	29,92	1002,17	103	0
2	Disko Fan	ROV/Benthic	2021-08-02	23:48	67,9689977	-59,494767	Gravity Core	Deployment	881	319	2,5	-0,5	0,51	30,58	1002,21	103	0
2	Disko Fan	ROV/Benthic	2021-08-03	0:02	67,9693022	-59,4945562	Gravity Core	Bottom	879	264	3,6	-0,8	0,83	30,05	1002,17	103	0
2	Disko Fan	ROV/Benthic	2021-08-03	0:17	67,9694017	-59,4938167	Gravity Core	Recovery	877	245	3,4	-1,2	0,80	30,02	1002,49	103	0
2	Disko Fan	ROV/Benthic	2021-08-03	0:34	67,970948	-59,491041	Tucker Net	Deployment	863	244	2,7	-1,3	0,87	29,92	1002,48	103	0
2	Disko Fan	ROV/Benthic	2021-08-03	0:41	67,9740478	-59,4904598	Tucker Net	Bottom	849	225	4,4	-1,3	0,88	29,93	1002,53	103	0
2	Disko Fan	ROV/Benthic	2021-08-03	0:51	67,9757047	-59,499234	Tucker Net	Recovery	869	229	5,7	-1,2	0,87	29,92	1002,47	103	0
2	Disko Fan	ROV/Benthic	2021-08-03	1:11	67,9730013	-59,5046892	IKMT	Deployment	897	217	6,5	-1,5	0,90	29,90	1002,59	103	0
2	Disko Fan	ROV/Benthic	2021-08-03	1:29	67,9668295	-59,4979208	IKMT	Bottom	895	130	0,6	-1,2	0,89	29,90	1002,55	103	0
2	Disko Fan	ROV/Benthic	2021-08-03	2:49	67,9920507	-59,5375157	IKMT	Recovery	928	187	0,8	-1,2	0,92	29,79	1002,70	103	0
2	McBeth Fjord	Mooring	2021-08-03	20:48	69,911364	-66,807295	Mooring	Deployment		139	15	2,6	3,27	29,30	1000,13	103	0
2	McBeth Fjord	Mooring	2021-08-03	20:49	69,9113662	-66,807296	Mooring	Bottom		135	13,7	2,6	3,27	29,30	1000,13	103	0
2	Scott Inlet -ROV1	ROV/Benthic	2021-08-04	10:02	71,3792032	-70,0758108	CTD Rosette	Deployment	265	101	10,5	3	3,98	30,75	998,53	102	0
2	Scott Inlet -ROV1	ROV/Benthic	2021-08-04	10:11	71,3794755	-70,0755572	CTD Rosette	Bottom	265	113	10,5	3,1	3,74	30,78	998,63	102	0
2	Scott Inlet -ROV1	ROV/Benthic	2021-08-04	10:21	71,3799633	-70,075931	CTD Rosette	Recovery	268	110	10,9	3	3,52	30,83	998,63	102	0
2	Scott Inlet-ROV1	ROV/Benthic	2021-08-04	11:11	71,3798225	-70,068406	ROV	Deployment					3,14	30,98			0
2	Scott Inlet-ROV1	ROV/Benthic	2021-08-04	11:40	71,3802337	-70,0692442	ROV	Bottom		105	9,5	3	3,54	30,74	998,49	102	0
2	Scott Inlet-ROV1	ROV/Benthic	2021-08-04	21:07	71,3803142	-70,0743347	ROV	Recovery		39	10,5	3,2	3,17	30,75	996,82	102	0
2	0t2	ROV/Benthic	2021-08-04	21:37	71,3792827	-70,0713255	CTD Rosette	Deployment		28	11,4	2,7	3,44	30,71	996,48	102	0
2	0t2	ROV/Benthic	2021-08-04	21:45	71,3794015	-70,0719958	CTD Rosette	Bottom		27	11	2,8	3,58	30,67	996,49	102	0
2	0t2	ROV/Benthic	2021-08-04	22:04	71,3790067	-70,0753275	CTD Rosette	Recovery		29	11,2	3,1	3,37	30,77	996,26	102	0
2	Scott Inlet-ROV1	ROV/Benthic	2021-08-04	22:32	71,3790148	-70,0732022	Baited Camera	Deployment	264	36	10,9	3,3	3,73	30,50	996,11	102	0
2	Scott Inlet-ROV1	ROV/Benthic	2021-08-04	22:40	71,3790255	-70,073537	Baited Camera	Bottom	265				3,44	30,76			0
2	SE-1K	ROV/Benthic	2021-08-04	23:11	71,3725972	-70,048885	CTD Rosette	Deployment	210	53	7,8	3,7	3,75	30,47	995,95	102	0
2	NE-1K	ROV/Benthic	2021-08-04	23:31	71,3866107	-70,0552897	CTD Rosette	Deployment	259	68	9,9	3,7	3,90	30,64	995,84	102	0
2	NE-5K	ROV/Benthic	2021-08-05	0:01	71,409624	-69,976387	CTD Rosette	Deployment	263	78	7,6	3,5	4,52	30,26	995,70	102	0
2	Scott Inlet	ROV/Benthic	2021-08-05	1:13	71,3909877	-70,3016733	CTD Rosette	Deployment	698	75	9,3	3,5	4,26	30,47	995,59	102	0
2	Scott Inlet	ROV/Benthic	2021-08-05	1:31	71,3907572	-70,3014155	CTD Rosette	Bottom	698	63	8,9	3,3	4,27	30,48	995,62	102	0
2	Scott Inlet	ROV/Benthic	2021-08-05	2:08	71,3895138	-70,3016597	CTD Rosette	Recovery	698	67	9,3	2,9	4,29	30,44	995,63	102	0
2	Scott Inlet-Deep	ROV/Benthic	2021-08-05	2:43	71,3894058	-70,3031523	Hydrobios	Deployment	698	88	8,4	2,7	4,28	30,43	995,77	102	0
2	Scott Inlet-Deep	ROV/Benthic	2021-08-05	2:52	71,3888822	-70,3027842	Hydrobios	Bottom	698	65	6,3	2,7	4,29	30,42	995,81	102	0

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						
2	Scott Inlet-Deep	ROV/Benthic	2021-08-05	3:15	71,3876883	-70,295955	Hydrobios	Recovery	697	59	4,8	2,5	3,89	30,52	995,71	102	0
2	Scott Inlet-Deep	ROV/Benthic	2021-08-05	3:29	71,3913687	-70,3086288	Hydrobios	Deployment	698	82	6,5	2,4	4,23	30,50	995,86	102	0
2	Scott Inlet-Deep	ROV/Benthic	2021-08-05	3:46	71,3902225	-70,3087142	Hydrobios	Bottom	698	33	6,5	2,3	4,23	30,47	995,82	102	0
2	Scott Inlet-Deep	ROV/Benthic	2021-08-05	4:08	71,3893353	-70,3075082	Hydrobios	Recovery	698	61	8,9	2,2	3,86	30,53	995,90	102	0
2	Scott Inlet-Deep	ROV/Benthic	2021-08-05	4:38	71,3923905	-70,3345798	IKMT	Deployment		43	11,2	2,1	4,25	30,42	995,88	102	0
2	Scott Inlet-Deep	ROV/Benthic	2021-08-05	4:57	71,3939835	-70,3493095	IKMT	Bottom		50	4,6	2,3	4,26	30,41	996,05	102	0
2	Scott Inlet-Deep	ROV/Benthic	2021-08-05	5:43	71,3961418	-70,3333583	IKMT	Recovery		16	5,9	2,7	4,25	30,43	996,30	102	0
2	Scott Inlet-ROV1	ROV/Benthic	2021-08-05	10:28	71,3791102	-70,0707147	Baited Camera	Recovery	256	94	12,6	3,9	3,51	30,90	996,91	102	0
2	Scott Inlet-ROV2	ROV/Benthic	2021-08-05	12:35	71,3468872	-70,1718037	ROV	Deployment		81	11	3,5	3,13	30,83	997,56	102	0
2	Scott Inlet-ROV2	ROV/Benthic	2021-08-05	12:49	71,3471998	-70,1721638	ROV	Bottom		86	10,7	3,5	2,42	31,03	997,62	102	0
2	Scott Inlet-ROV2	ROV/Benthic	2021-08-05	14:18	71,3467997	-70,1703335	ROV	Recovery		64	9,9	3,5	3,43	30,41	997,53	102	0
2	SE-25K (ROV3)	ROV/Benthic	2021-08-05	16:49	71,2229583	-69,549526	Drop Camera	Deployment	154	70	11,8	3,8	4,22	29,91	997,06	102	0
2	SE-25K (ROV3)	ROV/Benthic	2021-08-05	16:54	71,223042	-69,549719	Drop Camera	Bottom	154	75	13,3	3,8	4,20	29,92	997,04	102	0
2	SE-25K (ROV3)	ROV/Benthic	2021-08-05	17:28	71,218537	-69,5510868	Drop Camera	Recovery	161	72	13,1	3,9	4,25	29,89	997,09	102	0
2	SE-25K (ROV3)	ROV/Benthic	2021-08-05	17:39	71,2226648	-69,5523373	Drop Camera	Deployment		76	13,3	4	3,71	30,22	997,11	102	0
2	SE-25K (ROV3)	ROV/Benthic	2021-08-05	17:41	71,222629	-69,5521972	Drop Camera	Bottom		84	12,8	4	2,93	30,42	997,13	102	0
2	SE-25K (ROV3)	ROV/Benthic	2021-08-05	18:16	71,2184863	-69,5520257	Drop Camera	Recovery		78	14,7	4	3,32	30,39	997,13	103	0
2	SE-25K (ROV3)	ROV/Benthic	2021-08-05	18:27	71,2230077	-69,5465202	Drop Camera	Deployment		81	13,1	4	4,16	29,95	997,13	103	0
2	SE-25K (ROV3)	ROV/Benthic	2021-08-05	18:30	71,2229582	-69,5465035	Drop Camera	Bottom	154	78	13,1	3,9	4,09	30,01	997,12	103	0
2	SE-25K (ROV3)	ROV/Benthic	2021-08-05	19:04	71,2185045	-69,54434	Drop Camera	Recovery		75	14,3	4	3,83	30,04	996,90	103	0
2	Scott Inlet-Deep	ROV/Benthic	2021-08-05	22:14	71,3959915	-70,312777	Piston Core	Deployment		45	13,5	4,2	4,25	30,49	997,15	103	0
2	Scott Inlet-Deep	ROV/Benthic	2021-08-05	22:25	71,3961958	-70,312826	Piston Core	Bottom	699	49	15	4,2	3,85	30,67	996,93	103	0
2	Scott Inlet-Deep	ROV/Benthic	2021-08-05	22:36	71,3962657	-70,3130073	Piston Core	Recovery	699	43	12	4,2	3,93	30,65	996,98	103	0
2	Scott Inlet-Deep	ROV/Benthic	2021-08-05	23:22	71,3963285	-70,3128703	Box Core	Deployment	700	49	12,9	4,2	4,27	30,42	996,99	103	0
2	Scott Inlet-Deep	ROV/Benthic	2021-08-05	23:34	71,3961172	-70,3125178	Box Core	Bottom	699	44	12,8	4,2	4,26	30,46	997,00	103	0
2	Scott Inlet-Deep	ROV/Benthic	2021-08-05	23:48	71,3960657	-70,3130578	Box Core	Recovery	699	51	14,3	4,3	4,12	30,53	996,95	103	0
2	Scott Inlet-Deep	ROV/Benthic	2021-08-06	0:37	71,3963842	-70,3131663	Piston Core	Deployment	699	32	13,3	4,2	4,27	30,42	996,90	103	0
2	Scott Inlet-Deep	ROV/Benthic	2021-08-06	0:51	71,3962857	-70,3131563	Piston Core	Bottom	700	44	12,9	4,2	4,25	30,45	996,99	103	0
2	Scott Inlet-Deep	ROV/Benthic	2021-08-06	1:06	71,3961967	-70,3157537	Piston Core	Recovery	699	48	11,8	4,2	4,27	30,46	996,99	103	0
2	0t1	ROV/Benthic	2021-08-06	2:25	71,377131	-70,0788612	CTD Rosette	Deployment		46	13,3	4,4	3,57	30,75	996,88	103	0
2	0t1	ROV/Benthic	2021-08-06	2:32	71,3774753	-70,079026	CTD Rosette	Bottom		50	12,4	4,4	3,66	30,45	996,92	103	0
2	0t1	ROV/Benthic	2021-08-06	2:57	71,3785897	-70,0786893	CTD Rosette	Recovery		41	11	4,4	3,84	30,46	996,89	103	0
2	Scott Inlet ROV1	ROV/Benthic	2021-08-06	3:42	71,3777585	-70,0690478	Tucker Net	Deployment		48	11,2	4,4	3,66	30,52	997,00	103	0
2	Scott Inlet ROV1	ROV/Benthic	2021-08-06	3:47	71,3797157	-70,0648742	Tucker Net	Bottom					3,88	30,32			0
2	Scott Inlet ROV1	ROV/Benthic	2021-08-06	3:56	71,3830543	-70,0706813	Tucker Net	Recovery		65	6,1	4,8	3,81	30,27	997,06	103	0
2	Scott Inlet ROV1	ROV/Benthic	2021-08-06	4:31	71,3762183	-70,0737748	Beam Trawl	Deployment		35	8,2	5,5	3,96	30,14	997,17	103	0
2	Scott Inlet ROV1	ROV/Benthic	2021-08-06	4:49	71,3741992	-70,0543585	Beam Trawl	Bottom		42	13,5	4,5	3,73	30,13	997,14	103	0
2	Scott Inlet ROV1	ROV/Benthic	2021-08-06	5:35	71,3776432	-70,0813013	Beam Trawl	Recovery		28	9,3	4,4	3,89	30,00	997,35	103	0
2	Scott Inlet ROV 3	ROV/Benthic	2021-08-06	10:25	71,4279458	-70,1398657	Baited Camera	Deployment	439	15	8,4	4,2	3,98	30,61	998,19	103	0
2	Scott Inlet ROV 3	ROV/Benthic	2021-08-06	10:36	71,428095	-70,1400325	Baited Camera	Bottom	442	23	7,8	4,3	4,08	30,63	998,25	103	0
2	Scott Inlet ROV 3	ROV/Benthic	2021-08-06	11:42	71,4346395	-70,2053067	ROV	Deployment		292	8,4	3,9	4,29	30,38	998,28	103	0
2	Scott Inlet ROV 3	ROV/Benthic	2021-08-06	12:12	71,43503	-70,2052063	ROV	Bottom		302	9,1	4	3,51	30,76	998,35	103	0
2	Scott Inlet ROV 3	ROV/Benthic	2021-08-06	15:49	71,4336055	-70,1964302	ROV	Recovery		324	7,6	4,1	3,99	30,60	998,50	103	0
2	Scott Inlet ROV 3	ROV/Benthic	2021-08-06	17:04	71,428034	-70,1445408	Baited Camera	Recovery		324	7,2	4,1	4,24	30,42	998,69	103	0
2	Scott Inlet ROV 4	ROV/Benthic	2021-08-06	17:57	71,3391195	-70,2605162	ROV	Deployment		327	14,5	4,3	2,91	31,02	998,73	103	0
2	Scott Inlet ROV 4	ROV/Benthic	2021-08-06	18:24	71,3391492	-70,2600345	ROV	Bottom		333	16,6	4,3	4,31	30,41	998,83	103	0
2	Scott Inlet ROV 4	ROV/Benthic	2021-08-06	20:48	71,3363268	-70,25022	ROV	Recovery		334	15	4	4,39	30,22	998,95	103	0
2	Scott Inlet Piston	ROV/Benthic	2021-08-06	21:50	71,397022	-70,3179293	Piston Core	Deployment	699	337	16,8	3,9	4,17	30,48	999,35	103	0
2	Scott Inlet Piston	ROV/Benthic	2021-08-06	22:00	71,3976577	-70,315663	Piston Core	Bottom	698	334	17,1	3,9	4,34	30,41	999,31	103	0
2	Scott Inlet Piston	ROV/Benthic	2021-08-06	22:10	71,3969853	-70,3181343	Piston Core	Recovery	698				4,20	30,45			0
2	Scott Inlet Piston	ROV/Benthic	2021-08-06	23:06	71,3950922	-70,3504722	IKMT	Deployment		87	3,4	3,9	4,27	30,37	999,79	103	0
2	Scott Inlet Piston	ROV/Benthic	2021-08-06	23:31	71,382788	-70,3540868	IKMT	Bottom		79	7,2	3,3	4,30	30,38	999,96	103	0
2	Scott Inlet Piston	ROV/Benthic	2021-08-07	0:10	71,3829262	-70,3076975	IKMT	Recovery		48	3,6	3,7	4,20	30,01	1000,06	103	0
2	Scott Inlet Box Co	ROV/Benthic	2021-08-07	0:59	71,3389662	-70,259766	Box Core	Deployment	377	81	8	2,6	3,00	30,70	1000,14	103	0
2	Scott Inlet Box Co	ROV/Benthic	2021-08-07	1:07	71,3395323	-70,2583063	Box Core	Bottom	378	72	5,1	2,2	2,83	30,89	1000,14	102	0
2	Scott Inlet Box Co	ROV/Benthic	2021-08-07	1:15	71,3397423	-70,2572957	Box Core	Recovery	377	63	5,3	2,2	2,97	30,79	1000,10	103	0
2	Scott Inlet Beam	ROV/Benthic	2021-08-07	2:11	71,3310473	-70,1244147	Beam Trawl	Deployment	129	74	9,5	1,8	4,00	29,20	1000,27	102	0
2	Scott Inlet Beam	ROV/Benthic	2021-08-07	2:23	71,3351073	-70,1175702	Beam Trawl	Bottom	138	74	3	2,5	4,00	29,09	1000,24	103	0
2	Scott Inlet Beam	ROV/Benthic	2021-08-07	2:51	71,3301572	-70,1209873	Beam Trawl	Recovery	130	67	8,6	1,8	3,96	29,08	1000,20	102	0
2	Scott Inlet Beam	ROV/Benthic	2021-08-07	4:09	71,4532048	-69,7971607	Beam Trawl	Deployment	294	91	5,9	0,9	4,26	30,21	1000,16	102	0
2	Scott Inlet Beam	ROV/Benthic	2021-08-07	4:28	71,4507717	-69,7868697	Beam Trawl	Bottom	286	57	7,2	1,3	4,25	30,27	1000,18	102	0
2	Scott Inlet Beam	ROV/Benthic	2021-08-07	5:08	71,4499797	-69,792047	Beam Trawl	Recovery	285	70	4,2	1,5	4,27	30,27	1000,23	102	0
2	Scott Inlet Beam	ROV/Benthic	2021-08-07	5:48	71,4517342	-69,7974103	Tucker Net	Deployment		74	3	1,5	4,24	30,27	1000,50	102	0
2	Scott Inlet Beam	ROV/Benthic	2021-08-07	5:53	71,4520905	-69,8048018	Tucker Net	Bottom		102	5,7	1	4,24	30,23	1000,57	102	0
2	Scott Inlet Beam	ROV/Benthic	2021-08-07	6:01	71,449876	-69,7981665	Tucker Net	Recovery		93	9,7	1,3	4,24	30,24	1000,55	102	0
2	Gib-3.1	Coring	2021-08-07	13:47	70,6491142	-72,4828337	CTD Rosette	Deployment	299	80	15,6	4,7	3,52	12,23	1000,13	104	0
2	Gib-3.1	Coring	2021-08-07	14:20	70,649435	-72,4758815	Piston Core	Deployment	303	85	18,5	4,2	4,19	12,77	999,98	104	0
2	Gib-3.1	Coring	2021-08-07	14:26	70,649233	-72,4754643	Piston Core	Bottom	303	85	20	4,3	4,18	12,47	999,89	104	0
2	Gib-3.1	Coring	2021-08-07	14:32	70,6493397	-72,4761648	Piston Core	Recovery	303	76	16,4	4,1	4,09	13,71	1000,04	104	0
2	Gib-3.2	Coring	2021-08-07	17:27	70,8040375	-72,2018647	Piston Core	Deployment	261	67	5	3,5	3,03	23,75	1000,55	104	0
2	Gib-3.2	Coring	2021-08-07	17:31	70,8040023	-72,2016737	Piston Core	Bottom	261	49	3,4	3,6	3,08	23,84	1000,56	104	0

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						
2	Gib-3.2	Coring	2021-08-07	17:36	70,8040107	-72,2014503	Piston Core	Recovery	261	44	2,9	4,2	3,15	23,16	1000,57	104	0
2	Cla-3.1	Coring	2021-08-07	19:19	70,8873982	-72,2872957	Piston Core	Deployment	268	346	5	4,3	3,56	23,71	1000,43	104	0
2	Cla-3.1	Coring	2021-08-07	19:23	70,8874238	-72,2874635	Piston Core	Bottom	268	347	5,5	4,1	3,44	23,65	1000,41	104	0
2	Cla-3.1	Coring	2021-08-07	19:29	70,887413	-72,2874587	Piston Core	Recovery	268	344	5,9	3,9	3,36	23,81	1000,40	104	0
2	Cla-3.2		2021-08-07	20:33	70,9284217	-72,3015493	Box Core	Deployment	207	41	2,7	6	3,73	22,93	1000,58	104	0
2	Cla-3.2		2021-08-07	20:38	70,9284413	-72,3018447	Box Core	Bottom	207	24	4	6,2	3,79	24,14	1000,59	103	0
2	Cla-3.2		2021-08-07	20:44	70,9283702	-72,3025773	Box Core	Recovery	207	22	4,8	6,1	3,86	24,10	1000,60	103	0
2	Cla-3.1		2021-08-07	21:12	70,885124	-72,2964313	Box Core	Deployment	261	354	4	6,2	3,58	24,24	1000,40	103	0
2	Cla-3.1		2021-08-07	21:17	70,8849162	-72,296952	Box Core	Bottom	261	0	5	4,9	3,62	23,67	1000,36	104	0
2	Cla-3.1		2021-08-07	21:26	70,8846987	-72,2965605	Box Core	Recovery	262	3	5	4,3	3,57	24,55	1000,30	104	0
2	Clark Fjord CTD	CTD	2021-08-07	23:41	71,0491357	-71,5880715	CTD Rosette	Deployment	680				3,83	27,48			0
2	Clark Fjord CTD	CTD	2021-08-07	23:54	71,0481063	-71,5847582	CTD Rosette	Bottom	680				4,16	27,53			0
2	Clark Fjord CTD	CTD	2021-08-08	0:12	71,048023	-71,5796212	CTD Rosette	Recovery	680				3,96	27,21			0
2	Scott Inlet Moori	Mooring	2021-08-08	1:49	71,1358298	-70,8016795	Mooring	Deployment	152				3,67	28,69			0
2	Scott Inlet Moori	Mooring	2021-08-08	1:50	71,1357648	-70,8014342	Mooring	Bottom	152				3,70	28,48			0
2	padloping		2021-08-09	1:58	67,354176	-62,2484637	Ice sample	Deployment	234	132	12,4	3,2	0,54	29,20	1001,32	102	1
2	padloping		2021-08-09	2:21	67,3590895	-62,2555687	Ice sample	Recovery	220	179	7,4	3,6	0,58	29,25	1001,13	103	1
2	padloping		2021-08-09	2:27	67,3600937	-62,2425652	CTD Rosette	Deployment	234	139	16,6	3,2	0,62	29,22	1000,94	102	1
2	padloping		2021-08-09	2:57	67,3596583	-62,2299505	CTD Rosette	Recovery	243	144	11,8	4,3	0,57	29,70	1000,71	102	1
2	Cum-8.2	Coring	2021-08-09	20:55	64,9743893	-64,8493822	Piston Core	Deployment	798	134	19	6,6	4,88	31,18	988,12	102	0
2	Cum-8.2	Coring	2021-08-09	21:07	64,9734107	-64,8467843	Piston Core	Bottom	798	133	26,7	6,6	4,93	31,17	987,32	102	0
2	Cum-8.2	Coring	2021-08-09	21:18	64,9735392	-64,8499838	Piston Core	Recovery	798	136	23,8	6,3	4,95	31,16	987,03	102	0
2	Cum-8.2	Coring	2021-08-09	22:01	64,9726538	-64,8432665	Box Core	Deployment	799	137	21,3	6,6	4,92	31,14	986,71	102	0
2	Cum-8.2	Coring	2021-08-09	22:15	64,9733522	-64,8467463	Box Core	Bottom	799	131	16,6	6,7	4,89	31,15	986,92	102	0
2	Cum-8.2	Coring	2021-08-09	22:29	64,974592	-64,8491227	Box Core	Recovery	799	143	20	6,6	4,77	31,23	986,72	102	0
2	ID-12	DropCam	2021-08-10	6:39	66,187072	-65,6788312	Drop Camera	Deployment	83	223	5,7	5,7	5,07	27,71	993,10	102	0
2	ID-12	DropCam	2021-08-10	6:42	66,1870108	-65,6785693	Drop Camera	Bottom	83	214	5,1	5,7	5,13	27,72	993,10	102	0
2	ID-12	DropCam	2021-08-10	7:24	66,1824775	-65,6847095	Drop Camera	Recovery	89	16	0	6,2	5,09	28,28	993,18	102	0
2	ID-14	DropCam	2021-08-10	7:40	66,1751023	-65,665754	Drop Camera	Deployment	111				5,79	25,48			0
2	ID-14	DropCam	2021-08-10	7:42	66,1751352	-65,6654888	Drop Camera	Bottom	111				4,88	28,27			0
2	ID-14	DropCam	2021-08-10	8:14	66,1795563	-65,6602602	Drop Camera	Recovery	110	225	2,9	6,3	4,81	28,92	993,25	102	0
2	ID-11	DropCam	2021-08-10	8:39	66,174537	-65,7219862	Drop Camera	Deployment	96	273	5,5	6,3	4,93	26,23	993,26	101	0
2	ID-11	DropCam	2021-08-10	8:42	66,1746493	-65,7219432	Drop Camera	Bottom	95	301	6,9	6,4	5,22	28,12	993,21	101	0
2	ID-11	DropCam	2021-08-10	9:15	66,1766245	-65,712144	Drop Camera	Recovery	97	336	6,9	6,6	5,05	28,38	993,10	101	0
2	ID-13	DropCam	2021-08-10	9:30	66,1638307	-65,6974798	Drop Camera	Deployment	94	163	16,2	6,8	5,12	25,73	992,72	101	0
2	ID-13	DropCam	2021-08-10	9:34	66,164043	-65,6971778	Drop Camera	Bottom	96	162	16	6,9	5,31	28,22	992,72	101	0
2	ID-13	DropCam	2021-08-10	10:06	66,16632	-65,6901518	Drop Camera	Recovery	101	164	20,2	6,8	4,64	28,40	992,62	101	0
2			2021-08-10	10:49	66,1654443	-65,7178952	Zodiac	Deployment	152	159	13,7	7,3	6,36	27,22	992,98	101	0
2	ID-10	DropCam	2021-08-10	11:07	66,1636548	-65,7226133	Drop Camera	Deployment	153	165	17,7	7,5	4,87	27,88	993,02	101	0
2	ID-10	DropCam	2021-08-10	11:11	66,1637512	-65,7214968	Drop Camera	Bottom	153	174	18,7	7,6	4,74	26,52	993,05	101	0
2	ID-10	DropCam	2021-08-10	11:43	66,1665097	-65,7113687	Drop Camera	Recovery	153	185	12,8	7,6	6,04	26,85	993,44	101	0
2			2021-08-10	12:24	66,1564867	-65,7550798	Zodiac	Recovery	135	188	21,3	8,2	6,56	24,91	993,20	101	0
2	ID-9	DropCam	2021-08-10	12:50	66,153011	-65,7532407	Drop Camera	Deployment	148	202	18,3	8,4	5,86	27,60	993,80	101	0
2	ID-9	DropCam	2021-08-10	12:54	66,1533807	-65,7518522	Drop Camera	Bottom	133	208	23,8	8,3	5,92	27,64	993,77	101	0
2	ID-9	DropCam	2021-08-10	13:31	66,1573767	-65,7416638	Drop Camera	Recovery	150	226	22,8	7,6	5,76	27,79	994,38	101	0
2	Pangnirtung Pisto	Coring	2021-08-10	13:57	66,164013	-65,7200005	Piston Core	Deployment	150	227	23,4	7,9	6,30	26,59	994,84	101	0
2	Pangnirtung Pisto	Coring	2021-08-10	14:00	66,1640625	-65,7201288	Piston Core	Bottom	150	235	20,2	7,8	6,30	26,18	994,98	101	0
2	Pangnirtung Pisto	Coring	2021-08-10	14:03	66,164107	-65,7196618	Piston Core	Recovery	150	230	22,8	7,7	6,20	26,69	995,10	101	0
2	ID-2	DropCam	2021-08-10	14:54	66,1355087	-65,7750063	Drop Camera	Deployment	116	230	18,5	7,6	6,27	27,13	995,84	101	0
2	ID-2	DropCam	2021-08-10	15:03	66,1362587	-65,7725587	Drop Camera	Bottom	108	219	16,8	7,5	5,96	27,74	995,95	100	0
2	ID-2	DropCam	2021-08-10	15:31	66,1383188	-65,7650477	Drop Camera	Recovery	101	228	14,5	7,7	5,93	27,75	996,17	100	0
2	ID-1	DropCam	2021-08-10	15:46	66,1378727	-65,8166835	Drop Camera	Deployment	96	235	16,8	7,3	6,28	25,45	996,21	101	0
2	ID-1	DropCam	2021-08-10	15:49	66,1381298	-65,8162367	Drop Camera	Bottom	93	226	15,6	7,3	4,90	27,75	996,19	101	0
2	ID-1	DropCam	2021-08-10	15:49	66,1381437	-65,8161928	Drop Camera	Bottom	93	224	16	7,4	4,90	27,83	996,22	100	0
2	ID-1	DropCam	2021-08-10	16:21	66,1418718	-65,808743	Drop Camera	Recovery		260	13,3	7,4	5,42	27,80	996,63	100	0
2	ID-8	DropCam	2021-08-10	16:46	66,1236553	-65,8661422	Drop Camera	Deployment	69	213	14,5	7	4,61	28,81	996,81	100	0
2	ID-8	DropCam	2021-08-10	16:49	66,123838	-65,8657532	Drop Camera	Bottom	70	215	17,1	7,1	4,35	28,84	996,77	100	0
2	ID-8	DropCam	2021-08-10	17:22	66,1252075	-65,858168	Drop Camera	Recovery	89	216	15,8	7,4	5,37	28,02	997,32	100	0
2	ID-0	DropCam	2021-08-10	17:47	66,1143428	-65,8671253	Drop Camera	Deployment		215	14,9	7,3	4,95	28,48	997,79	100	0
2	ID-0	DropCam	2021-08-10	17:49	66,1145723	-65,8669267	Drop Camera	Bottom		222	16,2	7,4	5,29	28,84	997,72	100	0
2	ID-0	DropCam	2021-08-10	18:22	66,1183917	-65,8607063	Drop Camera	Recovery		205	12	7,1	5,56	28,35	998,26	100	0
2	ID-6	DropCam	2021-08-10	18:44	66,1188108	-65,909473	Drop Camera	Deployment		217	9,9	6,6	4,53	28,80	998,59	101	0
2	ID-6	DropCam	2021-08-10	18:47	66,1188858	-65,9093023	Drop Camera	Bottom	112	204	10,1	6,6	4,25	29,05	998,65	100	0
2	ID-6	DropCam	2021-08-10	19:20	66,122014	-65,9016405	Drop Camera	Recovery		265	4,8	6,8	5,34	28,74	999,03	100	0
2	ID-7	DropCam	2021-08-10	19:45	66,0905415	-65,9765793	Drop Camera	Deployment		184	9,3	6,8	5,18	28,49	999,10	100	0
2	ID-7	DropCam	2021-08-10	19:48	66,0906137	-65,9759653	Drop Camera	Bottom		193	10,7	6,8	5,41	28,68	999,17	100	0
2	ID-7	DropCam	2021-08-10	20:02	66,0924232	-65,9725003	Drop Camera	Recovery		192	9,1	6,7	5,41	28,48	999,11	100	0
2	ID-4	DropCam	2021-08-10	20:21	66,109472	-65,9208145	Drop Camera	Deployment		230	12,6	7,3	5,94	27,92	999,24	100	0
2	ID-4	DropCam	2021-08-10	20:26	66,109833	-65,9192877	Drop Camera	Bottom		216	11,6	7,3	5,98	27,96	999,27	100	0
2	ID-4	DropCam	2021-08-10	20:58	66,1129107	-65,9112328	Drop Camera	Recovery		211	9,1	7,1	5,95	28,15	999,75	100	0
Leg 3																	

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						
3	MVP Start point		2021-08-14	4:59	62,1790358	-68,412386	CTD Rosette	Bottom	131				0,98	30,90			
3	MVP Start point		2021-08-14	5:03	62,1799562	-68,412594	CTD Rosette	Recovery	132	28	5,1	-3,5	0,93	30,94	1019,83	98	
3			2021-08-14	5:30	62,161649	-68,4266938	MVP	Deployment	132	35	5	-3,5	0,84	30,99	1019,79	97	
3			2021-08-14	17:42	61,1281185	-69,5403238	MVP	Recovery	132	18	5,5	-2,6	0,74	31,09	1019,74	96	
3	Basic_Q3	Basic	2021-08-14	18:46	61,0481585	-69,6664385	Tucker Net	Deployment	132	314	5,7	-2	0,95	30,91	1019,66	94	
3	Basic_Q3	Basic	2021-08-14	18:51	61,0521353	-69,6641003	Tucker Net	Bottom	132	23	4,8	-2,4	0,92	30,94	1019,69	93	
3	Basic_Q3	Basic	2021-08-14	19:05	61,0614337	-69,666117	Tucker Net	Recovery	259	295	7,8	-4,1	-0,94	29,64	1019,07	99	
3			2021-08-14	19:28	61,0481308	-69,6671947	Plankton Net	Deployment	289	302	6,9	-4,2	-1,06	29,46	1018,96	99	
3			2021-08-14	19:31	61,0488323	-69,6664293	Plankton Net	Bottom	296	287	7	-4,1	-1,12	29,39	1018,98	99	
3			2021-08-14	19:34	61,0496748	-69,6661488	Plankton Net	Recovery	211	311	9,9	-4,1	-1,24	29,49	1019,09	99	
3			2021-08-14	20:18	61,0482537	-69,6688477	CTD Rosette	Deployment	214	300	7,8	-4,1	-1,31	29,27	1019,17	99	
3			2021-08-14	20:27	61,0500645	-69,666538	CTD Rosette	Bottom	214	293	8,2	-4,2	-1,18	29,61	1019,16	99	
3			2021-08-14	20:42	61,0547508	-69,6634395	CTD Rosette	Recovery	104	281	7,8	-4,7	-1,30	27,41	1019,34	99	
3			2021-08-14	21:04	61,0461642	-69,6684978	Agassiz Trawl	Deployment	108				-1,31	27,36			
3			2021-08-14	21:10	61,049086	-69,6645027	Agassiz Trawl	Bottom	108				-1,32	27,28			
3			2021-08-14	21:12	61,0507248	-69,6630628	Agassiz Trawl	Recovery	164	290	8,9	-4,8	-1,35	27,21	1019,53	99	
3			2021-08-14	21:34	61,0482632	-69,666664	Van Veen Grab	Deployment	164	293	7,8	-4,5	-1,33	27,39	1019,51	99	
3			2021-08-14	21:36	61,0483377	-69,6668818	Van Veen Grab	Bottom	164	275	5,3	-4,7	-1,33	27,35	1019,61	99	
3			2021-08-14	21:39	61,0483978	-69,6665948	Van Veen Grab	Recovery	157	261	8,6	-4,6	-1,33	27,30	1019,62	99	
3	Nutrient_Q4	Nutrient	2021-08-14	22:07	61,03085	-69,6919245	CTD Rosette	Deployment	154	290	11,8	-4,4	-1,33	27,47	1019,72	99	
3	Nutrient_Q4	Nutrient	2021-08-14	22:14	61,0327613	-69,6901803	CTD Rosette	Bottom	155				-1,33	27,44			
3	Nutrient_Q4	Nutrient	2021-08-14	22:26	61,0343263	-69,6901045	CTD Rosette	Recovery	154	286	8,8	-4,1	-1,35	27,37	1019,71	99	
3			2021-08-14	23:19	61,0266292	-69,6975342	Agassiz Trawl	Deployment	154	268	10,5	-4,1	-1,33	27,43	1019,61	99	
3			2021-08-14	23:21	61,026654	-69,6995777	Agassiz Trawl	Bottom	155	284	5,1	-4	-1,36	27,35	1019,73	99	
3			2021-08-14	23:26	61,0248698	-69,70075	Agassiz Trawl	Recovery	295	275	9,9	-3,6	-1,17	29,36	1019,18	99	
3			2021-08-14	23:51	61,030329	-69,6892345	Box Core	Deployment	295	305	12	-3,9	-1,18	29,37	1019,14	99	
3			2021-08-14	23:54	61,0306582	-69,6892332	Box Core	Bottom	297	287	11,6	-3,4	-1,19	29,38	1019,02	99	
3			2021-08-14	23:57	61,030918	-69,6891062	Box Core	Recovery	299	264	6,5	-1,1	-1,11	29,37	1019,10	99	
3	Nutrient_Q6	Nutrient	2021-08-15	0:38	61,050376	-69,7146487	CTD Rosette	Deployment	299	271	6,3	-1,4	-1,06	29,37	1019,03	99	
3	Nutrient_Q6	Nutrient	2021-08-15	0:47	61,0510662	-69,7129575	CTD Rosette	Bottom	299	244	5	-2,3	-1,15	29,37	1018,99	99	
3	Nutrient_Q6	Nutrient	2021-08-15	1:12	61,0544312	-69,7089193	CTD Rosette	Recovery	295	268	6,9	-3	-1,14	29,46	1018,97	99	
3	Nutrient_Q6	Nutrient	2021-08-15	1:14	61,0547557	-69,7083297	CTD Rosette	Recovery	296	270	9,5	-3,7	-1,13	29,41	1018,81	99	
3			2021-08-15	1:31	61,050764	-69,7108373	Box Core	Deployment	297				-1,15	29,50			
3			2021-08-15	1:35	61,0513113	-69,7110632	Box Core	Bottom	297	76	0	-3,4	-1,14	29,57	1018,81	99	
3			2021-08-15	1:39	61,0516313	-69,7113372	Box Core	Recovery	293	296	9,5	-3,9	-1,18	29,39	1018,76	99	
3			2021-08-15	2:11	61,05042	-69,7147355	Agassiz Trawl	Deployment	292	273	8,2	-3,9	-1,17	29,40	1018,69	99	
3			2021-08-15	2:17	61,0527898	-69,7095403	Agassiz Trawl	Bottom	296	237	1,1	-2,9	-1,19	29,37	1018,77	99	
3			2021-08-15	2:25	61,0561432	-69,7102845	Agassiz Trawl	Recovery	217	305	3,8	-3,6	0,88	30,40	1018,51	97	
3	Nutrient_Q2	Nutrient	2021-08-15	3:04	61,0730827	-69,6397943	CTD Rosette	Deployment	218	348	3,2	-3,8	0,95	30,42	1018,34	99	
3	Nutrient_Q2	Nutrient	2021-08-15	3:11	61,0749992	-69,6380132	CTD Rosette	Bottom	218	313	5,5	-4	0,92	30,43	1018,35	99	
3	Nutrient_Q2	Nutrient	2021-08-15	3:35	61,078826	-69,6379748	CTD Rosette	Recovery	210	322	3	-3,4	0,99	30,53	1018,05	99	
3			2021-08-15	3:58	61,0712447	-69,6394547	Agassiz Trawl	Deployment	210	46	2,5	-3,3	1,01	30,54	1018,00	99	
3			2021-08-15	4:04	61,0747133	-69,6401333	Agassiz Trawl	Bottom	210				0,98	30,52			
3			2021-08-15	4:12	61,0796863	-69,6435108	Agassiz Trawl	Recovery	197	357	11,2	-3,6	1,16	30,36	1017,76	99	
3			2021-08-15	5:02	61,0724045	-69,6367913	Box Core	Deployment	197	8	11,8	-3,7	1,19	30,35	1017,83	99	
3			2021-08-15	5:05	61,0723	-69,6368338	Box Core	Bottom	198	350	8,2	-3,6	1,13	30,33	1017,82	99	
3			2021-08-15	5:05	61,0723007	-69,6368678	Box Core	Recovery	199	301	9,3	-3,7	1,16	30,42	1017,75	99	
3	Nutrient_356	Nutrient	2021-08-15	18:16	60,8065025	-64,7254018	Moonpool TM	Deployment	197	310	11,2	-3,6	1,15	30,43	1017,46	99	
3			2021-08-15	21:45	60,8019338	-64,7224017	CTD Rosette	Deployment	196	315	11,6	-3,5	1,11	30,43	1017,44	99	
3			2021-08-15	22:10	60,811388	-64,6865185	CTD Rosette	Bottom	197	336	11,2	-3,3	1,13	30,33	1017,32	99	
3			2021-08-15	22:49	60,8183752	-64,6331953	CTD Rosette	Recovery	196	328	12,2	-3,3	1,14	30,37	1017,32	99	
3			2021-08-15	23:31	60,8085823	-64,7144673	Plankton Net	Deployment	196	319	9,9	-3,2	1,16	30,34	1017,40	99	
3			2021-08-15	23:35	60,8089823	-64,7084112	Plankton Net	Bottom	236	347	5	-2,6	0,97	30,76	1017,18	97	
3			2021-08-15	23:39	60,8097278	-64,702885	Plankton Net	Recovery	235	307	11,2	-2,9	0,96	30,80	1017,07	97	
3	Nutrient_354	Nutrient	2021-08-16	0:55	60,9701762	-64,7876257	CTD Rosette	Deployment	235	330	13,1	-2,7	0,92	30,83	1017,06	99	
3	Nutrient_354	Nutrient	2021-08-16	1:16	60,9660237	-64,7982952	CTD Rosette	Bottom	261	313	14,1	-2,8	0,98	30,70	1016,92	98	
3	Nutrient_354	Nutrient	2021-08-16	2:06	60,9645015	-64,846009	CTD Rosette	Recovery	270	341	4,8	-2,8	1,04	30,19	1016,93	97	
3	Nutrient_352	Nutrient	2021-08-16	4:13	61,1724205	-64,7723888	CTD Rosette	Deployment	267	338	10,1	-2	1,02	30,20	1016,71	95	
3	Nutrient_352	Nutrient	2021-08-16	4:21	61,1713763	-64,7869482	CTD Rosette	Bottom	265	271	5,7	-1,5	1,05	30,20	1016,74	94	
3	Nutrient_352	Nutrient	2021-08-16	5:04	61,1673683	-64,864014	CTD Rosette	Recovery	266	305	7,6	-1,7	1,03	30,25	1016,55	95	
3			2021-08-16	10:47	62,0452892	-63,8329542	CPR		266	305	6,7	-1,4	1,01	30,34	1016,46	94	
3			2021-08-16	10:50	62,0505902	-63,827793	CPR		91	328	2,7	-0,9	0,94	30,57	1015,94	89	
3			2021-08-16	10:53	62,0611055	-63,8183175	CPR		89	336	9,7	-0,7	0,96	30,60	1015,95	83	
3	Full_A1	Full	2021-08-17	11:16	66,5480997	-61,2363023	Baited Cam	Deployment	93	333	8,4	-0,7	0,98	30,59	1015,90	88	
3	Full_A1	Full	2021-08-17	11:24	66,5472902	-61,2402062	Baited Cam	Bottom	92	359	3,8	-1,3	0,96	30,61	1015,82	89	
3			2021-08-17	12:22	66,6052638	-61,1965708	Moonpool TM	Deployment	179	291	8,4	-2,2	0,86	30,89	1015,58	89	
3			2021-08-17	12:44	66,6008925	-61,1940442	Moonpool TM	Bottom	185	315	8,4	-0,6	0,86	30,90	1015,55	87	
3			2021-08-17	12:57	66,5980412	-61,1954773	Moonpool TM	Recovery	183	269	4,2	0,1	0,83	30,90	1015,53	83	
3			2021-08-17	13:20	66,6060233	-61,1931392	CTD Rosette	Deployment	183				0,85	30,90			
3			2021-08-17	13:28	66,6046602	-61,1948732	CTD Rosette	Bottom	186	320	7,8	1,2	0,90	30,90	1015,38	81	
3			2021-08-17	13:54	66,5990735	-61,1998443	CTD Rosette	Recovery	187	275	6,9	-0,3	0,78	30,97	1015,15	84	
3			2021-08-17	14:08	66,599089	-61,1995767	Tucker Net	Deployment	187	287	6,9	2,4	0,79	30,97	1015,08	77	
3			2021-08-17	14:16	66,6006923	-61,2021555	Tucker Net	Bottom	186	285	3,2	-0,8	0,84	30,90	1014,89	88	

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						
3			2021-08-17	14:21	66,6013548	-61,2076308	Tucker Net	Recovery	185	309	6,3	-0,5	0,83	30,90	1014,93	84	
3			2021-08-17	14:59	66,6046903	-61,2030537	Monster Net	Deployment	184				0,85	30,90			
3			2021-08-17	15:04	66,6042295	-61,2020048	Monster Net	Bottom	168	4	10,3	-3,9	-0,72	27,29	1013,70	99	
3			2021-08-17	15:08	66,6040778	-61,2020273	Monster Net	Recovery	168	343	11,4	-3,6	-0,77	27,26	1013,59	99	
3			2021-08-17	15:30	66,6046228	-61,2013452	Zodiac	Deployment	162	333	19,2	-3,5	-1,49	28,61	1012,75	97	
3			2021-08-17	15:34	66,604146	-61,2016135	Zodiac	Bottom	163	333	13,7	-3,5	-1,48	28,61	1012,89	99	
3			2021-08-17	15:37	66,6037165	-61,201032	Van Veen Grab	Recovery	164	159	0,6	-3,3	-1,47	28,63	1012,77	98	
3			2021-08-17	17:00	66,5464682	-61,238883	Baited Cam	Recovery	165	59	2,3	-3,5	-1,47	28,63	1012,80	97	
3	Basic A2	Basic	2021-08-17	19:23	66,669212	-60,4618278	CTD Rosette	Deployment	164	35	4,6	-2,9	-1,47	28,63	1012,82	97	
3	Basic A2	Basic	2021-08-17	19:34	66,6707075	-60,4654057	CTD Rosette	Bottom	165	355	1,5	-3	-1,48	28,62	1012,75	96	
3	Basic A2	Basic	2021-08-17	20:11	66,6749283	-60,4739413	CTD Rosette	Recovery	166	326	11	-3,3	-1,49	28,62	1012,66	99	
3			2021-08-17	20:38	66,6655237	-60,4601757	Monster Net	Deployment	166	316	2,1	-3,3	-1,50	28,63	1012,45	99	
3			2021-08-17	20:57	66,66701	-60,4674008	Monster Net	Bottom	167	343	16,2	-3,2	-1,48	28,61	1012,47	99	
3			2021-08-17	21:14	66,6690863	-60,4733792	Monster Net	Recovery	167				-1,49	28,60			
3			2021-08-17	21:29	66,6642785	-60,4557335	Plankton Net	Deployment	167	333	12,8	-3,2	-1,48	28,60	1012,37	99	
3			2021-08-17	21:33	66,664632	-60,4573993	Plankton Net	Bottom	166	312	11,8	-4,1	-0,56	30,58	1011,83	99	
3			2021-08-17	21:36	66,664875	-60,4584697	Plankton Net	Recovery	172	317	12,4	-4,1	-0,60	30,53	1011,73	99	
3			2021-08-17	21:43	66,6653328	-60,4602765	Van Veen Grab	Deployment	168	326	12	-3,4	-0,59	30,51	1011,94	99	
3			2021-08-17	21:55	66,6655332	-60,4620375	Van Veen Grab	Bottom	170	319	12,2	-3,9	-0,24	30,68	1011,89	99	
3			2021-08-17	22:05	66,6656448	-60,4634378	Van Veen Grab	Recovery	171	316	13,5	-4	-0,23	30,84	1011,83	99	
3			2021-08-17	22:27	66,665364	-60,4527205	Box Core	Deployment	171	325	8,8	-4	-0,57	30,52	1011,97	98	
3			2021-08-17	22:37	66,6656403	-60,45533	Box Core	Bottom	171	335	9,5	-4,2	-0,51	30,56	1011,92	99	
3			2021-08-17	22:46	66,665449	-60,4571683	Box Core	Recovery	172				-0,50	30,55			
3			2021-08-17	23:15	66,6646407	-60,4549722	Agassiz Trawl	Deployment	171	348	13,7	-3	-0,50	30,51	1011,98	98	
3			2021-08-17	23:44	66,6626825	-60,4722613	Agassiz Trawl	Bottom	129				0,12	30,06			
3			2021-08-18	0:34	66,6632428	-60,4600587	Beam trawl	Deployment	129	332	8,2	-4,5	0,08	30,04	1012,10	99	
3			2021-08-18	1:04	66,6560902	-60,4304342	Beam trawl	Bottom	129	334	10,3	-4,5	0,12	29,99	1012,03	99	
3			2021-08-18	1:48	66,6650007	-60,3565357	Beam trawl	Recovery	130	335	14,1	-4,5	0,11	29,95	1011,95	99	
3	Full A3	Full	2021-08-18	3:50	66,736284	-59,629497	Tucker Net	Deployment	128				-0,04	29,96			
3	Full A3	Full	2021-08-18	3:59	66,7313112	-59,6276162	Tucker Net	Bottom	129	320	11,2	-4,2	0,03	30,14	1012,26	99	
3	Full A3	Full	2021-08-18	4:07	66,7277702	-59,6217827	Tucker Net	Recovery	129	330	10,7	-0,5	0,05	30,02	1011,91	92	
3			2021-08-18	4:33	66,7338235	-59,6115327	CTD Rosette	Deployment	128	355	13,3	-2,1	0,13	30,09	1012,10	89	
3			2021-08-18	4:50	66,7320183	-59,6104935	CTD Rosette	Bottom	129	344	8,9	-2,2	0,10	29,95	1012,19	95	
3			2021-08-18	5:44	66,7283417	-59,6153333	CTD Rosette	Recovery	695	265	17,3	-1,2	1,00	31,01	1007,50	84	
3			2021-08-18	6:06	66,7355312	-59,6144638	Monster Net	Deployment	689	285	19,6	-1,2	0,97	30,98	1007,37	84	
3			2021-08-18	6:27	66,7349638	-59,615842	Monster Net	Bottom	679	279	16,9	-1,2	0,97	30,97	1007,39	86	
3			2021-08-18	6:55	66,7351088	-59,616521	Monster Net	Recovery	733	287	16,9	1,2	1,17	31,13	1007,52	76	
3			2021-08-18	7:33	66,7357562	-59,6162178	Hydrobios	Deployment	698	277	21,9	-0,8	1,03	31,07	1007,47	83	
3			2021-08-18	7:55	66,7361222	-59,6195292	Hydrobios	Bottom	683				1,00	31,00			
3			2021-08-18	8:21	66,738154	-59,6207135	Hydrobios	Recovery	693	303	24,4	-1,2	1,11	30,99	1007,50	81	
3			2021-08-18	8:53	66,7341887	-59,6129918	Box Core	Deployment	688	284	16,2	-1,1	1,04	31,06	1007,73	85	
3			2021-08-18	9:10	66,7356762	-59,6140085	Box Core	Bottom	679	272	21,3	1,5	1,19	31,06	1007,58	74	
3			2021-08-18	9:25	66,7375768	-59,6134257	Box Core	Recovery	772	275	23,4	-0,2	3,20	32,17	1007,27	86	
3			2021-08-18	10:06	66,732172	-59,614939	Agassiz Trawl	Deployment	771	293	17,5	2,6	3,15	32,16	1007,25	81	
3			2021-08-18	10:57	66,7343243	-59,6656262	Agassiz Trawl	Bottom	772	261	13,7	2,1	3,14	32,15	1007,80	82	
3			2021-08-18	11:37	66,7192447	-59,6682152	Agassiz Trawl	Recovery	790	316	12,9	3,1	1,93	31,75	1007,39	75	
3	Basic A4	Basic	2021-08-18	14:06	66,8018388	-58,7581137	Moonpool TM	Deployment	789	272	22,3	1,1	2,12	31,74	1007,15	83	
3	Basic A4	Basic	2021-08-18	14:18	66,8017937	-58,7534608	Moonpool TM	Bottom	791	269	17,3	0,8	2,27	31,74	1007,46	79	
3	Basic A4	Basic	2021-08-18	14:31	66,8018187	-58,7493417	Moonpool TM	Recovery	700	271	19,8	-1,7	2,75	32,00	1007,64	90	
3			2021-08-18	14:48	66,8025427	-58,7726152	CTD Rosette	Deployment	701	278	25,3	-1,7	2,70	31,95	1007,63	85	
3			2021-08-18	15:10	66,8028913	-58,7660665	CTD Rosette	Bottom	701	258	25,9	-1,9	2,69	31,94	1007,11	91	
3			2021-08-18	15:58	66,803823	-58,7524963	CTD Rosette	Recovery	663	273	24,8	-1,7	1,68	31,34	1006,94	78	
3			2021-08-18	16:38	66,8012777	-58,7618447	Zodiac	Deployment	662	285	29,1	-2,1	1,64	31,36	1007,03	77	
3			2021-08-18	16:50	66,799095	-58,7663313	Monster Net	Deployment	661	276	23,2	-2	1,57	31,38	1007,09	79	
3			2021-08-18	17:14	66,7974828	-58,764613	Monster Net	Bottom	662	284	27	-2,2	1,55	31,37	1007,42	76	
3			2021-08-18	17:43	66,7962282	-58,7623162	Monster Net	Recovery	604	306	9,5	-1	1,32	30,92	1008,79	59	
3			2021-08-18	17:53	66,7941405	-58,767379	Zodiac	Recovery	604	296	13,1	-1	1,39	30,92	1008,64	65	
3			2021-08-18	18:38	66,7998168	-58,77952	IKMT	Deployment	604	276	11,8	-0,8	1,43	30,94	1008,96	59	
3			2021-08-18	18:57	66,7947943	-58,8011633	IKMT	Bottom	211				1,06	28,58			
3			2021-08-18	20:00	66,7677538	-58,8013277	IKMT	Recovery	210				1,08	28,56			
3			2021-08-18	20:36	66,8031805	-58,7698352	Moonpool TM	Deployment	210				1,14	28,51			
3			2021-08-18	20:58	66,8055565	-58,7782392	Moonpool TM	Bottom	209				1,36	28,52			
3			2021-08-18	21:13	66,8075422	-58,7818833	Moonpool TM	Recovery	209				1,08	28,84			
3			2021-08-18	21:38	66,8022657	-58,763157	Box Core	Deployment	209				1,09	28,86			
3			2021-08-18	21:55	66,8068758	-58,7631325	Box Core	Bottom	760	262	19	1,5	0,95	29,35	1006,97	93	
3			2021-08-18	22:09	66,810153	-58,7675318	Box Core	Recovery	758	285	10,1	2,6	0,90	29,35	1007,01	85	
3	Full A5	Full	2021-08-19	0:20	66,8665325	-57,9712707	Tucker Net	Deployment	758	251	12,8	3,5	0,92	29,36	1006,98	83	
3	Full A5	Full	2021-08-19	0:31	66,8628885	-57,9718978	Tucker Net	Bottom	220	231	6,7	2	1,04	29,16	1007,50	87	
3	Full A5	Full	2021-08-19	0:45	66,8643318	-57,9548703	Tucker Net	Recovery	216	224	11,4	1,9	1,08	29,24	1007,42	88	
3			2021-08-19	0:57	66,8686982	-57,9521915	CTD Rosette	Deployment	213	248	9,9	2,1	1,07	29,10	1007,40	86	
3			2021-08-19	1:18	66,8722453	-57,9490283	CTD Rosette	Bottom	214	244	10,1	3,2	0,93	28,89	1007,33	85	
3			2021-08-19	2:10	66,8766477	-57,9447995	CTD Rosette	Recovery	216	358	2,1	2,1	0,91	28,96	1007,44	97	
3			2021-08-19	2:38	66,867308	-57,952312	Monster Net	Deployment	214	3	1,7	2,6	0,89	28,94	1007,39	87	
3			2021-08-19	2:59	66,8656355	-57,9499015	Monster Net	Bottom	242	223	10,9	0,9	1,34	31,35	1007,10	100	
3			2021-08-19	3:27	66,8640843	-57,9488982	Monster Net	Recovery	261	237	10,7	0,9	2,43	31,44	1007,30	100	
3			2021-08-19	3:35	66,8667633	-57,9507435	Plankton Net	Deployment	258	183	11	1,6	2,63	31,49	1007,32	100	
3			2021-08-19	3:39	66,866321	-57,950071	Plankton Net	Bottom	259	219	7,6	0,6	2,57	31,54	1007,37	100	
3			2021-08-19	3:42	66,8656002	-57,9487143	Plankton Net	Recovery	259	227	7,2	0,5	2,51	31,51	1007,42	100	
3			2021-08-19	4:12	66,8666805	-57,9533155	Hydrobios	Deployment	259	228	6,3	0,5	2,48	31,56	1007,37	100	
3			2021-08-19	4:33	66,8650352	-57,9486298	Hydrobios	Bottom	227				1,91	31,10			
3			2021-08-19	4:59	66,8640603	-57,9478503	Hydrobios	Recovery	227	229	8,2	2,4	2,00	31,09	1007,47	100	
3			2021-08-19	5:26	66,8667858	-57,9536965	Box Core	Deployment	226	244	7,6	0,2	1,94	31,09	1007,38	100	
3			2021-08-19	5:41	66,8669175	-57,953681	Box Core	Bottom	228	251	3,8	0,4	1,84	31,01	1007,48	100	
3			2021-08-19	5:57	66,8684583	-57,955614	Box Core	Recovery	228				1,80	30,97			
3			2021-08-19	6:25	66,8683937	-57,9596308	Agassiz Trawl	Deployment	227	200	6,9	0,6	1,81	30,97	1007,79	100	
3			2021-08-19	7:14	66,85796	-57,9065445	Agassiz Trawl	Bottom	228	191	4,8	0,8	2,06	31,11	1007,91	100	

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						
3			2021-08-19	8:01	66,8449043	-57,8620038	Agassiz Trawl	Recovery	228	190	5,5	0,6	1,92	31,06	1008,02	100	
3	Nutrient 195	Nutrient	2021-08-19	10:30	66,891681	-56,9145075	CTD Rosette	Deployment	227				2,37	31,21			
3	Nutrient 195	Nutrient	2021-08-19	10:48	66,8917885	-56,9202597	CTD Rosette	Bottom	400	243	4,2	0,4	0,77	29,71	1008,23	100	
3	Nutrient 195	Nutrient	2021-08-19	11:29	66,891802	-56,932241	CTD Rosette	Recovery	328	327	4,8	0,3	0,79	30,02	1008,37	100	
3			2021-08-19	12:33	66,8948053	-56,9175248	IKMT	Deployment	368	10	2,7	0,3	0,79	29,75	1008,39	100	
3			2021-08-19	13:04	66,8916117	-56,9612102	IKMT	Bottom	359	339	4,6	0,1	0,76	29,74	1008,40	100	
3			2021-08-19	13:40	66,874917	-56,9630642	IKMT	Recovery	355	349	5,1	0	0,75	29,72	1008,38	100	
3			2021-08-19	13:52	66,8790535	-56,9690375	IKMT	Deployment	356	340	6,1	0,1	0,67	29,83	1008,51	100	
3			2021-08-19	13:58	66,8800638	-56,9776045	IKMT	Recovery	356	340	6,7	0,2	0,75	29,73	1008,57	100	
3	Basic 196	Basic	2021-08-19	16:21	66,9839257	-56,062584	Moonpool TM	Deployment	355	342	6,3	0	0,77	29,72	1008,59	100	
3	Basic 196	Basic	2021-08-19	16:34	66,985359	-56,063983	Moonpool TM	Bottom	355	345	7,2	0,1	0,74	29,71	1008,65	100	
3	Basic 196	Basic	2021-08-19	16:42	66,9862823	-56,0656233	Moonpool TM	Recovery	354	349	7,4	0,2	0,78	29,68	1008,59	100	
3			2021-08-19	17:05	66,982092	-56,0682845	CTD Rosette	Deployment	354				0,80	29,67			
3			2021-08-19	17:09	66,9824448	-56,068239	CTD Rosette	Bottom	357	342	6,9	0,2	0,78	29,67	1008,76	100	
3			2021-08-19	17:35	66,9864595	-56,0681312	CTD Rosette	Recovery	365	337	6,9	0,2	0,83	30,00	1008,82	100	
3			2021-08-19	17:45	66,9852	-56,064357	Zodiac	Deployment	363				0,98	29,83			
3			2021-08-19	17:53	66,983115	-56,0690485	Plankton Net	Deployment	358	334	8,4	0,3	0,80	29,75	1008,86	100	
3			2021-08-19	17:58	66,9843457	-56,0692745	Plankton Net	Bottom	353	340	8	0,2	1,08	29,90	1008,86	100	
3			2021-08-19	18:02	66,9850597	-56,0691853	Plankton Net	Recovery	353	342	7,6	0,2	0,81	29,69	1008,88	100	
3			2021-08-19	18:09	66,9861617	-56,068523	Zodiac	Recovery	352	356	7	0,2	0,81	29,91	1008,98	100	
3	Basic 196	Basic	2021-08-19	18:23	66,984144	-56,0644777	Agassiz Trawl	Deployment	395	9	11,2	0,7	1,09	30,37	1009,08	100	
3	Basic 196	Basic	2021-08-19	18:32	66,9883825	-56,0728053	Agassiz Trawl	Bottom	376	313	2,5	1,7	0,88	30,65	1009,06	100	
3	Basic 196	Basic	2021-08-19	18:43	66,9924432	-56,0807522	Agassiz Trawl	Recovery	365	7	8	2,2	0,98	30,77	1009,08	100	
3			2021-08-19	19:03	66,9828593	-56,062302	Moonpool TM	Deployment	348	11	11,4	0,9	1,04	30,24	1009,14	100	
3			2021-08-19	19:15	66,9851988	-56,0604205	Moonpool TM	Bottom	354	8	9,7	0,8	1,03	30,39	1009,28	100	
3			2021-08-19	19:22	66,9868032	-56,0617365	Moonpool TM	Recovery	364	16	5,1	0,8	1,03	30,44	1009,37	100	
3	Nutrient 197	Nutrient	2021-08-19	22:14	67,0490943	-55,0833313	CTD Rosette	Recovery	349	35	3,6	1	0,90	30,99	1009,29	100	
3	Full 198	Full	2021-08-20	0:53	67,0851148	-54,2140697	Tucker Net	Deployment	758	69	4,6	0,8	1,15	29,55	1015,88	100	
3	Full 198	Full	2021-08-20	0:59	67,0881397	-54,2074563	Tucker Net	Bottom	759	67	5,9	0,7	1,24	29,13	1015,95	100	
3	Full 198	Full	2021-08-20	1:06	67,0922642	-54,2079418	Tucker Net	Recovery	758	77	4,8	0,8	1,43	29,30	1016,02	100	
3	Full 198	Full	2021-08-20	1:33	67,0839698	-54,2021488	CTD Rosette	Deployment	756	88	4	1,8	1,11	29,33	1016,28	100	
3	Full 198	Full	2021-08-20	1:41	67,0843507	-54,2006773	CTD Rosette	Bottom	753	108	6,3	0,8	1,16	29,65	1016,52	100	
3	Full 198	Full	2021-08-20	2:07	67,0832888	-54,202523	CTD Rosette	Recovery	240	129	11,8	5,1	0,71	28,96	1017,10	100	
3	Full 198	Full	2021-08-20	2:24	67,0828365	-54,2013853	Moonpool TM	Deployment	265	124	10,5	2,4	0,74	29,37	1017,32	100	
3	Full 198	Full	2021-08-20	2:43	67,0820167	-54,1990097	Moonpool TM	Bottom	262	177	13,3	1,4	0,67	28,95	1017,64	100	
3	Full 198	Full	2021-08-20	2:52	67,0813868	-54,1983472	Moonpool TM	Recovery	245	159	13,5	4	0,89	29,49	1020,44	100	
3	Full 198	Full	2021-08-20	3:04	67,0825455	-54,2104803	Plankton Net	Deployment	246	141	16,2	4,7	0,78	29,68	1020,63	99	
3	Full 198	Full	2021-08-20	3:07	67,081927	-54,2098633	Plankton Net	Bottom	243	151	12,4	3,3	0,95	29,43	1020,62	100	
3	Full 198	Full	2021-08-20	3:09	67,0814863	-54,208876	Plankton Net	Recovery	149	121	12,9	4,9	0,69	29,77	1020,66	100	
3	Full 198	Full	2021-08-20	3:25	67,0846942	-54,2365663	Box Core	Deployment	156	150	18,5	3,7	0,56	29,93	1021,14	100	
3	Full 198	Full	2021-08-20	3:28	67,0840192	-54,2352852	Box Core	Bottom	157	148	13,9	4,2	0,68	29,77	1021,35	100	
3	Full 198	Full	2021-08-20	3:32	67,0834297	-54,2326317	Box Core	Recovery	162	127	14,9	6,5	0,64	30,07	1021,38	99	
3	Full 198	Full	2021-08-20	4:01	67,083361	-54,2449022	Beam trawl	Deployment	168	150	15,2	4,3	0,51	30,13	1021,47	100	
3	Full 198	Full	2021-08-20	4:07	67,0791572	-54,2466735	Beam trawl	Bottom	171	128	11	5	0,84	29,64	1021,53	100	
3	Full 198	Full	2021-08-20	4:30	67,0633048	-54,2357107	Beam trawl	Recovery	324	139	21,5	1,7	0,72	29,76	1021,08	100	
3	Full 198	Full	2021-08-20	5:01	67,0776323	-54,3259687	Baited Cam	Recovery	336	148	18,5	1,9	0,84	29,76	1021,87	100	
3	Full B5	Full	2021-08-20	16:01	67,5867605	-59,0092362	Tucker Net	Deployment	322	135	18,8	3,5	0,84	29,78	1022,18	100	
3	Full B5	Full	2021-08-20	16:12	67,5826852	-58,9985397	Tucker Net	Bottom	332	147	17,9	1,9	0,75	29,87	1022,29	100	
3	Full B5	Full	2021-08-20	16:20	67,5806245	-58,989368	Tucker Net	Recovery	338	163	9,1	4,8	0,81	29,77	1022,58	100	
3	Full B5	Full	2021-08-20	16:51	67,588909	-59,0204172	CTD Rosette	Deployment	331	142	15	4	0,84	29,80	1022,82	100	
3	Full B5	Full	2021-08-20	17:12	67,5872933	-59,0191728	CTD Rosette	Bottom	329	152	18,8	2,7	0,80	29,74	1022,49	100	
3	Full B5	Full	2021-08-20	18:04	67,5816655	-59,0158605	CTD Rosette	Recovery	382	153	19,2	3,9	1,27	31,21	1023,00	100	
3	Full B5	Full	2021-08-20	18:21	67,5880043	-59,0215297	Monster Net	Deployment	381	146	21,9	3,3	1,58	31,33	1023,09	100	
3	Full B5	Full	2021-08-20	18:51	67,585291	-59,0221413	Monster Net	Bottom	383	146	20,6	2,2	1,58	31,12	1022,96	100	
3	Full B5	Full	2021-08-20	19:27	67,5833118	-59,0263492	Monster Net	Recovery	437	154	18,5	4	3,41	31,86	1023,20	100	
3	Full B5	Full	2021-08-20	20:12	67,5862885	-59,019129	Hydrobios	Deployment	436	163	14,1	5,9	3,35	31,89	1023,33	99	
3	Full B5	Full	2021-08-20	20:42	67,5845108	-59,0256837	Hydrobios	Bottom	437	152	11	6	3,40	31,89	1023,29	99	
3	Full B5	Full	2021-08-20	21:22	67,584045	-59,0364933	Hydrobios	Recovery	472	152	18,1	2,4	3,44	31,77	1023,09	100	
3	Full B5	Full	2021-08-20	21:53	67,59167167	-59,0021867	Box Core	Deployment	448	139	15,8	2,3	3,42	31,88	1023,19	100	
3	Full B5	Full	2021-08-20	22:15	67,5911658	-59,006996	Box Core	Bottom	450				3,56	32,01			
3	Full B5	Full	2021-08-20	22:41	67,5899165	-59,0110832	Box Core	Recovery	449	121	12,2	4,9	3,57	32,02	1023,58	100	
3	Basic B4	Basic	2021-08-21	0:34	67,4615618	-59,6507078	CTD Rosette	Deployment	448	134	18,7	3,9	3,53	32,03	1023,60	100	
3	Basic B4	Basic	2021-08-21	1:08	67,4680715	-59,6378102	CTD Rosette	Bottom	448				3,53	32,04			
3	Basic B4	Basic	2021-08-21	2:17	67,4771508	-59,6304262	CTD Rosette	Recovery	449	138	18,8	1,8	3,47	32,11	1023,56	100	
3	Basic B4	Basic	2021-08-21	2:46	67,4612967	-59,6425563	Monster Net	Deployment	450	147	19	1,9	3,55	32,03	1023,38	100	
3	Basic B4	Basic	2021-08-21	3:25	67,4641077	-59,6494315	Monster Net	Bottom	448	137	16,4	1,7	3,51	32,07	1023,63	100	
3	Basic B4	Basic	2021-08-21	4:09	67,4641932	-59,6483478	Monster Net	Recovery	450	143	18,7	1,6	3,54	32,02	1023,66	100	
3	Basic B4	Basic	2021-08-21	4:35	67,4610507	-59,6498313	Box Core	Deployment	450	154	17,7	1,7	3,53	32,04	1023,52	100	
3	Basic B4	Basic	2021-08-21	5:03	67,4611705	-59,6487812	Box Core	Bottom	451	153	15,2	2,3	3,53	32,03	1023,77	100	
3	Basic B4	Basic	2021-08-21	5:31	67,4612917	-59,6474802	Box Core	Recovery	450	139	14,1	3,6	3,58	32,03	1023,99	99	
3	Full B3	Full	2021-08-21	7:50	67,3294362	-60,2746515	Tucker Net	Deployment	449	147	9,9	3,2	3,58	32,02	1023,84	100	
3	Full B3	Full	2021-08-21	7:57	67,3258717	-60,2694722	Tucker Net	Bottom	449	139	11,6	1,3	3,53	32,01	1023,94	100	
3	Full B3	Full	2021-08-21	8:04	67,3230195	-60,2636487	Tucker Net	Recovery	449	140	14,1	3,8	3,58	31,99	1023,97	99	
3	Full B3	Full	2021-08-21	8:30	67,3309887	-60,278205	CTD Rosette	Deployment	449	161	11,4	4,6	3,55	32,01	1023,89	99	
3	Full B3	Full	2021-08-21	8:55	67,3293952	-60,2782327	CTD Rosette	Bottom	448	155	7,4	6,7	3,56	32,02	1023,72	99	
3	Full B3	Full	2021-08-21	9:46	67,3264962	-60,2750652	CTD Rosette	Recovery	449	259	10,5	2,7	3,57	31,99	1023,70	100	
3	Full B3	Full	2021-08-21	10:16	67,329486	-60,2815373	Monster Net	Deployment	450	140	8,9	4,3	3,55	31,99	1023,68	99	
3	Full B3	Full	2021-08-21	10:47	67,3253845	-60,2940998	Monster Net	Bottom	448	151	10,7	3,9	3,58	32,01	1023,64	100	
3	Full B3	Full	2021-08-21	11:20	67,3244482	-60,304364	Monster Net	Recovery	448	152	14,9	2,1	3,46	31,91	1023,51	100	
3	Full B3	Full	2021-08-21	12:26	67,3311288	-60,2775605	Hydrobios	Deployment	449	148	12,4	2,2	3,51	31,98	1023,39	100	
3	Full B3	Full	2021-08-21	12:55	67,3329768	-60,2795177	Hydrobios	Bottom	450	154	6,9	3,9	3,58	31,98	1023,39	100	
3	Full B3	Full	2021-08-21	13:30	67,3338367	-60,2756643	Hydrobios	Recovery	456	162	10,3	4,7	3,52	32,05	1023,27	100	
3	Full B3	Full	2021-08-21	13:59	67,3310483	-60,2700717	Box Core	Deployment	453	140	7,2	3,9	3,55	32,01	1023,20	100	
3	Full B3	Full	2021-08-21	14:21	67,3307513	-60,2696443	Box Core	Bottom	454	140	15	3,5	3,59	31,97	1022,92	100	
3	Full B3	Full	2021-08-21	14:40	67,3309202	-60,2701348	Box Core	Recovery	533	159	13,3	2,9	3,56	32,00	1023,02	100	
3	Basic B2	Basic	2021-08-21	16:59	67,1973557	-60,8940403	Moonpool TM	Deployment	532	155	12,4	2,2	3,48	32,06	1023,02	100	

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						
3	Basic B2	Basic	2021-08-21	17:10	67,1958245	-60,8919135	Moonpool TM	Bottom	529	165	10,3	3	3,39	32,07	1023,08	100	
3	Basic B2	Basic	2021-08-21	17:18	67,1947192	-60,8920153	Moonpool TM	Recovery	599	160	12,9	2,8	3,60	31,95	1023,00	100	
3	Basic B2	Basic	2021-08-21	17:34	67,1976387	-60,896846	Monster Net	Deployment	595	152	13,1	2,4	3,60	31,94	1023,07	100	
3	Basic B2	Basic	2021-08-21	17:51	67,1951758	-60,8942545	Monster Net	Bottom	589	152	11,8	2,5	3,50	31,96	1023,09	100	
3	Basic B2	Basic	2021-08-21	18:13	67,1916753	-60,8889258	Monster Net	Recovery	599	148	14,3	2,3	3,55	31,96	1022,87	100	
3	Basic B2	Basic	2021-08-21	19:05	67,1981997	-60,8992133	CTD Rosette	Deployment	594	143	15,4	2,5	3,59	31,94	1022,88	100	
3	Basic B2	Basic	2021-08-21	19:16	67,1965337	-60,8977823	CTD Rosette	Bottom	594	142	10,3	2,6	3,65	31,94	1023,00	100	
3	Basic B2	Basic	2021-08-21	19:58	67,1936923	-60,893016	CTD Rosette	Recovery	594	124	9,5	2,2	3,60	31,93	1023,05	100	
3	Basic B2	Basic	2021-08-21	20:08	67,1982942	-60,8972702	Moonpool TM	Deployment	596	120	8,8	2,1	3,61	31,93	1023,00	100	
3	Basic B2	Basic	2021-08-21	20:32	67,1961608	-60,8893558	Moonpool TM	Bottom	596	126	10,7	1,8	3,60	31,93	1022,96	100	
3	Basic B2	Basic	2021-08-21	20:44	67,1947145	-60,8889612	Moonpool TM	Recovery	570	100	9,5	6,3	3,82	31,89	1023,21	99	
3	Basic B2	Basic	2021-08-21	21:10	67,1955362	-60,895438	IKMT	Deployment	570	149	7,8	4,8	3,66	31,89	1023,12	99	
3	Basic B2	Basic	2021-08-21	22:46	67,1805618	-60,7230218	IKMT	Recovery	567	174	5,5	4,5	3,68	31,90	1023,24	99	
3	Basic B2	Basic	2021-08-21	23:14	67,1874078	-60,8112192	Zodiac	Deployment	556	151	8,9	5,3	3,88	32,15	1023,20	98	
3	Basic B2	Basic	2021-08-21	23:39	67,1987827	-60,8996307	Box Core	Deployment	552	163	8,8	5	3,86	32,19	1022,97	99	
3	Basic B2	Basic	2021-08-21	23:52	67,1986282	-60,900439	Box Core	Bottom	557	123	6,5	4,4	3,76	32,23	1022,93	99	
3	Basic B2	Basic	2021-08-22	0:05	67,1982807	-60,901546	Box Core	Recovery	614	165	9,3	4,4	3,98	31,41	1022,94	99	
3	Basic B2	Basic	2021-08-22	0:44	67,2004303	-60,9005565	Agassiz Trawl	Deployment	617	152	6,5	5,3	4,00	31,39	1022,92	99	
3	Basic B2	Basic	2021-08-22	1:24	67,1986672	-60,8887597	Agassiz Trawl	Bottom	616	143	11,6	3,7	3,91	31,58	1022,89	99	
3	Basic B2	Basic	2021-08-22	2:02	67,2009637	-60,8827905	Agassiz Trawl	Recovery	663	137	11,4	3,2	3,97	31,57	1022,70	100	
3	Full B1	Full	2021-08-22	3:39	67,0626375	-61,5006428	Tucker Net	Deployment	663	136	10,3	2,6	3,99	31,44	1022,47	99	
3	Full B1	Full	2021-08-22	3:48	67,059474	-61,4868105	Tucker Net	Bottom	662	138	11,4	4,6	3,91	31,47	1022,45	100	
3	Full B1	Full	2021-08-22	4:01	67,0610965	-61,4684977	Tucker Net	Recovery	665	135	12,4	3,1	3,88	31,60	1022,41	100	
3	Full B1	Full	2021-08-22	4:18	67,0636925	-61,5104412	Moonpool TM	Deployment	671	153	10,1	6,1	3,67	31,76	1022,39	99	
3	Full B1	Full	2021-08-22	4:33	67,0594202	-61,5076902	Moonpool TM	Bottom	675	135	12,4	2,5	3,93	31,37	1022,28	100	
3	Full B1	Full	2021-08-22	4:41	67,0567498	-61,5048795	Moonpool TM	Recovery	656	155	14,1	2,8	3,98	31,38	1022,33	100	
3	Full B1	Full	2021-08-22	5:04	67,0604582	-61,5159568	CTD Rosette	Deployment	658	150	13,3	2,8	3,86	31,71	1022,40	100	
3	Full B1	Full	2021-08-22	5:07	67,0594203	-61,5160857	CTD Rosette	Bottom	673	149	12,8	2,9	3,97	31,40	1022,39	100	
3	Full B1	Full	2021-08-22	5:35	67,052476	-61,5125218	CTD Rosette	Recovery	674	130	13,1	2,7	3,93	31,46	1022,41	100	
3	Full B1	Full	2021-08-22	5:57	67,0641975	-61,5093337	Monster Net	Deployment	673	144	12,2	2,7	3,80	31,73	1022,47	100	
3	Full B1	Full	2021-08-22	6:01	67,0628323	-61,5087152	Monster Net	Bottom	673	149	12,8	2,4	3,79	31,67	1022,37	100	
3	Full B1	Full	2021-08-22	6:07	67,0615247	-61,506176	Monster Net	Recovery	643	145	15	2,6	3,77	31,49	1022,22	100	
3	Full B1	Full	2021-08-22	6:20	67,0635948	-61,5128467	Moonpool TM	Deployment	648	136	14,5	2,1	3,74	31,62	1022,50	100	
3	Full B1	Full	2021-08-22	6:31	67,0607843	-61,5114552	Moonpool TM	Bottom	660	131	11,2	2,1	3,57	31,71	1022,57	100	
3	Full B1	Full	2021-08-22	6:40	67,0585662	-61,508875	Moonpool TM	Recovery	672	128	13,7	2	3,91	31,14	1022,51	100	
3	Full B1	Full	2021-08-22	7:09	67,0627515	-61,5122805	Box Core	Deployment	673	130	9,9	1,9	3,93	31,11	1022,55	100	
3	Full B1	Full	2021-08-22	7:14	67,0624635	-61,5119943	Box Core	Bottom	674	141	11	2,2	3,89	31,16	1022,58	100	
3	Full B1	Full	2021-08-22	7:19	67,062093	-61,5114373	Box Core	Recovery	656	103	4,2	2,8	3,89	31,09	1022,63	100	
3	Full B1	Full	2021-08-22	7:31	67,0635257	-61,5119468	Agassiz Trawl	Deployment	659	158	6,5	2,9	3,90	31,12	1022,65	100	
3	Full B1	Full	2021-08-22	7:39	67,0658243	-61,5146918	Agassiz Trawl	Bottom	672	113	6,9	3	3,87	31,17	1022,61	100	
3	Full B1	Full	2021-08-22	7:51	67,0612813	-61,5201023	Agassiz Trawl	Recovery	671	140	9,1	2,6	3,85	31,10	1022,57	100	
3	Full B1	Full	2021-08-22	8:11	67,0606177	-61,5251922	Beam trawl	Deployment	667	136	8,9	2,6	3,84	31,09	1022,57	100	
3	Full B1	Full	2021-08-22	8:37	67,0603758	-61,5004308	Beam trawl	Bottom	661	140	7,6	3	3,89	31,13	1022,59	100	
3	Full B1	Full	2021-08-22	8:44	67,0640417	-61,5055752	Beam trawl	Recovery	661	134	6,7	4	3,90	31,09	1022,56	100	
3	Merchants Troug		2021-08-22	10:54	67,3049105	-62,1725243	CTD Rosette	Deployment	660	95	7,4	4,5	3,83	31,23	1022,36	100	
3	Merchants Troug		2021-08-22	11:06	67,305308	-62,1708342	CTD Rosette	Bottom	666	115	8,2	3,6	3,88	31,18	1022,37	100	
3	Merchants Troug		2021-08-22	11:14	67,3052968	-62,1705178	CTD Rosette	Recovery	135	124	12,4	3,3	3,40	30,43	1022,16	99	
3			2021-08-22	17:02	67,2794347	-62,218553	Piston Core	Deployment	136	127	14,3	2,5	3,48	30,52	1022,15	99	
3			2021-08-22	17:12	67,2792912	-62,2198087	Piston Core	Bottom	138	118	13,3	3,2	3,40	30,01	1022,14	99	
3	Merchants Troug		2021-08-22	20:23	67,4782177	-61,64647	CTD Rosette	Deployment	138	127	13,7	2,5	3,43	30,03	1022,13	99	
3	Merchants Troug		2021-08-22	20:35	67,4776648	-61,6462372	CTD Rosette	Bottom	138	130	12,4	2,5	3,33	30,08	1022,15	99	
3	Merchants Troug		2021-08-22	20:42	67,477279	-61,6451002	CTD Rosette	Recovery	138	137	13,9	2,8	3,23	29,72	1022,07	99	
3	Full C1	Full	2021-08-23	2:56	67,350487	-62,522607	Tucker Net	Deployment	139	135	10,5	2,6	3,23	29,74	1022,02	99	
3	Full C1	Full	2021-08-23	3:07	67,3445768	-62,532435	Tucker Net	Bottom	141	121	9,7	3	3,14	28,77	1022,01	99	
3	Full C1	Full	2021-08-23	3:18	67,3397415	-62,5224535	Tucker Net	Recovery	134	117	9,1	6,2	3,29	29,58	1022,00	98	
3	Full C1	Full	2021-08-23	3:34	67,3480567	-62,5229018	CTD Rosette	Deployment	139	133	8,9	3,9	3,59	30,38	1021,93	99	
3	Full C1	Full	2021-08-23	3:44	67,3485968	-62,5229953	CTD Rosette	Bottom	132	133	11,2	2,7	3,43	29,77	1021,84	99	
3	Full C1	Full	2021-08-23	4:12	67,3486092	-62,5212643	CTD Rosette	Recovery	130	131	8,8	2,6	3,61	30,34	1021,83	99	
3	Full C1	Full	2021-08-23	4:28	67,3490532	-62,5204515	Monster Net	Deployment	139				3,34	29,06			
3	Full C1	Full	2021-08-23	4:32	67,349123	-62,5194622	Monster Net	Bottom	1982	273	8	2,1	3,16	30,35	1016,02	100	
3	Full C1	Full	2021-08-23	4:37	67,3487512	-62,5171652	Monster Net	Recovery	1976	288	6,7	1,8	3,23	30,28	1015,98	100	
3	Full C1	Full	2021-08-23	4:47	67,3477402	-62,5248233	Van Veen Grab	Deployment	1975	280	5	2,2	3,25	30,27	1015,84	100	
3	Full C1	Full	2021-08-23	4:51	67,3477902	-62,5241933	Van Veen Grab	Bottom	1976	279	7	2,1	3,23	30,29	1015,86	100	
3	Full C1	Full	2021-08-23	4:56	67,3476715	-62,5231785	Van Veen Grab	Recovery	1975	285	5,9	2,2	3,23	30,29	1015,83	100	
3	Full C1	Full	2021-08-23	5:05	67,3490477	-62,5235592	Agassiz Trawl	Deployment	1975	279	5,9	2,5	3,23	30,29	1015,83	100	
3	Full C1	Full	2021-08-23	5:19	67,3522892	-62,5345025	Agassiz Trawl	Bottom	1976	177	0,2	2,5	3,23	30,29	1015,80	100	
3	Full C1	Full	2021-08-23	5:34	67,348002	-62,5408003	Agassiz Trawl	Recovery	1976	279	2,5	2,6	3,14	30,33	1015,71	100	
3	Basic C2	Full	2021-08-23	7:33	67,5518005	-61,9008537	Monster Net	Deployment	1975	305	3,4	2,6	3,22	30,31	1015,62	100	
3	Basic C2	Full	2021-08-23	7:46	67,5502577	-61,9007777	Monster Net	Bottom	1975	343	5	1,6	3,20	30,34	1015,67	100	
3	Basic C2	Full	2021-08-23	8:03	67,5474625	-61,8978872	Monster Net	Recovery	1976	289	4,8	1,6	3,19	30,34	1015,75	100	
3	Basic C2	Full	2021-08-23	8:24	67,5524937	-61,90392	CTD Rosette	Deployment	1976	309	6,9	1,6	3,18	30,35	1015,63	100	
3	Basic C2	Full	2021-08-23	8:40	67,5489075	-61,91081	CTD Rosette	Bottom	1976	348	3,6	1,8	3,18	30,36	1015,69	100	
3	Basic C2	Full	2021-08-23	9:21	67,5420448	-61,9200122	CTD Rosette	Recovery	1976	335	6,7	1,8	3,12	30,41	1015,79	100	
3	Basic C2	Full	2021-08-23	9:45	67,5532152	-61,9077398	Van Veen Grab	Deployment	1976	22	5,7	2	3,13	30,38	1015,87	100	
3	Basic C2	Full	2021-08-23	10:04	67,5539668	-61,8986017	Van Veen Grab	Bottom	1976	33	6,1	2	3,14	30,38	1015,89	100	
3	Basic C2	Full	2021-08-23	10:20	67,5551622	-61,8932578	Van Veen Grab	Recovery	1976	27	5	2,1	3,14	30,37	1015,90	100	
3	Basic C2	Full	2021-08-23	10:34	67,5541228	-61,9057158	Agassiz Trawl	Deployment	1976	22	6,3	2,1	3,14	30,39	1015,90	100	
3	Basic C2	Full	2021-08-23	10:50	67,5549613	-61,927138	Agassiz Trawl	Bottom	1975	22	6,5	2,3	3,21	30,32	1015,78	100	
3	Basic C2	Full	2021-08-23	11:11	67,5615085	-61,9451862	Agassiz Trawl	Recovery	1975	274	4,8	1,9	3,26	30,28	1015,81	100	
3	Basic C2	Full	2021-08-23	12:05	67,5534387	-61,905528	Beam trawl	Deployment	1975	284	4,6	2	3,31	30,19	1015,79	100	
3	Basic C2	Full	2021-08-23	12:36	67,566009	-61,9317517	Beam trawl	Bottom	1975	142	0,8	2,5	3,31	30,24	1015,72	100	
3	Basic C2	Full	2021-08-23	13:23	67,5848333	-61,9938702	Beam trawl	Recovery	1977	248	3,6	2,1	3,31	30,20	1015,66	100	
3	Full C3	Full	2021-08-23	15:14	67,7526663	-61,2778615	Tucker Net	Deployment	1977	318	4,4	2,2	3,32	30,20	1015,66	100	
3	Full C3	Full	2021-08-23	15:26	67,75376	-61,2962955	Tucker Net	Bottom	1975	6	3,4	2,1	3,30	30,22	1015,74	100	
3	Full C3	Full	2021-08-23	15:37	67,7497505	-61,313021	Tucker Net	Recovery	1976				2,64	30,59			
3	Full C3	Full	2021-08-23	16:29	67,754449	-61,2660032	Monster Net	Deployment	1858	57	5,7	1,8	3,68	30,59	1015,40	100	

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						
3	Full C3	Full	2021-08-23	17:11	67,7553542	-61,2591742	Monster Net	Bottom	1858	63	8	2,1	3,73	30,58	1015,17	100	
3	Full C3	Full	2021-08-23	17:56	67,7556768	-61,2478253	Monster Net	Recovery	1859	61	8,2	2,2	3,73	30,56	1014,96	100	
3	Full C3	Full	2021-08-23	18:26	67,7530828	-61,2807817	CTD Rosette	Deployment	1854	41	5,9	2,2	3,75	30,54	1014,81	100	
3	Full C3	Full	2021-08-23	19:07	67,7497018	-61,2765017	CTD Rosette	Bottom	1856	58	7,2	2,4	3,99	30,47	1014,35	100	
3	Full C3	Full	2021-08-23	20:17	67,748023	-61,2645757	CTD Rosette	Recovery	1857	57	8	2,7	3,97	30,52	1014,19	100	
3	Full C3	Full	2021-08-23	20:46	67,7539532	-61,2629438	Hydrobios	Deployment	1306	20	10,3	2,8	3,39	31,01	1012,79	100	
3	Full C3	Full	2021-08-23	21:28	67,7538583	-61,2437977	Hydrobios	Bottom	1310	18	9,9	2,9	3,39	31,01	1012,80	100	
3	Full C3	Full	2021-08-23	22:14	67,7552963	-61,2246928	Hydrobios	Recovery	1298	23	12	2,8	3,41	31,01	1012,64	100	
3	Full C3	Full	2021-08-23	22:55	67,7541882	-61,2682638	Box Core	Deployment	1319	15	13,7	2,8	3,39	31,02	1012,20	100	
3	Full C3	Full	2021-08-23	23:23	67,75384	-61,2587067	Box Core	Bottom	1273	19	11,6	2,8	3,36	31,01	1011,90	100	
3	Full C3	Full	2021-08-23	23:48	67,7535457	-61,249623	Box Core	Recovery	1282	33	12,8	2,8	3,32	31,00	1011,75	100	
3	Basic C4	Full	2021-08-24	2:13	67,9536578	-60,6316797	Monster Net	Deployment	1300	51	3	4,1	3,31	30,99	1011,64	100	
3	Basic C4	Full	2021-08-24	2:58	67,9544502	-60,6256012	Monster Net	Bottom	1301	40	12,6	3,2	3,32	30,99	1011,44	100	
3	Basic C4	Full	2021-08-24	3:48	67,9552417	-60,6154613	Monster Net	Recovery	1307	47	14,3	3,3	3,32	30,98	1011,19	100	
3	Basic C4	Full	2021-08-24	4:19	67,9554777	-60,6278712	CTD Rosette	Deployment	1312	37	14,5	3,3	3,30	30,99	1011,23	100	
3	Basic C4	Full	2021-08-24	4:50	67,9580488	-60,6296203	CTD Rosette	Bottom	1296	46	11,4	3,4	3,39	30,99	1011,04	100	
3	Basic C4	Full	2021-08-24	5:53	67,9594077	-60,6336715	CTD Rosette	Recovery	1318	64	11,6	3,2	3,37	30,98	1010,64	100	
3	Full C5	Full	2021-08-24	7:44	68,1473558	-59,9648677	Tucker Net	Deployment	1323	53	9,9	3,2	3,21	31,02	1010,40	100	
3	Full C5	Full	2021-08-24	7:56	68,1502252	-59,9798745	Tucker Net	Bottom	1330	48	10,1	3,2	2,49	31,41	1010,14	100	
3	Full C5	Full	2021-08-24	8:06	68,1507457	-59,994904	Tucker Net	Recovery	1330	51	9,1	3,1	3,03	31,13	1009,95	100	
3	Full C5	Full	2021-08-24	8:27	68,1494708	-59,9657467	CTD Rosette	Deployment	1333	56	8,2	3,1	3,19	31,10	1009,85	100	
3	Full C5	Full	2021-08-24	8:58	68,146231	-59,9745407	CTD Rosette	Bottom	1295	78	10,3	3,4	3,41	31,00	1009,51	100	
3	Full C5	Full	2021-08-24	10:01	68,139419	-59,977732	CTD Rosette	Recovery	1302	77	10,1	3,5	3,42	30,99	1009,40	100	
3	Full C5	Full	2021-08-24	10:18	68,1495215	-59,9681385	Monster Net	Deployment	1309	75	8,6	3,4	3,41	31,00	1009,38	100	
3	Full C5	Full	2021-08-24	10:56	68,1490247	-59,964742	Monster Net	Bottom	1267				3,43	31,01			
3	Full C5	Full	2021-08-24	11:37	68,1492913	-59,9629922	Monster Net	Recovery	1287	95	13,1	3	3,45	31,01	1008,83	100	
3	Full C5	Full	2021-08-24	12:35	68,1542908	-59,9754377	IKMT	Deployment	1320	89	10,1	3,9	3,44	31,00	1008,84	100	
3	Full C5	Full	2021-08-24	13:05	68,1696332	-60,0204343	IKMT	Bottom	1257	95	9,7	3,3	3,40	31,03	1008,87	100	
3	Full C5	Full	2021-08-24	13:54	68,1875762	-60,1030755	IKMT	Recovery	1267	100	7,8	3,4	3,40	31,02	1008,84	100	
3	Full C5	Full	2021-08-24	14:28	68,162631	-60,0139112	CTD Rosette	Deployment	1310	92	10,3	4,5	3,44	31,01	1008,82	100	
3	Full C5	Full	2021-08-24	14:46	68,1660588	-60,0157858	CTD Rosette	Bottom	503	104	10,5	3,3	3,07	30,52	1008,11	100	
3	Full C5	Full	2021-08-24	14:57	68,1681197	-60,0185743	CTD Rosette	Recovery	497	104	12,2	3,3	3,09	30,51	1008,05	100	
3	Full C5	Full	2021-08-24	16:05	68,1501373	-59,9639002	Box Core	Deployment	543	108	12,8	3,8	2,09	30,76	1008,04	100	
3	Full C5	Full	2021-08-24	16:44	68,1498877	-59,9689923	Box Core	Bottom	543				1,11	31,08			
3	Full C5	Full	2021-08-24	17:10	68,1531305	-59,9637527	Box Core	Recovery	537	121	10,9	4	2,74	30,61	1007,96	100	
3	Full D5	Full	2021-08-24	22:53	68,9996847	-61,407271	Tucker Net	Deployment	489	169	5,5	5	2,81	30,64	1008,04	100	
3	Full D5	Full	2021-08-24	23:06	69,004745	-61,420251	Tucker Net	Bottom	505	81	9,1	8	2,44	30,75	1007,98	99	
3	Full D5	Full	2021-08-24	23:16	69,007307	-61,432982	Tucker Net	Recovery	504	138	7,2	7,3	2,55	30,68	1007,90	99	
3	Full D5	Full	2021-08-24	23:38	68,9997825	-61,4026893	CTD Rosette	Deployment	420	127	10,7	3,5	2,71	30,04	1007,39	100	
3	Full D5	Full	2021-08-25	1:16	69,0087302	-61,420518	CTD Rosette	Bottom	419	125	8,4	3,2	2,75	29,91	1007,34	100	
3	Full D5	Full	2021-08-25	1:29	69,0109	-61,424198	CTD Rosette	Recovery	437	122	7,8	4,1	3,02	29,67	1007,19	100	
3	Full D5	Full	2021-08-25	1:48	69,0016577	-61,412067	Monster Net	Deployment	444	123	11,4	3,7	2,40	30,11	1007,09	100	
3	Full D5	Full	2021-08-25	2:30	69,0102323	-61,4182077	Monster Net	Bottom	421	127	7,4	3,4	2,72	29,92	1006,91	100	
3	Full D5	Full	2021-08-25	3:23	69,013953	-61,4330408	Monster Net	Recovery	426	124	8	3,2	2,56	29,89	1006,75	100	
3	Full D5	Full	2021-08-25	3:41	69,0024628	-61,4111803	Box Core	Deployment	441	126	11,2	3,6	2,65	29,82	1006,59	100	
3	Full D5	Full	2021-08-25	4:15	69,0004083	-61,4119168	Box Core	Bottom	440				2,60	29,83			
3	Full D5	Full	2021-08-25	4:45	69,0022712	-61,4176112	Box Core	Recovery	439	141	9,1	3,8	2,08	30,19	1006,71	100	
3	Basic D4	Full	2021-08-25	7:53	68,6299245	-61,9779142	CTD Rosette	Deployment	444	132	9,7	3,8	2,36	29,92	1006,77	100	
3	Basic D4	Full	2021-08-25	8:27	68,6284347	-61,9834663	CTD Rosette	Bottom	445	134	8,9	3,7	2,43	29,97	1006,76	100	
3	Basic D4	Full	2021-08-25	9:35	68,6259798	-62,0038637	CTD Rosette	Recovery	446	154	4,4	4,5	2,65	30,04	1006,67	100	
3	Full D3	Full	2021-08-25	12:12	68,2429867	-62,592713	Tucker Net	Deployment	443	142	2,7	5	2,74	30,06	1006,69	100	
3	Full D3	Full	2021-08-25	12:23	68,2401788	-62,605211	Tucker Net	Bottom	443	159	1,5	5,8	2,78	30,00	1006,79	99	
3	Full D3	Full	2021-08-25	12:35	68,2329502	-62,5995057	Tucker Net	Recovery	449	160	1,3	5,9	2,85	29,91	1006,77	99	
3	Full D3	Full	2021-08-25	12:54	68,2402078	-62,5895493	CTD Rosette	Deployment	449	73	0	5,7	2,81	29,93	1006,78	99	
3	Full D3	Full	2021-08-25	13:31	68,24148	-62,5938612	CTD Rosette	Bottom	450	60	0,6	5,3	2,88	29,91	1006,73	100	
3	Full D3	Full	2021-08-25	14:38	68,2434613	-62,5994645	CTD Rosette	Recovery	449				2,71	30,04			
3	Full D3	Full	2021-08-25	14:51	68,2413368	-62,6003818	Monster Net	Deployment	449	148	3,4	5,8	2,87	29,95	1006,68	100	
3	Full D3	Full	2021-08-25	15:30	68,241165	-62,6032447	Monster Net	Bottom	451	211	1,7	4,7	2,74	29,89	1006,58	100	
3	Full D3	Full	2021-08-25	16:14	68,2412453	-62,6058238	Monster Net	Recovery	449	137	2,7	6,5	2,62	29,91	1006,60	100	
3	Full D3	Full	2021-08-25	16:37	68,2417987	-62,5944367	Hydrobios	Deployment	450	152	1,1	6,6	2,60	29,90	1006,50	99	
3	Full D3	Full	2021-08-25	17:19	68,2421552	-62,6008653	Hydrobios	Bottom	449	70	0	6,7	2,66	29,85	1006,54	93	
3	Full D3	Full	2021-08-25	18:02	68,2410443	-62,6054487	Hydrobios	Recovery	451	153	2,1	5,9	2,66	29,72	1006,56	97	
3	Full D3	Full	2021-08-25	18:23	68,2398577	-62,5882182	Box Core	Deployment	450	193	3,6	5,7	2,51	29,79	1006,46	97	
3	Full D3	Full	2021-08-25	18:51	68,2402868	-62,5911223	Box Core	Bottom	451	189	3,6	5	2,19	29,91	1006,45	100	
3	Full D3	Full	2021-08-25	19:18	68,2400008	-62,5949358	Box Core	Recovery	453	219	2,3	4,9	2,59	29,71	1006,45	100	
3	Basic D2	Basic	2021-08-25	21:56	67,8583115	-63,147579	Zodiac	Deployment	443	189	7,4	5	2,58	29,71	1006,43	99	
3	Basic D2	Basic	2021-08-25	22:06	67,8570965	-63,1505305	Monster Net	Deployment	448	146	2,5	5,8	2,41	29,87	1006,45	99	
3	Basic D2	Basic	2021-08-25	22:13	67,8574045	-63,1490052	Monster Net	Bottom	497	290	4,2	3,9	2,83	28,59	1007,06	99	
3	Basic D2	Basic	2021-08-25	22:20	67,8574145	-63,1480865	Monster Net	Recovery	649	76	2,3	4,5	3,61	28,41	1007,23	99	
3	Basic D2	Basic	2021-08-25	22:31	67,8577288	-63,1492095	Zodiac	Recovery	665	88	2,7	4,6	4,25	27,79	1007,14	99	
3	Basic D2	Basic	2021-08-25	22:43	67,8577107	-63,1498692	CTD Rosette	Deployment	498	161	0,8	4,6	3,24	28,41	1007,31	99	
3	Basic D2	Basic	2021-08-25	22:56	67,8576632	-63,1475893	CTD Rosette	Bottom	678	139	2,7	4,6	1,96	29,69	1007,33	99	
3	Basic D2	Basic	2021-08-25	23:30	67,8575442	-63,150103	CTD Rosette	Recovery	677	140	4	4,9	2,34	29,50	1007,30	99	
3	Basic D2	Basic	2021-08-25	23:49	67,8573952	-63,1550957	Moonpool TM	Deployment	674	135	6,3	4,9	2,32	29,39	1007,26	99	
3	Basic D2	Basic	2021-08-26	0:02	67,8571107	-63,158763	Moonpool TM	Bottom	674	127	5,1	4,4	1,68	29,91	1007,38	99	
3	Basic D2	Basic	2021-08-26	0:11	67,8572613	-63,1592107	Moonpool TM	Recovery	674	108	5,7	4,4	1,76	29,91	1007,36	99	
3	Basic D2	Basic	2021-08-26	0:38	67,8595773	-63,154442	Beam trawl	Deployment	677	111	6,1	4,4	1,92	29,91	1007,45	100	
3	Basic D2	Basic	2021-08-26	0:55	67,8686223	-63,1659405	Beam trawl	Bottom	454	138	10,9	4,6	4,21	27,90	1007,52	100	
3	Basic D2	Basic	2021-08-26	1:23	67,8561623	-63,1741715	Beam trawl	Recovery	672	130	8	4,6	3,70	28,12	1007,69	100	
3	Basic D2	Basic	2021-08-26	1:44	67,8675222	-63,132977	Moonpool TM	Deployment	679				3,15	28,47			
3	Basic D2	Basic	2021-08-26	1:57	67,8684858	-63,1331997	Moonpool TM	Bottom	680	111	5,5	5,7	3,05	28,73	1007,67	100	
3	Basic D2	Basic	2021-08-26	2:09	67,8688185	-63,1328035	Moonpool TM	Recovery	678	123	9,5	5,3	2,91	28,96	1007,67	100	
3	Basic D2	Basic	2021-08-26	2:21	67,8718443	-63,1321363	Agassiz Trawl	Deployment	677	104	0,4	5	2,67	29,02	1007,62	100	
3	Basic D2	Basic	2021-08-26	2:40	67,8756893	-63,1434303	Agassiz Trawl	Bottom	681	108	2,9	5,7	2,98	28,82	1007,54	100	
3	Basic D2	Basic	2021-08-26	2:54	67,8724338	-63,1342558	Agassiz Trawl	Recovery	679	124	9,9	5,4	2,96	28,87	1007,47	100	
3			2021-08-26	3:15	67,8886085	-63,1007372	CTD Rosette	Deployment	674	115	9,1	5,1	3,27	28,61	1007,51	100	

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						
3			2021-08-26	3:29	67,8896172	-63,09961	CTD Rosette	Bottom	680	131	5,1	7,5	3,28	28,55	1007,57	99	
3			2021-08-26	3:42	67,8903345	-63,0999003	CTD Rosette	Recovery	680	40	1,7	5,9	2,92	28,76	1007,36	100	
3			2021-08-26	9:00	67,882465	-63,0943573	CTD Rosette		678	100	7,4	6,4	3,00	28,82	1007,35	99	
3			2021-08-26	9:09	67,8759763	-63,0993148	CTD Rosette	Deployment		97	11	5,2	3,56	28,32	1007,29	100	
3			2021-08-26	9:19	67,8740862	-63,093073	CTD Rosette	Bottom		96	9,1	5,2	4,01	27,98	1007,17	99	
3			2021-08-26	9:27	67,8730752	-63,0885865	CTD Rosette	Recovery					4,13	28,01			
3			2021-08-26	13:14	67,7271717	-63,3429248	Box Core	Deployment	412	55	4,2	5,3	3,53	28,15	1007,28	100	
3			2021-08-26	13:25	67,7273322	-63,3426127	Box Core	Bottom	497	104	2,5	6,4	3,12	28,76	1007,22	100	
3			2021-08-26	13:37	67,7278023	-63,3432557	Box Core	Recovery	496	72	1,7	7	3,19	28,57	1007,21	100	
3			2021-08-26	13:58	67,7280582	-63,3417262	Gravity Core	Deployment	589	168	6,1	5,5	3,11	28,96	1006,84	100	
3			2021-08-26	14:07	67,728349	-63,3431773	Gravity Core	Bottom	595	163	4,6	6,6	0,36	31,10	1006,78	100	
3			2021-08-26	14:18	67,7286585	-63,344829	Gravity Core	Recovery	600	156	3,2	7	2,04	29,84	1006,77	100	
3	Bro-6.3	Piston	2021-08-26	18:00	67,5999703	-63,6070667	Piston Core	Deployment	584	120	1,3	5,7	2,92	29,74	1005,83	100	
3	Bro-6.3	Piston	2021-08-26	18:13	67,6001103	-63,6038792	Piston Core	Bottom	585	338	0	5,4	2,92	29,72	1005,76	100	
3	Bro-6.3	Piston	2021-08-26	18:37	67,5972318	-63,601617	Piston Core	Recovery	585	78	0	5,8	2,91	29,70	1005,69	100	
3	Full D1	Full	2021-08-26	20:20	67,4675457	-63,8198317	Baited Cam	Deployment	583	293	2,1	5,5	2,74	29,68	1005,51	100	
3	Full D1	Full	2021-08-26	20:33	67,4663062	-63,818639	Baited Cam	Bottom	584	172	1	6	2,53	29,74	1005,48	100	
3	Full D1	Full	2021-08-26	20:53	67,4706747	-63,7682693	Zodiac	Deployment	582	156	1,1	5,8	1,80	30,23	1005,32	100	
3	Full D1	Full	2021-08-26	21:10	67,4719117	-63,7018443	Tucker Net	Deployment	296	328	2,7	7,4	3,02	30,52	1003,75	100	
3	Full D1	Full	2021-08-26	21:19	67,4697472	-63,7142963	Tucker Net	Bottom	289	328	4,8	7,3	3,56	30,32	1003,66	100	
3	Full D1	Full	2021-08-26	21:28	67,4653602	-63,716012	Tucker Net	Recovery	289	351	4,8	7	2,99	30,75	1003,64	100	
3	Full D1	Full	2021-08-26	21:43	67,4733247	-63,6927542	CTD Rosette	Deployment	326	255	12	5,3	3,84	30,06	1003,47	100	
3	Full D1	Full	2021-08-26	22:01	67,4733583	-63,6925662	CTD Rosette	Bottom	352	131	3,8	5,7	4,24	29,94	1001,46	100	
3	Full D1	Full	2021-08-26	22:47	67,4734742	-63,6916505	CTD Rosette	Recovery	351	132	4,8	5,9	3,80	30,25	1001,44	100	
3	Full D1	Full	2021-08-26	22:54	67,4730935	-63,6933108	Zodiac	Recovery	349	156	2,3	6	4,00	30,04	1001,46	100	
3	Full D1	Full	2021-08-26	23:09	67,4737518	-63,6925865	Moonpool TM	Deployment	274	157	2,1	5,7	4,08	29,94	1001,41	100	
3	Full D1	Full	2021-08-26	23:21	67,4734185	-63,6926032	Moonpool TM	Bottom	278	212	6,7	5,4	4,01	29,98	1001,51	100	
3	Full D1	Full	2021-08-26	23:29	67,4729817	-63,6928095	Moonpool TM	Recovery	276	228	6,3	5,1	4,09	29,95	1001,48	100	
3	Full D1	Full	2021-08-26	23:42	67,4732967	-63,6928845	Monster Net	Deployment	270	217	6,5	5,2	3,93	30,05	1001,60	100	
3	Full D1	Full	2021-08-26	23:58	67,4734655	-63,6924637	Monster Net	Bottom	270	220	6,1	6,3	4,25	29,94	1001,48	100	
3	Full D1	Full	2021-08-27	0:20	67,4738267	-63,6919345	Monster Net	Recovery	269	199	4,6	6,9	4,05	29,94	1001,38	100	
3			2021-08-27	0:41	67,4726992	-63,6988243	IKMT	Deployment	282	212	1,9	6,3	4,06	29,97	1001,39	100	
3			2021-08-27	1:30	67,4772357	-63,705339	IKMT	Bottom	284	242	10,7	5,9	4,11	29,95	1001,24	100	
3	Full D1	Full	2021-08-27	2:23	67,4739578	-63,69254	Moonpool TM	Deployment	272	245	5,7	5,7	4,14	29,95	1001,17	100	
3	Full D1	Full	2021-08-27	2:37	67,4735658	-63,6938348	Moonpool TM	Bottom	279	169	2,5	6,9	4,07	29,94	1000,98	100	
3	Full D1	Full	2021-08-27	2:50	67,4733702	-63,6964718	Moonpool TM	Recovery	279	101	9,1	6,5	4,16	29,93	1000,82	100	
3	Full D1	Full	2021-08-27	3:10	67,4731087	-63,6958162	Box Core	Deployment	271	95	8,2	6,4	4,23	29,93	1000,77	100	
3	Full D1	Full	2021-08-27	3:24	67,4732773	-63,6940797	Box Core	Bottom	271	88	7,4	6,8	4,03	30,01	1000,78	100	
3	Full D1	Full	2021-08-27	3:37	67,4735172	-63,6941535	Box Core	Recovery	269	185	0,4	6,4	4,13	29,98	1000,86	100	
3	Full D1	Full	2021-08-27	4:01	67,4681003	-63,7499982	Agassiz Trawl	Deployment	273	26	1,5	6,9	4,11	29,99	1000,82	100	
3	Full D1	Full	2021-08-27	4:30	67,4646958	-63,7203555	Agassiz Trawl	Bottom	266	42	2,3	6,9	4,12	30,00	1000,89	100	
3	Full D1	Full	2021-08-27	4:52	67,4653935	-63,6955285	Agassiz Trawl	Recovery	265	80	1,3	5,9	4,12	30,02	1000,84	100	
3	Full D1	Full	2021-08-27	6:01	67,4644487	-63,8202317	Baited Cam	Recovery	268	34	2,1	5,4	3,92	30,06	1000,84	100	
3	Full E1	Full	2021-08-27	12:00	68,2785075	-65,137824	Tucker Net	Deployment	263	331	1,5	5,2	4,13	30,02	1000,84	100	
3	Full E1	Full	2021-08-27	12:12	68,2799147	-65,1515083	Tucker Net	Bottom	268	267	1,3	5,3	3,01	30,62	1000,72	100	
3	Full E1	Full	2021-08-27	12:22	68,2745683	-65,1491193	Tucker Net	Recovery	1563	347	5	4,5	3,44	30,19	999,81	100	
3	Full E1	Full	2021-08-27	12:35	68,2774863	-65,1383372	CTD Rosette	Deployment	1570	15	3,8	4,6	3,39	30,23	999,74	100	
3	Full E1	Full	2021-08-27	12:48	68,2770403	-65,1367293	CTD Rosette	Bottom	1575	344	5,3	4,6	3,30	30,29	999,53	100	
3	Full E1	Full	2021-08-27	13:22	68,27667	-65,1320863	CTD Rosette	Recovery	1555	3	5	4,7	3,52	30,32	999,42	100	
3	Full E1	Full	2021-08-27	13:34	68,277115	-65,1377915	Moonpool TM	Deployment	1556	321	3,6	5,7	3,52	30,40	999,19	100	
3	Full E1	Full	2021-08-27	13:44	68,276646	-65,1388922	Moonpool TM	Bottom	1564	136	0	5,8	3,46	30,38	999,05	100	
3	Full E1	Full	2021-08-27	13:54	68,2765275	-65,1387283	Moonpool TM	Recovery	1554	127	2,5	5,7	3,31	30,36	998,97	100	
3	Full E1	Full	2021-08-27	14:05	68,2779327	-65,1394593	Monster Net	Deployment	1554	214	4,8	4,8	3,22	30,45	998,73	100	
3	Full E1	Full	2021-08-27	14:19	68,2767505	-65,1407725	Monster Net	Bottom	1554	214	5,9	4,2	3,26	30,38	998,45	100	
3	Full E1	Full	2021-08-27	14:33	68,2762552	-65,141564	Monster Net	Recovery	1552	212	8,8	4,5	3,26	30,39	998,15	100	
3	Full E1	Full	2021-08-27	14:45	68,2780055	-65,1401137	Plankton Net	Deployment	1563	94	16,4	6,2	3,30	30,06	998,02	100	
3	Full E1	Full	2021-08-27	14:54	68,2770637	-65,1417668	Plankton Net	Bottom	1571	165	12,2	6,3	3,25	29,97	997,90	100	
3	Full E1	Full	2021-08-27	14:58	68,276632	-65,1422403	Plankton Net	Recovery	1566	158	13,1	4,8	3,30	29,85	997,73	100	
3	Full E1	Full	2021-08-27	15:08	68,278753	-65,1398523	Moonpool TM	Deployment	1557	163	12	4,5	3,28	29,96	997,84	100	
3	Full E1	Full	2021-08-27	15:22	68,2785188	-65,1430965	Moonpool TM	Bottom	1562	164	9,5	4,3	3,28	29,86	997,69	100	
3	Full E1	Full	2021-08-27	15:36	68,2780957	-65,1442223	Moonpool TM	Recovery	1810	133	5,9	3,7	3,11	30,33	997,27	101	
3	Full E1	Full	2021-08-27	16:19	68,2789812	-65,140644	Box Core	Deployment	1808	113	3,8	4,2	3,09	30,37	997,22	101	
3	Full E1	Full	2021-08-27	16:28	68,2788688	-65,1402923	Box Core	Bottom	1809	147	7	2,9	3,07	30,38	996,96	101	
3	Full E1	Full	2021-08-27	16:38	68,2794478	-65,1403792	Box Core	Recovery	1841	156	12,4	2,7	2,66	31,07	996,15	101	
3	Full E1	Full	2021-08-27	17:00	68,2799668	-65,1400342	Zodiac	Deployment	1840	155	12	2,7	2,46	31,08	995,99	101	
3	Full E1	Full	2021-08-27	17:04	68,2798078	-65,1372865	Agassiz Trawl	Deployment	1840	138	12,8	2,6	2,75	30,99	995,91	101	
3	Full E1	Full	2021-08-27	17:24	68,2843688	-65,1502008	Agassiz Trawl	Bottom	1848	138	12,2	2,6	2,78	30,91	995,75	101	
3	Full E1	Full	2021-08-27	17:48	68,2833305	-65,1766373	Agassiz Trawl	Recovery	1844	144	12,2	2,7	2,74	30,98	995,83	101	
3	Full E1	Full	2021-08-27	18:06	68,2761277	-65,1817048	Zodiac	Recovery	1841	165	13,7	2,4	2,71	31,00	995,85	101	
3	Full E1	Full	2021-08-27	18:34	68,2827783	-65,127764	Beam trawl	Deployment	1846	154	8,2	8,6	2,77	30,95	995,49	100	
3	Full E1	Full	2021-08-27	18:57	68,2858042	-65,1599425	Beam trawl	Bottom	1845				2,76	30,96			
3	Full E1	Full	2021-08-27	19:27	68,2787323	-65,207717	Beam trawl	Recovery	1838	150	10,5	5,8	2,94	31,01	995,14	101	
3	Basic E2	Basic	2021-08-27	21:25	68,53786	-64,6580107	CTD Rosette	Deployment	1845	141	14,7	2,4			994,89	101	
3	Basic E2	Basic	2021-08-27	21:36	68,5372437	-64,6602183	CTD Rosette	Bottom	1843	149	14,3	2,6			994,89	101	
3	Basic E2	Basic	2021-08-27	22:12	68,5348507	-64,6610363	CTD Rosette	Recovery	1837	145	5,3	4,3			995,10	101	
3	Basic E2	Basic	2021-08-27	22:26	68,5403872	-64,6534678	Monster Net	Deployment	1351	155	12,2	6	2,22	30,72	995,48	100	
3	Basic E2	Basic	2021-08-27	22:40	68,5408893	-64,652882	Monster Net	Bottom	1372	151	22,7	3	2,25	30,70	995,44	101	
3	Basic E2	Basic	2021-08-27	22:57	68,540846	-64,653064	Monster Net	Recovery	1358	133	12,9	5,4	2,20	30,78	995,59	101	
3	Basic E2	Basic	2021-08-27	23:29	68,5372398	-64,6682502	Agassiz Trawl	Bottom	1414	116	18,8	5,1	2,47	30,69	996,02	100	
3	Basic E2	Basic	2021-08-27	23:47	68,5355368	-64,6578132	Agassiz Trawl	Recovery	1408				2,51	30,71			
3	Full E3	Full	2021-08-28	1:45	68,800214	-64,1629613	Tucker Net	Deployment	1401	145	22,3	3,2	2,40	30,76	996,01	101	
3	Full E3	Full	2021-08-28	1:54	68,7984043	-64,1776797	Tucker Net	Bottom	1433	145	19,6	2,9	2,49	30,69	995,78	101	
3	Full E3	Full	2021-08-28	2:03	68,7946955	-64,1872773	Tucker Net	Recovery	1415	132	15,8	2,9	2,60	30,79	996,29	101	
3	Full E3	Full	2021-08-28	2:19	68,8012457	-64,1565278	CTD Rosette	Deployment	1358	145	13,9	5,4	2,70	30,79	997,66	101	
3	Full E3	Full	2021-08-28	2:49	68,7979972	-64,1648275	CTD Rosette	Bottom	1362	136	24,9	3,1	2,69	30,81	997,21	101	
3	Full E3	Full	2021-08-28	3:53	68,7922112	-64,1824918	CTD Rosette	Recovery	1369	140	23,8	3	2,40	30,97	997,19	101	

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						
3	Full E3	Full	2021-08-28	4:07	68,797973	-64,1595323	Moonpool TM	Deployment	1372	144	24	3,1	2,64	30,81	997,30	101	
3	Full E3	Full	2021-08-28	4:18	68,7974807	-64,161914	Moonpool TM	Bottom	1410	150	27,6	5,6	2,58	30,70	997,21	101	
3	Full E3	Full	2021-08-28	4:26	68,7968918	-64,1641435	Moonpool TM	Recovery	1387	141	19,2	6,7	2,68	30,69	997,89	100	
3	Full E3	Full	2021-08-28	5:03	68,8040993	-64,1426655	Monster Net	Deployment	1369	147	17,3	5,8	2,61	30,70	997,80	101	
3	Full E3	Full	2021-08-28	5:38	68,799956	-64,145438	Monster Net	Bottom	1388	129	23,4	2,5	2,45	30,68	997,41	101	
3	Full E3	Full	2021-08-28	6:17	68,7944577	-64,1443945	Monster Net	Recovery	1378	134	19,2	2,5	2,53	30,67	998,11	101	
3	Full E3	Full	2021-08-28	6:46	68,8041675	-64,1565558	Hydrobios	Deployment	1379	142	13,3	4,7	2,45	30,65	998,56	101	
3	Full E3	Full	2021-08-28	7:23	68,7998623	-64,1589568	Hydrobios	Bottom	1608	139	19	6,6	2,46	30,99	997,73	100	
3	Full E3	Full	2021-08-28	8:03	68,7941113	-64,1605162	Hydrobios	Recovery	1608	150	14,5	5,4	2,59	30,97	998,60	101	
3	Full E3	Full	2021-08-28	8:29	68,7983903	-64,1574602	Moonpool TM	Deployment	1608	144	13,5	4,5	2,67	30,92	998,92	101	
3	Full E3	Full	2021-08-28	8:41	68,7961472	-64,1571193	Moonpool TM	Bottom	1606	143	23,8	2,9	2,76	30,89	998,65	101	
3	Full E3	Full	2021-08-28	8:53	68,794021	-64,15772	Moonpool TM	Recovery	1608	143	20,6	3,6	2,89	30,92	999,16	101	
3	Full E3	Full	2021-08-28	9:11	68,7916548	-64,1554507	IKMT	Deployment	1610				2,71	30,92			
3	Full E3	Full	2021-08-28	9:40	68,7755232	-64,1708277	IKMT	Bottom	1571	128	22,7	3,4	2,84	30,34	998,73	101	
3	Full E3	Full	2021-08-28	10:20	68,746956	-64,1735998	IKMT	Recovery	1571	128	24	3,4	2,84	30,47	998,46	101	
3	Full E3	Full	2021-08-28	11:07	68,7979822	-64,1505303	Box Core	Deployment	1571	141	17,1	4	1,45	30,73	998,30	101	
3	Full E3	Full	2021-08-28	11:29	68,7960382	-64,1610553	Box Core	Bottom	1571	125	19,8	4,3	2,92	30,42	998,80	101	
3	Full E3	Full	2021-08-28	11:51	68,7872228	-64,1641912	Box Core	Recovery	1571	118	24,8	5,5	3,18	30,20	998,87	101	
3	Full E3	Full	2021-08-28	12:00	68,781937	-64,1667052	Zodiac	Recovery	1570	131	30,7	3,4	3,17	30,20	998,74	101	
3	Basic E4	Basic	2021-08-28	16:16	69,2148245	-63,3474882	CTD Rosette	Deployment	1565	143	13,9	7,7	3,23	30,11	999,28	101	
3	Basic E4	Basic	2021-08-28	16:50	69,2174732	-63,3509047	CTD Rosette	Bottom	1565	237	26,3	4,3	3,15	30,22	999,79	101	
3	Basic E4	Basic	2021-08-28	18:00	69,2212053	-63,3653923	CTD Rosette	Recovery	1568	124	22,5	3,8	3,24	30,07	999,91	101	
3	Basic E4	Basic	2021-08-28	18:14	69,2110522	-63,3390265	Box Core	Deployment	1571	92	15,2	5,2	3,08	30,40	1000,79	100	
3	Basic E4	Basic	2021-08-28	18:47	69,2106105	-63,3390475	Box Core	Bottom	1569	113	22,7	3	3,16	30,32	1000,90	101	
3	Basic E4	Basic	2021-08-28	19:19	69,209549	-63,3388965	Box Core	Recovery	1568	129	13,9	4,9	2,78	30,57	1001,43	101	
3	Full E5	Full	2021-08-28	22:11	69,6043737	-62,537967	Zodiac	Deployment	1565	112	14,7	3	3,26	30,03	1001,81	101	
3	Full E5	Full	2021-08-28	22:23	69,6055298	-62,5299053	Tucker Net	Deployment	1569	116	14,7	3	3,25	30,05	1001,63	101	
3	Full E5	Full	2021-08-28	22:33	69,610254	-62,5273633	Tucker Net	Bottom	1567	187	12,8	4	3,25	30,07	1002,13	101	
3	Full E5	Full	2021-08-28	22:44	69,6113475	-62,5446683	Tucker Net	Recovery	738	107	20,8	3,7	3,02	30,09	1001,59	101	
3	Full E5	Full	2021-08-28	23:02	69,60283	-62,5388915	Zodiac	Recovery	658	114	19,2	3,6	3,35	29,83	1002,44	101	
3	Full E5	Full	2021-08-28	23:23	69,604108	-62,5413387	CTD Rosette	Deployment	522	127	17,3	3,6	3,66	29,56	1002,78	101	
3	Full E5	Full	2021-08-29	0:02	69,6042798	-62,539567	CTD Rosette	Bottom	561	109	18,7	3,6	3,58	29,60	1002,50	101	
3	Full E5	Full	2021-08-29	1:17	69,6038332	-62,5416713	CTD Rosette	Recovery	495	110	19,6	3,7	3,07	30,08	1002,71	100	
3	Full E5	Full	2021-08-29	1:36	69,6039788	-62,5419213	Moonpool TM	Deployment	534	108	15,6	3,9	3,18	30,00	1003,15	100	
3	Full E5	Full	2021-08-29	1:48	69,6030323	-62,5414512	Moonpool TM	Bottom	596				3,33	29,99			
3	Full E5	Full	2021-08-29	1:56	69,6024902	-62,5411472	Moonpool TM	Recovery	568	127	21,7	4,9	3,30	29,93	1003,33	100	
3	Full E5	Full	2021-08-29	2:10	69,6047532	-62,5438228	Monster Net	Deployment	508	111	17,5	3,8	3,20	30,02	1003,04	100	
3	Full E5	Full	2021-08-29	3:00	69,604494	-62,5427587	Monster Net	Bottom	354	87	11	8	3,23	29,99	1003,12	100	
3	Full E5	Full	2021-08-29	4:04	69,6044512	-62,5438872	Monster Net	Recovery	446				3,12	29,99			
3	Full E5	Full	2021-08-29	4:19	69,6043445	-62,5434682	Moonpool TM	Deployment	516	96	20,6	4,7	3,24	29,98	1004,04	100	
3	Full E5	Full	2021-08-29	4:31	69,6049073	-62,542735	Moonpool TM	Bottom	452	113	18,5	4	2,77	30,27	1004,54	100	
3	Full E5	Full	2021-08-29	4:44	69,6052063	-62,5434788	Moonpool TM	Recovery	485	130	17,5	4,2	3,31	29,96	1004,82	100	
3	Full E5	Full	2021-08-29	5:36	69,6044028	-62,5413448	CTD Rosette	Deployment	516	98	13,1	6,8	2,94	30,10	1005,01	100	
3	Full E5	Full	2021-08-29	5:42	69,6045168	-62,540959	CTD Rosette	Bottom	163	112	10,7	2,8	2,15	30,45	1005,78	101	
3	Full E5	Full	2021-08-29	5:52	69,6049695	-62,539619	CTD Rosette	Recovery	191	118	7,8	2,8	2,29	30,36	1006,10	101	
3	Full E5	Full	2021-08-29	5:59	69,6050678	-62,5388608	Plankton Net	Deployment	147	101	2,3	3,9	2,43	30,33	1006,33	101	
3	Full E5	Full	2021-08-29	6:04	69,6050465	-62,5383607	Plankton Net	Bottom	138	107	9,9	4,6	2,31	30,36	1006,33	100	
3	Full E5	Full	2021-08-29	6:07	69,6049382	-62,53822	Plankton Net	Recovery	138	67	8,2	4	2,34	30,33	1006,41	100	
3	Full E5	Full	2021-08-29	6:25	69,6039465	-62,5260215	IKMT	Deployment	138	116	6,7	4,2	2,47	30,30	1006,45	100	
3	Full E5	Full	2021-08-29	6:46	69,6109243	-62,5017132	IKMT	Bottom	140	121	10,1	6	2,65	30,19	1006,57	100	
3	Full E5	Full	2021-08-29	7:23	69,63526	-62,4899127	IKMT	Recovery	141	113	7,2	5,6	2,63	30,19	1006,55	100	
3	Nutrient 116	Nutrient	2021-08-31	9:10	76,3803058	-70,5191022	Moonpool TM	Deployment	142	84	8,2	4,9	2,62	30,18	1006,62	100	
3	Nutrient 116	Nutrient	2021-08-31	9:34	76,3854112	-70,5220563	Moonpool TM	Bottom	139	79	14,1	6,5	2,58	30,19	1006,62	100	
3	Nutrient 116	Nutrient	2021-08-31	9:43	76,386424	-70,5234365	Moonpool TM	Recovery	140	118	12,4	4,2	2,58	30,21	1007,01	100	
3	Nutrient 116	Nutrient	2021-08-31	9:58	76,37993	-70,5168198	CTD Rosette	Deployment	138	88	9,9	4,2	2,25	30,35	1007,47	100	
3	Nutrient 116	Nutrient	2021-08-31	10:30	76,3809233	-70,5034227	CTD Rosette	Recovery	153	93	17,7	3,3	2,60	30,18	1007,12	101	
3	Nutrient 116	Nutrient	2021-08-31	10:39	76,3797548	-70,5174955	Moonpool TM	Deployment	142	94	9,9	3	2,57	30,19	1007,47	101	
3	Nutrient 116	Nutrient	2021-08-31	10:56	76,3808	-70,5215315	Moonpool TM	Bottom	161	91	12	2,8	2,70	30,13	1007,69	101	0
3	Nutrient 116	Nutrient	2021-08-31	11:03	76,380939	-70,520305	Moonpool TM	Recovery	368	57	5,1	4,8	3,30	29,74	1012,04	101	0
3			2021-08-31	11:24	76,380534	-70,516896	Van Veen Grab		369	69	5,7	4,8	3,81	29,39	1012,11	101	0
3	Nutrient 116	Nutrient	2021-08-31	11:25	76,3805133	-70,5163498	Van Veen Grab	Deployment	378	53	5,3	4,3	3,76	29,43	1012,06	101	0
3			2021-08-31	11:25	76,3805152	-70,5162678	Van Veen Grab		413	79	7	3,2	2,37	30,28	1013,67	101	0
3	Nutrient 116	Nutrient	2021-08-31	11:30	76,3809828	-70,5153997	Van Veen Grab	Bottom	413	75	6,7	3,3	2,70	30,18	1013,89	101	0
3	Nutrient 116	Nutrient	2021-08-31	11:34	76,3814632	-70,5142458	Van Veen Grab	Recovery	388	344	3,8	5,9	2,32	30,26	1015,33	101	0
3	Full 115	Full	2021-08-31	12:55	76,3334495	-71,2006322	CTD Rosette	Deployment	388	338	3,8	5,4	2,32	30,33	1015,38	101	0
3	Full 115	Full	2021-08-31	13:13	76,3338998	-71,2016105	CTD Rosette	Bottom	387	335	3,6	5,4	1,97	30,52	1015,40	100	0
3	Full 115	Full	2021-08-31	13:41	76,3342557	-71,2053075	CTD Rosette	Recovery	117	297	10,3	4,1	1,79	30,55	1015,31	101	0
3	Full 115	Full	2021-08-31	13:53	76,335337	-71,2111032	Tucker Net	Deployment	114	298	8	4,5	1,78	30,56	1015,33	100	0
3	Full 115	Full	2021-08-31	14:03	76,3361938	-71,2332967	Tucker Net	Bottom	107	290	6,9	4,7	1,74	30,57	1015,25	100	0
3	Full 115	Full	2021-08-31	14:13	76,3328787	-71,2509573	Tucker Net	Recovery	109	322	2,3	5,1	1,70	30,59	1015,20	100	0
3	Full 115	Full	2021-08-31	14:26	76,3326105	-71,1968468	Moonpool TM	Deployment	121	294	7,6	4,5	1,75	30,57	1015,24	100	0
3	Full 115	Full	2021-08-31	14:38	76,3338967	-71,201276	Moonpool TM	Bottom	118	304	6,3	4,3	1,68	30,60	1015,28	100	0
3	Full 115	Full	2021-08-31	14:46	76,3348123	-71,2020975	Moonpool TM	Recovery	115	295	5,1	4,4	1,58	30,63	1015,32	100	0
3	Full 115	Full	2021-08-31	14:56	76,3323843	-71,1994438	Plankton Net	Deployment	117	300	5,1	4,5	1,58	30,63	1015,35	100	0
3	Full 115	Full	2021-08-31	15:02	76,3320982	-71,2014128	Plankton Net	Bottom	117	313	6,1	4,5	1,60	30,63	1015,32	100	
3	Full 115	Full	2021-08-31	15:07	76,3316568	-71,2024023	Plankton Net	Recovery	116				1,47	30,67			
3	Full 115	Full	2021-08-31	15:18	76,331613	-71,2037637	CTD Rosette	Deployment	115	301	4,8	4,3	1,69	30,63	1015,24	100	
3	Full 115	Full	2021-08-31	15:30	76,3313058	-71,2067817	CTD Rosette	Bottom	118	315	5,9	4,5	2,18	30,46	1015,24	100	
3	Full 115	Full	2021-08-31	16:21	76,332307	-71,2190872	CTD Rosette	Recovery	114	304	4,8	4,2	1,77	30,54	1015,34	100	
3	Full 115	Full	2021-08-31	17:14	76,3320193	-71,2041982	Hydrobios	Deployment	121	288	4,8	4,3	1,68	30,60	1015,39	100	
3	Full 115	Full	2021-08-31	17:30	76,3329217	-71,2104417	Hydrobios	Bottom	123	286	5,5	4,3	1,67	30,60	1015,34	100	
3	Full 115	Full	2021-08-31	17:52	76,3349985	-71,21951	Hydrobios	Recovery	110	270	5,5	4,2	1,59	30,65	1015,07	100	
3	Full 115	Full	2021-08-31	18:23	76,3334463	-71,2007493	Moonpool TM	Deployment	112	259	4,4	4,2	1,68	30,61	1015,01	100	
3	Full 115	Full	2021-08-31	18:42	76,335098	-71,2022925	Moonpool TM	Bottom	114	259	4,6	4,2	1,67	30,61	1015,04	100	
3	Full 115	Full	2021-08-31	18:58	76,3361405	-71,2055383	Moonpool TM	Recovery	109	277	2,9	4,1	1,58	30,63	1015,01	100	
3	Full 115	Full	2021-08-31	19:10	76,3321903	-71,1972532	Plankton Net	Deployment	115	282	3	4,1	1,65	30,62	1015,08	101	

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						
3	Full 115	Full	2021-08-31	19:16	76,3331092	-71,1994207	Plankton Net	Bottom	121	312	3,2	4,5	2,02	30,49	1015,02	100	
3	Full 115	Full	2021-08-31	19:22	76,3338528	-71,2009205	Plankton Net	Recovery	133	301	7,6	4,4	2,58	30,30	1015,10	101	
3	Full 115	Full	2021-08-31	19:39	76,3338953	-71,19811	IKMT	Deployment	121	306	4	4,2	2,45	30,38	1015,21	101	
3	Full 115	Full	2021-08-31	20:07	76,3445647	-71,2512765	IKMT	Bottom	120	292	3,4	4,6	2,45	30,38	1015,22	101	0
3	Full 115	Full	2021-08-31	20:57	76,3439405	-71,260715	IKMT	Recovery	652	320	8,6	4,4	3,14	29,97	1014,97	101	0
3	CTD 114		2021-08-31	21:57	76,3262508	-71,7860342	CTD Rosette	Deployment	647	334	8	4,1	3,14	29,97	1014,93	101	0
3	CTD 114		2021-08-31	22:13	76,3260007	-71,786587	CTD Rosette	Bottom	645	342	10,5	4,3	3,12	29,97	1014,87	101	
3	CTD 114		2021-08-31	22:24	76,325948	-71,7874208	CTD Rosette	Recovery	641	332	9,3	4	3,07	29,96	1014,76	101	0
3	Nutrient 113	Nutrient	2021-08-31	23:08	76,3207797	-72,2170023	CTD Rosette	Deployment	641	335	8,9	4	2,54	30,14	1014,73	101	0
3	Nutrient 113	Nutrient	2021-08-31	23:28	76,3205033	-72,220643	CTD Rosette	Bottom	642	25	10,1	4,1	3,20	29,93	1014,64	101	0
3	Nutrient 113	Nutrient	2021-09-01	0:10	76,3205317	-72,2297978	CTD Rosette	Recovery	666	323	13,3	4,5	2,93	30,12	1014,37	101	0
3	CTD 112		2021-09-01	0:58	76,3156297	-72,7020455	CTD Rosette	Deployment	702	314	8,9	4,2	3,19	30,00	1014,35	101	0
3	CTD 112		2021-09-01	1:13	76,3157782	-72,7045318	CTD Rosette	Bottom	643	319	12	6,7	3,24	29,92	1014,19	101	0
3	CTD 112		2021-09-01	1:24	76,3154138	-72,7058082	CTD Rosette	Recovery	643	327	14,7	5,1	2,92	30,03	1013,83	101	0
3	Basic 111	Basic	2021-09-01	2:16	76,3071548	-73,2166245	Moonpool TM	Deployment	644	328	13,9	5,2	2,88	29,94	1013,76	101	0
3	Basic 111	Basic	2021-09-01	2:27	76,3078932	-73,2203143	Moonpool TM	Bottom	645	320	10,5	4,7	2,62	30,24	1014,07	101	0
3	Basic 111	Basic	2021-09-01	2:36	76,3074437	-73,2230138	Moonpool TM	Recovery	643	329	14,3	4,6	3,26	29,92	1013,97	101	0
3	Basic 111	Basic	2021-09-01	2:47	76,3070767	-73,223242	CTD Rosette	Deployment	641	326	9,5	4,3	3,25	29,93	1013,95	101	0
3	Basic 111	Basic	2021-09-01	3:03	76,3066487	-73,2211902	CTD Rosette	Bottom	641				3,25	29,94			0
3	Basic 111	Basic	2021-09-01	3:54	76,3050757	-73,2222967	CTD Rosette	Recovery	641	317	11	4	3,12	29,96	1013,93	101	0
3	Basic 111	Basic	2021-09-01	4:08	76,303889	-73,2276547	Moonpool TM	Deployment	642	320	11,6	4	3,17	29,93	1013,83	101	0
3	Basic 111	Basic	2021-09-01	4:28	76,30437	-73,2254952	Moonpool TM	Bottom	643	317	11,8	4	3,15	29,93	1013,88	101	0
3	Basic 111	Basic	2021-09-01	4:43	76,3044138	-73,2225883	Moonpool TM	Recovery	641	324	10,9	4	3,00	29,97	1013,91	101	0
3	Nutrient 110	Nutrient	2021-09-01	5:35	76,2993543	-73,6364085	CTD Rosette	Deployment	641				2,51	30,25			0
3	Nutrient 110	Nutrient	2021-09-01	5:50	76,2996448	-73,6333447	CTD Rosette	Bottom	641	324	12,9	4	2,41	30,32	1013,72	101	0
3	Nutrient 110	Nutrient	2021-09-01	6:33	76,3020442	-73,6221102	CTD Rosette	Recovery	1091	310	16,8	2,7	2,65	30,45	1013,11	102	0
3	CTD 109		2021-09-01	7:30	76,2910603	-74,1154078	CTD Rosette	Deployment	1091	311	13,5	1,7	2,69	30,43	1012,84	102	0
3	CTD 109		2021-09-01	7:39	76,2918967	-74,1153083	CTD Rosette	Bottom	1091	323	12,4	3,4	2,67	30,44	1013,03	101	0
3	CTD 109		2021-09-01	7:48	76,2929847	-74,1134838	CTD Rosette	Recovery	1096				2,73	30,39			0
3	Full 108	Full	2021-09-01	8:38	76,265576	-74,6097057	Tucker Net	Deployment	1095	298	15	3	2,74	30,35	1012,51	102	0
3	Full 108	Full	2021-09-01	8:48	76,2681508	-74,6282892	Tucker Net	Bottom	1093	295	1	2,5	2,70	30,37	1012,51	102	0
3	Full 108	Full	2021-09-01	8:58	76,2655803	-74,6516355	Tucker Net	Recovery	1082	320	12	6,9	2,76	30,32	1012,42	101	0
3	Full 108	Full	2021-09-01	9:12	76,2638583	-74,5981923	Moonpool TM	Deployment	1085	323	14,5	2,3	2,87	30,30	1012,18	102	0
3	Full 108	Full	2021-09-01	9:30	76,2638405	-74,6033115	Moonpool TM	Bottom	1090	308	18,8	1,5	1,44	30,98	1011,84	102	0
3	Full 108	Full	2021-09-01	9:39	76,2640225	-74,6059428	Moonpool TM	Recovery	1085	320	10,5	5,9	2,85	30,33	1011,79	102	0
3	Full 108	Full	2021-09-01	9:54	76,264139	-74,5973333	CTD Rosette	Deployment	1090	318	9,3	7,9	2,89	30,33	1011,79	102	0
3	Full 108	Full	2021-09-01	10:07	76,2644993	-74,5998937	CTD Rosette	Bottom	1093	312	7,6	6,9	2,70	30,39	1011,68	102	0
3	Full 108	Full	2021-09-01	10:52	76,2653417	-74,6164848	CTD Rosette	Recovery	1081	302	13,3	2,8	2,72	30,32	1011,39	102	0
3	Full 108	Full	2021-09-01	11:12	76,2648858	-74,6055375	Plankton Net	Deployment	1085	313	15,4	3,5	2,69	30,31	1011,21	102	0
3	Full 108	Full	2021-09-01	11:19	76,26503	-74,602627	Plankton Net	Bottom	1091	312	8,8	5,6	2,42	30,53	1011,37	103	0
3	Full 108	Full	2021-09-01	11:22	76,2645103	-74,6032408	Plankton Net	Recovery	1433	321	14,5	2,2	2,00	30,45	1010,22	102	0
3	Full 108	Full	2021-09-01	12:06	76,2643968	-74,6035817	Moonpool TM	Deployment	1429	319	18,1	2,2	1,99	30,45	1010,21	102	0
3	Full 108	Full	2021-09-01	12:27	76,2658013	-74,6063368	Moonpool TM	Bottom	1428	319	16,8	2,3	1,67	30,48	1010,32	102	0
3	Full 108	Full	2021-09-01	12:40	76,2659797	-74,6063407	Moonpool TM	Recovery	1432	315	17,7	2,4	1,59	30,71	1010,36	103	0
3	Full 108	Full	2021-09-01	13:00	76,2643015	-74,6001735	Hydrobios	Deployment	1432	316	15,6	2	2,09	30,47	1010,20	102	0
3	Full 108	Full	2021-09-01	13:11	76,2641478	-74,602048	Hydrobios	Bottom	1431	308	15,6	3,1	1,81	30,52	1010,24	102	0
3	Full 108	Full	2021-09-01	13:26	76,2643713	-74,6016493	Hydrobios	Recovery	1432	321	15	4,3	2,01	30,43	1010,04	102	0
3	Full 108	Full	2021-09-01	13:40	76,263769	-74,5993952	Plankton Net	Deployment	1442	327	15,2	2,1	1,75	30,47	1010,18	102	0
3	Full 108	Full	2021-09-01	13:45	76,2638132	-74,5999713	Plankton Net	Bottom	1424	325	8,6	2,7	2,00	30,41	1010,17	103	0
3	Full 108	Full	2021-09-01	13:49	76,2636463	-74,5998107	Plankton Net	Recovery	1179	319	15,8	2,8	2,38	30,31	1009,92	102	0
3	Full 108	Full	2021-09-01	14:07	76,2673128	-74,6108662	IKMT	Deployment	1176	321	15,8	1,8	2,02	30,47	1009,62	102	0
3	Full 108	Full	2021-09-01	14:29	76,2726137	-74,6684515	IKMT	Bottom					2,44	30,29			0
3	Full 108	Full	2021-09-01	15:24	76,2738983	-74,8177715	IKMT	Recovery					2,32	30,37			0
3	Nutrient 107	Nutrient	2021-09-01	16:31	76,2836512	-75,0036302	CTD Rosette	Deployment	1198	305	13,1	1,8	2,39	30,35	1009,32	103	0
3	Nutrient 107	Nutrient	2021-09-01	16:39	76,2838298	-75,0058563	CTD Rosette	Bottom	1195	316	13,3	1,7	2,39	30,35	1009,13	103	0
3	Nutrient 107	Nutrient	2021-09-01	17:19	76,286811	-75,0202953	CTD Rosette	Recovery	1201	314	14,9	4,1	2,31	30,37	1008,94	102	0
3	CTD 106		2021-09-01	19:16	76,3101052	-75,3487062	CTD Rosette	Deployment	1196	317	14,3	2,5	1,97	30,48	1008,82	103	0
3	CTD 106		2021-09-01	19:28	76,310953	-75,3517182	CTD Rosette	Bottom	1194	314	11,2	2,8	2,43	30,33	1008,86	103	0
3	CTD 106		2021-09-01	19:36	76,3107175	-75,3550632	CTD Rosette	Recovery	1207	307	12,6	2,3	2,50	30,30	1008,76	103	0
3	Basic 105	Basic	2021-09-01	20:25	76,3189143	-75,7643568	Moonpool TM	Deployment	1192				2,50	30,30			0
3	Basic 105	Basic	2021-09-01	20:51	76,3173062	-75,7664765	CTD Rosette	Deployment	1189				2,49	30,30			0
3	Basic 105	Basic	2021-09-01	21:05	76,3161307	-75,7940483	CTD Rosette	Bottom	1202	313	8,8	2,9	2,50	30,32	1008,51	103	0
3	Basic 105	Basic	2021-09-01	21:48	76,313842	-75,8296892	CTD Rosette	Recovery	1205	317	8,9	2,2	2,49	30,31	1008,56	103	0
3	Basic 105	Basic	2021-09-01	22:14	76,3175537	-75,7398733	IKMT	Deployment	1187	320	7,4	3,9	2,47	30,31	1008,55	103	0
3	Basic 105	Basic	2021-09-01	22:31	76,3222957	-75,7794558	IKMT	Bottom	85	4	14,3	6,6	6,45	33,02	1003,78	104	0
3	Basic 105	Basic	2021-09-01	23:04	76,326138	-75,8858998	IKMT	Recovery	88	7	9,5	6,5	6,37	32,97	1004,05	104	0
3	CTD 104		2021-09-02	0:06	76,3509105	-76,2038908	CTD Rosette	Deployment	84	358	11,8	6,9	6,38	33,01	1004,16	104	0
3	CTD 104		2021-09-02	0:13	76,3515052	-76,2111563	CTD Rosette	Bottom	81	346	9,5	7,5	6,40	33,00	1004,24	104	0
3	CTD 104		2021-09-02	0:17	76,3513407	-76,2153638	CTD Rosette	Recovery	83	337	9,9	7,4	6,36	32,96	1004,25	104	0
3	Nutrient 103	Nutrient	2021-09-02	0:53	76,3673582	-76,5427652	CTD Rosette	Deployment	86	0	6,1	7,4	6,38	32,95	1004,29	104	0
3	Nutrient 103	Nutrient	2021-09-02	1:03	76,3690742	-76,5516768	CTD Rosette	Bottom	84	30	5,1	7,4	6,41	32,93	1004,34	104	0
3	Nutrient 103	Nutrient	2021-09-02	1:31	76,3735063	-76,5822845	CTD Rosette	Recovery	75	11	6,5	7,1	6,42	32,77	1004,36	104	0
3	CTD 102		2021-09-02	2:09	76,3736662	-76,9752013	CTD Rosette	Deployment	72	348	9,7	7,5	6,43	32,74	1004,45	104	0
3	CTD 102		2021-09-02	2:18	76,3752178	-76,9810355	CTD Rosette	Bottom	72	354	4,2	7,5	6,43	32,62	1004,46	104	0
3	CTD 102		2021-09-02	2:24	76,3758467	-76,9840987	CTD Rosette	Recovery	77	27	2,3	7,8	6,37	31,80	1004,55	104	0
3	Smith Bay		2021-09-02	7:42	77,1600313	-77,9798148	CTD Rosette	Deployment	77	21	2,5	7,8	6,40	31,76	1004,58	104	0
3	Smith Bay		2021-09-02	7:55	77,1598548	-77,9824183	CTD Rosette	Bottom	74	20	3	7,8	6,39	31,75	1004,63	104	0
3	Smith Bay		2021-09-02	8:29	77,1610793	-78,0000103	CTD Rosette	Recovery	72	330	1,1	7,7	6,37	31,74	1004,64	104	0
3	Smith Bay		2021-09-02	9:40	77,1929802	-78,589738	CTD Rosette	Deployment	75	312	4,2	7,8	6,36	31,72	1004,73	104	0
3	Smith Bay		2021-09-02	10:13	77,1942257	-78,590318	CTD Rosette	Recovery	73	309	5,1	8,6	6,40	31,65	1004,70	104	0
3			2021-09-02	10:33	77,1956873	-78,5899278	Box Core	Deployment	84	336	11,2	7,2	6,66	31,60	1004,76	104	0
3			2021-09-02	10:48	77,1974015	-78,5934958	Box Core	Bottom	83	340	9,1	7,1	6,49	31,82	1004,89	104	0
3			2021-09-02	11:04	77,198795	-78,6011238	Box Core	Recovery	84	338	7	7	6,36	32,05	1004,93	104	0
3	Full 101	Full	2021-09-02	20:37	76,3851765	-77,4001532	Zodiac	Deployment	72	82	1,1	7	5,95	33,15	1004,93	104	0
3	Full 101	Full	2021-09-02	20:46	76,3829937	-77,4095515	Tucker Net	Deployment	132	162	5,9	5,5	5,83	32,49	1004,33	104	0
3	Full 101	Full	2021-09-02	20:56	76,3812362	-77,3910885	Tucker Net	Bottom	131	143	5,5	5,5	5,88	32,29	1004,46	104	0

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						
3	Full 101	Full	2021-09-02	21:05	76,3864875	-77,3852245	Tucker Net	Recovery	126	143	6,9	5,6	5,83	32,45	1004,54	104	0
3	Full 101	Full	2021-09-02	21:34	76,3838368	-77,4119372	CTD Rosette	Deployment	262	156	5	5,4	6,04	32,59	1004,26	104	0
3	Full 101	Full	2021-09-02	21:47	76,3862787	-77,4194573	CTD Rosette	Bottom	265	159	6,3	5,5	5,82	32,74	1004,25	104	0
3	Full 101	Full	2021-09-02	22:28	76,3892508	-77,4332295	CTD Rosette	Recovery	256	163	7,6	5,6	5,66	32,91	1004,28	104	0
3	Full 101	Full	2021-09-02	22:46	76,3835118	-77,3977093	Moonpool TM	Deployment	124	147	9,9	5,7	5,87	32,81	1004,39	104	0
3	Full 101	Full	2021-09-02	22:57	76,3842165	-77,3998603	Moonpool TM	Bottom	127	153	11,2	5,6	5,58	33,05	1004,33	104	0
3	Full 101	Full	2021-09-02	23:05	76,385157	-77,4048228	Moonpool TM	Recovery	131	153	11,8	6,2	5,80	32,54	1004,24	104	0
3	Full 101	Full	2021-09-02	23:15	76,3862758	-77,4110065	Plankton Net	Deployment	131	138	8,9	5,5	5,98	32,51	1004,23	104	0
3	Full 101	Full	2021-09-02	23:20	76,3869	-77,41413	Plankton Net	Bottom	130	144	11	5,7	5,99	32,69	1004,31	104	0
3	Full 101	Full	2021-09-02	23:24	76,3875632	-77,4155397	Plankton Net	Recovery	126	150	10,3	5,9	5,92	32,87	1004,31	104	0
3	Full 101	Full	2021-09-02	23:40	76,383093	-77,4008778	Hydrobios	Deployment	132	138	10,9	5,8	5,64	33,04	1004,23	104	0
3	Full 101	Full	2021-09-02	23:50	76,383957	-77,4004698	Hydrobios	Bottom	132	141	9,1	5,8	5,54	33,07	1004,17	104	0
3	Full 101	Full	2021-09-03	0:02	76,3842842	-77,400433	Hydrobios	Recovery	129	162	11	5,9	5,89	32,86	1004,28	104	0
3	Full 101	Full	2021-09-03	0:17	76,3844082	-77,4030465	Plankton Net	Deployment	129	161	11,6	5,9	5,79	32,93	1004,11	104	0
3	Full 101	Full	2021-09-03	0:21	76,3846435	-77,4043807	Plankton Net	Bottom	127	149	11,2	5,9	6,02	32,74	1004,08	104	0
3	Full 101	Full	2021-09-03	0:26	76,3849275	-77,4057422	Plankton Net	Recovery	673	94	8,8	4,6	2,38	30,95	1003,90	103	0
3	Full 101	Full	2021-09-03	0:37	76,3860833	-77,4086678	Moonpool TM	Deployment	669				2,26	30,92			0
3	Full 101	Full	2021-09-03	0:54	76,388233	-77,412305	Moonpool TM	Bottom	665	82	10,7	3,9	2,23	30,92	1003,93	103	0
3	Full 101	Full	2021-09-03	1:09	76,3895667	-77,4149788	Moonpool TM	Recovery	673	116	9,5	4,4	2,35	30,96	1004,02	103	0
3	Full 101	Full	2021-09-03	1:27	76,3890435	-77,4185858	Beam trawl	Deployment	657	114	8	5,7	2,00	30,92	1004,05	103	0
3	Full 101	Full	2021-09-03	1:53	76,395639	-77,3897052	Beam trawl	Bottom	661	141	9,7	10,5	2,29	30,94	1003,75	102	0
3	Full 101	Full	2021-09-03	2:27	76,3985502	-77,471072	Beam trawl	Recovery	658	126	11,2	8,5	2,22	30,96	1003,72	102	0
3	Nutrient 100	Nutrient	2021-09-03	3:09	76,4107928	-77,9511857	Moonpool TM	Deployment	656	148	10,7	5,2	2,20	30,96	1003,63	102	0
3	Nutrient 100	Nutrient	2021-09-03	3:22	76,4106387	-77,9541108	Moonpool TM	Bottom	746	88	12,2	4,4	2,21	30,74	1003,62	101	0
3	Nutrient 100	Nutrient	2021-09-03	3:30	76,410466	-77,956118	Moonpool TM	Recovery	795	99	12,6	4,5	2,17	30,75	1003,88	101	0
3	Nutrient 100	Nutrient	2021-09-03	3:42	76,4105753	-77,9565213	CTD Rosette	Deployment	820	74	14,5	4,6	2,10	30,77	1003,79	101	0
3	Nutrient 100	Nutrient	2021-09-03	3:52	76,410446	-77,956114	CTD Rosette	Bottom	817	100	10,7	4,4	2,13	30,76	1003,98	100	0
3	Nutrient 100	Nutrient	2021-09-03	4:31	76,409554	-77,9522202	CTD Rosette	Recovery	816	96	13,5	4,5	2,17	30,77	1004,02	100	0
3	Nutrient 100	Nutrient	2021-09-03	5:11	76,4115428	-77,9544605	Moonpool TM	Deployment	816	94	14,1	4,4	2,17	30,78	1003,96	100	0
3	Nutrient 100	Nutrient	2021-09-03	5:27	76,4107077	-77,9545635	Moonpool TM	Bottom	813	103	13,1	4,4	2,18	30,79	1004,09	100	0
3	Nutrient 100	Nutrient	2021-09-03	5:38	76,4104742	-77,953062	Moonpool TM	Recovery	815	68	12,4	3,8	2,23	30,80	1004,24	100	0
3	100A		2021-09-03	6:21	76,4592587	-77,825166	Box Core	Deployment	816	97	7,4	4,3	2,17	30,81	1004,46	100	0
3	100A		2021-09-03	6:28	76,4593822	-77,8250337	Box Core	Bottom	816	26	10,7	3,9	2,25	30,83	1004,75	100	0
3	100A		2021-09-03	6:35	76,4592652	-77,8275013	Box Core	Recovery	816	92	11,2	4,1	2,15	30,83	1004,70	100	0
3	100A		2021-09-03	6:56	76,4600957	-77,8291958	Agassiz Trawl	Deployment	816	99	4,6	4,1	2,15	30,83	1004,74	100	0
3	100A		2021-09-03	7:08	76,46376	-77,8151313	Agassiz Trawl	Bottom	813	94	12,4	3,9	2,15	30,85	1004,80	100	0
3	100A		2021-09-03	7:22	76,469147	-77,8073717	Agassiz Trawl	Recovery	815	75	7,6	4	2,11	30,85	1005,11	100	0
3	SB1	Nutrient	2021-09-03	16:28	76,963387	-79,1385173	CTD Rosette	Deployment	816	43	5,7	4,1	2,13	30,86	1005,21	100	0
3	SB1	Nutrient	2021-09-03	16:38	76,9626453	-79,1366108	CTD Rosette	Bottom	824	105	7	4,3	2,11	30,85	1005,38	100	0
3	SB1	Nutrient	2021-09-03	17:12	76,9605085	-79,1300823	CTD Rosette	Recovery	819	80	10,3	3,9	2,02	30,75	1005,60	100	0
3	SB1	Nutrient	2021-09-03	18:30	76,9551235	-79,1219898	Moonpool TM	Deployment	817	83	7,2	4,1	2,00	30,76	1005,72	100	0
3	SB1	Nutrient	2021-09-03	18:47	76,9555502	-79,1218683	Moonpool TM	Bottom	814	82	13,7	3,8	1,99	30,75	1005,40	100	0
3	SB1	Nutrient	2021-09-03	19:02	76,9564022	-79,1212117	Moonpool TM	Recovery	814	74	12,8	3,6	2,10	30,84	1005,53	100	0
3	Smith Bay	Coring	2021-09-03	23:47	77,1949862	-78,5862132		Deployment	817	64	11,4	4,7	2,04	30,79	1005,69	100	0
3	Smith Bay	Coring	2021-09-04	0:04	77,1954692	-78,5851542		Bottom	922	104	8	3,6	2,21	30,55	1005,54	100	0
3	Smith Bay	Coring	2021-09-04	0:20	77,1965687	-78,5899803		Recovery	913	99	7,8	5,5	2,14	30,57	1005,85	100	0
3			2021-09-04	3:18	76,999134	-79,0169793	Gravity Core	Deployment	910	100	11,6	4,1	2,19	30,59	1005,90	100	0
3			2021-09-04	3:22	76,998908	-79,0168965	Gravity Core	Bottom	926	101	11	3,5	2,05	30,67	1005,97	100	0
3			2021-09-04	3:27	76,9987542	-79,0172892	Gravity Core	Recovery	922	113	11,2	3,7	1,70	30,85	1005,85	100	0
3			2021-09-04	3:47	76,998659	-79,0156417	Box Core	Deployment	916	99	12	3,1	1,38	30,84	1005,99	100	0
3			2021-09-04	3:52	76,9985653	-79,014247	Box Core	Bottom	893	116	6,3	3	1,85	30,84	1005,96	100	0
3			2021-09-04	4:00	76,9985088	-79,0140252	Box Core	Recovery	918	103	9,7	3,6	1,85	30,86	1005,85	100	0
3	East 5	Coring	2021-09-04	21:36	75,3126048	-79,2250085	Gravity Core	Deployment	919	104	11	3,4	1,91	30,80	1006,00	100	0
3	East 5	Coring	2021-09-04	21:54	75,3124842	-79,217979	Gravity Core	Bottom	902	90	11,4	3,4	2,05	30,70	1006,23	100	0
3	East 5	Coring	2021-09-04	22:05	75,311019	-79,2148115	Gravity Core	Recovery	907	92	12,4	3,3	1,57	30,90	1006,21	100	0
3	Basic 322	Basic	2021-09-05	4:17	74,4955437	-80,5263175	Moonpool TM	Deployment	908	87	11,2	3,7	2,02	30,68	1006,05	100	0
3	Basic 322	Basic	2021-09-05	4:42	74,500351	-80,5293765	CTD Rosette	Deployment	911	103	11,8	3,5	2,00	30,68	1006,28	100	0
3	Basic 322	Basic	2021-09-05	5:02	74,5002902	-80,55287	CTD Rosette	Bottom	910	93	12,2	3,4	2,06	30,67	1006,28	100	0
3	Basic 322	Basic	2021-09-05	5:56	74,4975108	-80,6159573	CTD Rosette	Recovery	905	90	6,3	3,9	1,88	30,70	1006,63	100	0
3	Nutrient 300	Nutrient	2021-09-05	7:01	74,3160492	-80,4630477	CTD Rosette	Deployment	911	105	6,7	3,7	2,21	30,56	1006,85	100	0
3	Nutrient 300	Nutrient	2021-09-05	7:17	74,3158847	-80,4630062	CTD Rosette	Bottom	916	67	10,7	4,9	2,12	30,57	1006,76	100	0
3	Nutrient 300	Nutrient	2021-09-05	8:08	74,315745	-80,4628547	CTD Rosette	Recovery	905	76	9,9	3,2	2,18	30,56	1006,70	100	0
3	Nutrient 323	Nutrient	2021-09-05	9:15	74,1553637	-80,4718652	CTD Rosette	Deployment	905	89	10,9	3,3	2,17	30,58	1006,90	100	0
3	Nutrient 323	Nutrient	2021-09-05	9:33	74,155625	-80,4688023	CTD Rosette	Bottom	907	86	11,4	3,2	2,02	30,60	1007,02	100	0
3	Nutrient 323	Nutrient	2021-09-05	10:24	74,1550787	-80,4689605	CTD Rosette	Recovery	846				0,99	31,00			0
3	Nutrient 324	Nutrient	2021-09-05	11:42	73,985848	-80,4723727	CTD Rosette	Deployment	856	93	6,5	2,5	1,17	31,00	1007,04	100	0
3	Nutrient 324	Nutrient	2021-09-05	12:03	73,9870957	-80,4657195	CTD Rosette	Bottom	872	94	4,2	3,2	1,13	30,93	1007,01	100	0
3	Nutrient 324	Nutrient	2021-09-05	12:54	73,9867817	-80,4520785	CTD Rosette	Recovery	873	83	6,1	4,3	1,12	30,96	1007,02	100	0
3	Basic 325	Basic	2021-09-05	14:01	73,8174633	-80,4964867	Moonpool TM	Deployment	873	76	10,1	4,3	1,08	30,99	1006,77	100	0
3	Basic 325	Basic	2021-09-05	14:19	73,8160878	-80,4597433	Moonpool TM	Bottom	874	67	8,6	4,2	1,07	30,98	1006,67	100	0
3	Basic 325	Basic	2021-09-05	14:28	73,8155385	-80,4414005	Moonpool TM	Recovery	870	67	9,1	2,9	0,95	31,01	1006,72	100	0
3	Basic 325	Basic	2021-09-05	14:44	73,8180493	-80,4920802	CTD Rosette	Deployment	870	74	8,8	2,4	1,11	30,99	1006,61	100	0
3	Basic 325	Basic	2021-09-05	15:02	73,8184813	-80,466732	CTD Rosette	Bottom	873	68	10,1	2,5	1,13	30,99	1006,49	100	0
3	Basic 325	Basic	2021-09-05	15:47	73,8189038	-80,4136793	CTD Rosette	Recovery	873	84	8	3	1,00	31,02	1006,28	100	0
3	Basic 325	Basic	2021-09-05	16:26	73,81896	-80,5100808	Moonpool TM	Deployment	873	67	10,3	2,5	1,13	30,97	1006,19	100	0
3	Basic 325	Basic	2021-09-05	16:43	73,8186998	-80,4890233	Moonpool TM	Bottom	874	54	10,9	2,5	1,01	30,97	1006,11	100	0
3	Basic 325	Basic	2021-09-05	17:01	73,8182217	-80,4727382	Moonpool TM	Recovery	872	66	11,2	3,3	1,13	31,01	1006,20	100	0
3	Basic 305D	Basic	2021-09-07	1:23	74,6020853	-93,7293617	Moonpool TM	Deployment	875	67	11,8	4,3	0,80	31,03	1006,15	100	0
3	Basic 305D	Basic	2021-09-07	1:39	74,6021862	-93,73643	Moonpool TM	Bottom	875	53	10,1	2,8	1,09	30,99	1005,96	100	0
3	Basic 305D	Basic	2021-09-07	1:47	74,602032	-93,7385177	Moonpool TM	Recovery	869	56	12,9	2,8	1,17	31,02	1006,03	100	0
3	Basic 305D	Basic	2021-09-07	2:00	74,602464	-93,7410607	CTD Rosette	Deployment	865	36	12	2,7	1,17	31,01	1005,99	100	0
3	Basic 305D	Basic	2021-09-07	2:10	74,6024042	-93,740054	CTD Rosette	Bottom	864	45	11,2	2,6	1,25	30,97	1005,90	100	0
3	Basic 305D	Basic	2021-09-07	2:34	74,6018703	-93,7383283	CTD Rosette	Recovery	535	332	14,7	1,4	0,71	31,18	1006,55	100	0
3	Basic 305D	Basic	2021-09-07	3:01	74,6003492	-93,740778	Moonpool TM	Deployment	525	334	15	1,4	0,89	31,04	1006,61	100	0
3	Basic 305D	Basic	2021-09-07	3:14	74,5997528	-93,7406902	Moonpool TM	Bottom	524	327	4,6	1,7	0,94	31,02	1006,49	100	0
3	Basic 305D	Basic	2021-09-07	3:23	74,599528	-93,7397782	Moonpool TM	Recovery	523	335	14,7	1,8	0,99	30,97	1006,74	100	0

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						
3	Nutrient 305C	Nutrient	2021-09-07	4:20	74,484453	-93,637271	CTD Rosette	Deployment	523	350	14,9	1,3	0,98	31,04	1006,76	100	0
3	Nutrient 305C	Nutrient	2021-09-07	4:30	74,4837783	-93,6318078	CTD Rosette	Bottom	522	347	13,7	1	1,03	31,01	1006,65	100	0
3	Nutrient 305C	Nutrient	2021-09-07	5:00	74,4810857	-93,6260112	CTD Rosette	Recovery	523	345	12	1	1,05	31,02	1006,79	100	0
3			2021-09-07	5:16	74,4807062	-93,6144978	Plankton Net	Deployment	524	339	13,1	1	1,09	31,03	1006,61	100	0
3			2021-09-07	5:20	74,4801483	-93,612163	Plankton Net	Bottom	522	322	12,4	1	0,77	31,10	1006,51	100	0
3			2021-09-07	5:24	74,4796845	-93,6096468	Plankton Net	Recovery	522	332	10,5	0,9	0,75	31,11	1006,48	100	0
3	Nutrient 305C	Nutrient	2021-09-07	5:42	74,480076	-93,6551695	Beam trawl	Deployment	522	333	10,5	1	0,76	31,10	1006,34	100	0
3	Nutrient 305C	Nutrient	2021-09-07	5:57	74,4746415	-93,6274128	Beam trawl	Bottom	522	303	11	1,7	0,75	31,10	1006,57	100	0
3	Nutrient 305C	Nutrient	2021-09-07	6:16	74,4711912	-93,5790155	Beam trawl	Recovery	522	321	11	1,8	0,73	31,11	1006,58	100	0
3	Nutrient 305B	Nutrient	2021-09-07	8:34	74,3564867	-93,5603615	Moonpool TM	Deployment	523	318	9,1	1,1	0,73	31,11	1006,48	100	0
3	Nutrient 305B	Nutrient	2021-09-07	8:59	74,3529258	-93,5582083	Moonpool TM	Bottom	524	324	13,1	1,6	0,63	31,15	1006,15	100	0
3	Nutrient 305B	Nutrient	2021-09-07	9:04	74,3521542	-93,5572055	Moonpool TM	Recovery	525	329	12	1,2	0,60	31,16	1006,08	100	0
3	Nutrient 305B	Nutrient	2021-09-07	9:24	74,3526133	-93,5664075	CTD Rosette	Deployment	522	337	11,4	1,2	0,39	31,18	1006,08	100	0
3	Nutrient 305B	Nutrient	2021-09-07	9:34	74,350815	-93,5635153	CTD Rosette	Bottom	525	323	11	1,4	0,83	31,16	1005,79	100	0
3	Nutrient 305B	Nutrient	2021-09-07	10:03	74,3462957	-93,5565983	CTD Rosette	Recovery	526	16	10,5	1,7	0,69	31,13	1005,84	100	0
3	Nutrient 305A	Nutrient	2021-09-07	10:18	74,343908	-93,5530365	Moonpool TM	Deployment	525	28	9,1	1,8	0,75	31,09	1005,92	100	0
3	Nutrient 305B	Nutrient	2021-09-07	10:19	74,3437633	-93,5528372	Moonpool TM	Deployment	100	16	16,6	2,4	1,65	29,77	1005,08	100	0
3	Nutrient 305B	Nutrient	2021-09-07	10:22	74,3433307	-93,5522225	Moonpool TM	Deployment	91	4	18,1	2,7	0,78	30,36	1005,28	100	0
3	Nutrient 305B	Nutrient	2021-09-07	10:39	74,3412853	-93,556189	Moonpool TM	Bottom	92	358	14,9	2,8	1,82	29,69	1005,40	100	0
3	Nutrient 305B	Nutrient	2021-09-07	10:49	74,3406932	-93,5600602	Moonpool TM	Recovery	96	347	15,6	2,7	1,29	30,19	1005,31	100	0
3	Nutrient 305A	Nutrient	2021-09-07	12:26	74,2488957	-93,5002298	CTD Rosette	Deployment	91	13	2,9	3,9	1,50	29,90	1005,59	100	0
3	Nutrient 305A	Nutrient	2021-09-07	12:40	74,2489508	-93,4955383	CTD Rosette	Bottom	95	358	11,2	4,1	1,51	30,06	1005,59	100	0
3	Basic S10	Basic	2021-09-07	20:21	74,5432485	-90,4062458	Moonpool TM	Deployment	94	351	10,1	4,4	1,65	29,65	1005,61	100	0
3	Basic S10	Basic	2021-09-07	20:31	74,543283	-90,4037942	Moonpool TM	Bottom	83	207	2,5	4,3	1,84	29,65	1005,69	100	0
3	Basic S10	Basic	2021-09-07	20:38	74,5433112	-90,4011255	Moonpool TM	Recovery	82	218	2,7	4,1	1,75	29,66	1005,67	100	0
3	Basic S10	Basic	2021-09-07	21:08	74,54235	-90,410726	CTD Rosette	Deployment	96	248	3,4	4,1	1,86	29,59	1005,68	100	0
3	Basic S10	Basic	2021-09-07	21:19	74,5422612	-90,4099465	CTD Rosette	Bottom	97	167	1,1	5	1,29	30,05	1005,62	100	0
3	Basic S10	Basic	2021-09-07	21:47	74,5420317	-90,404562	CTD Rosette	Recovery	103	141	2,5	4,4	1,33	29,93	1005,68	100	0
3	Basic S10	Basic	2021-09-07	22:02	74,5434043	-90,4105927	Moonpool TM	Deployment	105	154	4,4	4,6	1,73	29,65	1005,65	100	0
3	Basic S10	Basic	2021-09-07	22:16	74,543242	-90,4060902	Moonpool TM	Bottom	103	141	7,4	4,6	1,58	29,75	1005,59	100	
3	Basic S10	Basic	2021-09-07	22:27	74,543175	-90,403027	Moonpool TM	Recovery	104	151	7,4	3,8	1,54	29,72	1005,53	100	
3	Basic S10	Basic	2021-09-07	22:43	74,5441337	-90,3908488	Zodiac	Deployment	102	202	2,7	4,3	1,69	29,63	1005,46	100	
3	CTD S11		2021-09-07	23:03	74,5733052	-90,3636532	CTD Rosette	Deployment	95	242	5,9	3,5	1,30	30,01	1005,19	100	
3	CTD S11		2021-09-07	23:11	74,5733153	-90,361633	CTD Rosette	Bottom	99	228	6,3	3,5	1,11	30,15	1005,20	100	
3	CTD S11		2021-09-07	23:13	74,573627	-90,3609262	CTD Rosette	Recovery	456	77	18,3	5,9	4,45	31,68	1003,45	100	
3	Basic S10	Basic	2021-09-07	23:19	74,5731628	-90,3595523	Zodiac	Recovery	466				4,63	31,68			
3	S9		2021-09-08	0:23	74,4628052	-90,529493	CTD Rosette	Deployment	461	109	14,1	6,2	4,66	31,67	1003,67	100	
3	S9		2021-09-08	0:33	74,4625045	-90,5267345	CTD Rosette	Bottom	311	220	4	3,8	0,69	32,57	1006,96	100	
3	S9		2021-09-08	1:10	74,4609332	-90,5194132	CTD Rosette	Recovery	368	208	3,4	3,4	0,63	32,63	1007,31	100	
3	S9		2021-09-08	1:31	74,4633545	-90,5229873	Beam trawl	Deployment	415	200	2,7	3,4	0,61	32,61	1007,48	100	
3	S9		2021-09-08	1:45	74,4639698	-90,4923348	Beam trawl	Bottom	607	221	8	4,1	1,30	32,81	1008,90	100	
3	S9		2021-09-08	2:14	74,480586	-90,4877388	Beam trawl	Recovery	578	205	10,3	5,2	1,28	32,92	1009,60	100	
3	Box core site	Basic	2021-09-08	2:41	74,5170683	-90,4424385	Box Core	Deployment	570	192	11,2	5	1,32	32,90	1009,61	100	
3	Box core site	Basic	2021-09-08	2:47	74,5171977	-90,4432817	Box Core	Bottom	353	195	13,5	4,1	2,28	32,18	1009,87	100	
3	Box core site	Basic	2021-09-08	2:56	74,5167613	-90,4427163	Box Core	Recovery	353	192	14,5	4,1	2,21	32,07	1009,94	100	
3	Basic S8	Basic	2021-09-08	4:05	74,4015637	-90,621925	Moonpool TM	Deployment	339	186	13,5	4,2	2,51	32,02	1009,84	100	
3	Basic S8	Basic	2021-09-08	4:16	74,4011102	-90,6201498	Moonpool TM	Bottom	346	209	8,4	10,4	2,45	32,05	1010,08	97	
3	Basic S8	Basic	2021-09-08	4:23	74,4005753	-90,6201375	Moonpool TM	Recovery	353	223	9,1	5,3	1,50	32,07	1010,05	100	
3	Basic S8	Basic	2021-09-08	4:35	74,4028177	-90,6241693	CTD Rosette	Deployment	335	192	14,1	4,4	1,74	31,99	1010,15	100	
3	Basic S8	Basic	2021-09-08	4:43	74,4025535	-90,6225678	CTD Rosette	Bottom	343	207	16,4	3,9	1,82	32,24	1010,13	100	
3	Basic S8	Basic	2021-09-08	5:16	74,4028268	-90,616522	CTD Rosette	Recovery	61	198	18,1	8,3	3,83	30,43	1006,47	100	
3	Basic S8	Basic	2021-09-08	5:28	74,4044487	-90,6091222	Moonpool TM	Deployment	61	199	17,5	8,3	3,83	30,43	1006,56	100	
3	Basic S8	Basic	2021-09-08	5:46	74,4043417	-90,6096827	Moonpool TM	Bottom	62	200	18,5	8,5	3,82	30,43	1006,55	100	
3	Basic S8	Basic	2021-09-08	5:57	74,4044585	-90,610007	Moonpool TM	Recovery	138	208	13,7	7,7	3,60	30,45	1006,40	100	
3	CTD S7		2021-09-08	6:30	74,3440905	-90,7124033	CTD Rosette	Deployment	94	200	16,2	7,9	3,78	30,44	1006,34	100	
3	CTD S7		2021-09-08	6:40	74,3441678	-90,712316	CTD Rosette	Bottom	71	201	15,4	8,4	3,74	30,46	1006,43	100	
3	CTD S7		2021-09-08	6:45	74,3438323	-90,7123297	CTD Rosette	Recovery	120	194	3,4	7,8	3,11	30,61	1006,50	100	
3	Nutrient S6	Nutrient	2021-09-08	7:16	74,2803152	-90,805319	CTD Rosette	Deployment	90	185	15	7,9	3,48	30,56	1006,34	100	
3	Nutrient S6	Nutrient	2021-09-08	7:28	74,280368	-90,8037663	CTD Rosette	Bottom	87	202	14,7	8,8	3,56	30,46	1006,14	100	0
3	Nutrient S6	Nutrient	2021-09-08	8:03	74,2784513	-90,7951098	CTD Rosette	Recovery	111	198	10,3	8,3	3,40	30,55	1006,33	100	0
3	Basic S5	Basic	2021-09-08	8:40	74,2187828	-90,9009275	Tucker Net	Deployment	96	210	11,4	8,2	3,10	30,59	1006,22	100	0
3	Basic S5	Basic	2021-09-08	8:49	74,2186875	-90,882171	Tucker Net	Bottom	104	198	8,4	9,4	3,23	30,57	1006,45	100	0
3	Basic S5	Basic	2021-09-08	9:00	74,2236547	-90,8682402	Tucker Net	Recovery	98	210	13,9	8,6	3,35	30,56	1006,58	100	0
3	Basic S5	Basic	2021-09-08	9:13	74,2239667	-90,8830527	Plankton Net	Deployment	93	194	11,8	8,5	3,57	30,54	1006,68	100	0
3	Basic S5	Basic	2021-09-08	9:17	74,2238712	-90,8793043	Plankton Net	Bottom	81	195	12,6	8,6	3,58	30,54	1006,51	100	0
3	Basic S5	Basic	2021-09-08	9:21	74,2237032	-90,877648	Plankton Net	Recovery	97	213	13,5	10,8	3,57	30,54	1006,41	100	0
3	Basic S5	Basic	2021-09-08	9:40	74,2191745	-90,8963722	Moonpool TM	Deployment	97	208	12,4	10,8	3,58	30,54	1006,60	100	0
3	Basic S5	Basic	2021-09-08	9:56	74,2199538	-90,9044752	CTD Rosette	Deployment	102	223	13,3	9,6	3,64	30,54	1006,68	100	0
3	Basic S5	Basic	2021-09-08	10:13	74,2208815	-90,9041813	CTD Rosette	Bottom	103	228	11,6	9,1	3,66	30,53	1006,67	100	0
3	Basic S5	Basic	2021-09-08	10:42	74,222338	-90,9011497	CTD Rosette	Recovery	54	223	12,6	9,7	3,82	30,38	1006,52	99	0
3	Basic S5	Basic	2021-09-08	10:54	74,2192792	-90,9024073	Moonpool TM	Deployment	54	220	11,8	9,6	3,82	30,37	1006,58	99	0
3	Basic S5	Basic	2021-09-08	11:09	74,2181703	-90,9008107	Moonpool TM	Bottom	53				3,89	30,35			0
3	Basic S5	Basic	2021-09-08	11:20	74,2185012	-90,8975917	Moonpool TM	Recovery	51	251	15	11,1	4,07	30,31	1006,24	99	0
3	Basic S3	Basic	2021-09-08	12:20	74,0981775	-91,0754358	Moonpool TM	Deployment	53	238	20	11,2	4,01	30,33	1006,21	97	0
3	Basic S3	Basic	2021-09-08	12:33	74,0974182	-91,0669235	Moonpool TM	Bottom	50	237	17,9	10,8	3,98	30,33	1006,25	98	0
3	Basic S3	Basic	2021-09-08	12:40	74,0970215	-91,0635507	Moonpool TM	Recovery	47	204	10,3	12,2	4,03	30,34	1005,97	99	0
3	Basic S3	Basic	2021-09-08	12:52	74,1006223	-91,0874985	CTD Rosette	Deployment	50	209	13,5	10	4,01	30,32	1005,88	99	0
3	Basic S3	Basic	2021-09-08	13:02	74,0987628	-91,080604	CTD Rosette	Bottom	49	246	4	10,2	3,92	30,34	1005,77	99	0
3	Basic S3	Basic	2021-09-08	13:25	74,0977985	-91,0596773	CTD Rosette	Recovery	42	209	14,5	9,5	3,99	30,41	1005,38	99	0
3	Basic S3	Basic	2021-09-08	13:37	74,0989827	-91,0451008	Moonpool TM	Deployment	42	232	15,8	10,4	3,97	30,42	1005,27	99	0
3	Basic S3	Basic	2021-09-08	13:59	74,0971172	-91,0231988	Moonpool TM	Bottom	42	236	14,1	10,1	4,01	30,41	1005,25	99	0
3	Basic S3	Basic	2021-09-08	14:08	74,096463	-91,0152267	Moonpool TM	Recovery	42	224	12,2	10,3	4,07	30,42	1004,85	99	0
3	Nutrient S1	Nutrient	2021-09-08	15:20	74,0584043	-91,0290778	CTD Rosette	Deployment	40				4,06	30,42			0
3	Nutrient S1	Nutrient	2021-09-08	15:30	74,0574618	-91,021656	CTD Rosette	Bottom	36	223	11,4	9,9	4,03	30,40	1004,98	99	0
3	Nutrient S1	Nutrient	2021-09-08	15:47	74,0558245	-91,0081503	CTD Rosette	Recovery	44	244	14,7	14,9	3,91	30,45	1004,77	95	0
3	Nutrient S4	Nutrient	2021-09-08	16:49	74,144368	-91,0103003	CTD Rosette	Deployment	48	236	8,8	12,2	3,77	30,47	1004,71	88	0

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						
3	Nutrient S4	Nutrient	2021-09-08	16:58	74,1444132	-91,007656	CTD Rosette	Bottom	48	246	13,3	9,7	3,86	30,43	1004,46	99	0
3	Nutrient S4	Nutrient	2021-09-08	17:31	74,1441018	-90,9902417	CTD Rosette	Recovery	49	199	10,3	11,2	4,03	30,42	1004,03	99	0
3	Basic S5	Basic	2021-09-08	18:14	74,2175172	-90,9038825	Beam trawl	Deployment	46	210	11,4	13	3,89	30,42	1004,09	84	0
3	Basic S5	Basic	2021-09-08	18:31	74,2193705	-90,867518	Beam trawl	Bottom	46				3,98	30,39			0
3	Basic S5	Basic	2021-09-08	19:04	74,2279798	-90,7909337	Beam trawl	Recovery	69				3,52	30,56			0
3	Coring radstock b	Coring	2021-09-08	22:37	74,6949242	-91,1440715	Gravity Core	Deployment	47				3,99	30,44			0
3	Coring radstock b	Coring	2021-09-08	22:40	74,6949095	-91,1439267	Gravity Core	Bottom	45				4,00	30,46			
3	Coring radstock b	Coring	2021-09-08	22:51	74,6954667	-91,1419702	Gravity Core	Recovery	251				3,11	30,75			
3	Coring		2021-09-08	23:17	74,6960065	-91,1441662	Box Core	Deployment	118	191	25,3	7,2	4,54	31,98	995,12	100	0
3	Coring		2021-09-08	23:22	74,6955963	-91,1445885	Box Core	Bottom		181	16,6	7	3,93	32,14	995,26	100	0
3	Coring		2021-09-08	23:27	74,6952457	-91,1451622	Box Core	Recovery	104	189	15,8	7,2	4,04	32,12	995,26	100	0
Leg 4																	
4	Nutrient C002	Nutrient	2021-09-10	21:45	73,9605817	-88,8162883	CTD Rosette	Deployment					-1,07	27,31			1
4	Nutrient C002	Nutrient	2021-09-10	21:57	73,96238	-88,8114633	CTD Rosette	Bottom					-0,97	27,35			
4	Nutrient C002	Nutrient	2021-09-10	22:39	73,9698333	-88,7910483	CTD Rosette	Recovery					-1,06	27,36			6
4	C002	Nutrient	2021-09-10	23:50	73,963065	-88,8073067	CTD Rosette	Deployment					-1,03	27,64			5
4	C002	Nutrient	2021-09-10	23:58	73,964585	-88,8033267	CTD Rosette	Bottom					-0,91	27,67			5
4	C002	Nutrient	2021-09-11	0:38	73,9725733	-88,77748	CTD Rosette	Recovery					-0,94	27,63			5
4	Nutrient C003	Nutrient	2021-09-11	12:31	72,364664	-91,3998058	CTD Rosette	Deployment	390	268	8,8	0,6	1,64	30,36	1024,95	85	0
4	Nutrient C003	Nutrient	2021-09-11	12:41	72,3641163	-91,3972898	CTD Rosette	Bottom	390	341	7,8	1,7	1,64	30,38	1024,84	84	0
4	Nutrient C003	Nutrient	2021-09-11	13:28	72,3597333	-91,3877357	CTD Rosette	Recovery	389	354	5,3	0,5	1,62	30,35	1024,85	86	0
4	C004 (427m)	Nutrient	2021-09-11	21:15	71,9559095	-95,835113	Monster	Deployment	431	62	2,3	0,8	0,27	24,23	1024,29	93	0
4	C004 (427m)	Nutrient	2021-09-11	21:26	71,9551442	-95,8340945	Monster	Bottom	427	92	2,7	0,6	0,34	24,30	1024,27	93	0
4	C004 (427m)	Nutrient	2021-09-11	21:39	71,9557323	-95,834768	Monster	Recovery	429	40	5	0,1	0,32	24,24	1024,15	93	0
4			2021-09-11	22:02	71,9553883	-95,8384667	CTD Rosette	Deployment	431	73	1	0,8	0,33	24,25	1023,99	91	0
4			2021-09-11	22:10	71,9549765	-95,8400033	CTD Rosette	Bottom	429				0,35	24,26			0
4			2021-09-11	23:01	71,9487858	-95,844301	CTD Rosette	Recovery	430	47	1,9	0,2	0,39	24,28	1023,66	93	0
4			2021-09-11	23:22	71,9543078	-95,8411737	Beam Trawl	Deployment	429	34	6,5	-0,4	0,43	24,30	1023,55	92	0
4			2021-09-11	23:45	71,9547683	-95,863342	Beam Trawl	Bottom	426	42	2,9	0,1	0,39	24,43	1023,49	90	0
4			2021-09-12	0:26	71,9372333	-95,7863	Beam Trawl	Recovery	420	43	6,3	-0,5	0,31	24,24	1023,33	92	0
4	Basic 310E (124r	Basic	2021-09-12	5:48	71,2872392	-97,68769	Tucker Net	Deployment	130	231	0,2	-1,2	-0,18	25,89	1021,07	98	0
4	Basic 310E (124r	Basic	2021-09-12	5:57	71,289109	-97,674835	Tucker Net	Bottom	139	305	5,5	-1,8	-0,21	25,98	1020,99	98	0
4	Basic 310E (124r	Basic	2021-09-12	6:04	71,2923978	-97,6731565	Tucker Net	Recovery	143	314	7	-1,7	-0,19	26,26	1020,91	98	0
4			2021-09-12	6:28	71,2921213	-97,7010922	CTD Rosette	Deployment	131	293	6,7	-1,7	-0,07	27,08	1020,76	94	0
4			2021-09-12	6:33	71,2922963	-97,7011412	CTD Rosette	Bottom	131	327	8,6	-1,6	0,01	27,26	1020,64	96	0
4			2021-09-12	6:52	71,292083	-97,6985568	CTD Rosette	Recovery	132	321	8	-1,9	-0,06	27,30	1020,55	96	0
4			2021-09-12	7:24	71,2911238	-97,6953098	Moonpool TM	Deployment	132	286	8,9	-1,8	-0,05	27,31	1020,37	95	0
4			2021-09-12	7:41	71,290328	-97,693516	Moonpool TM	Bottom	133	279	7,6	-1,8	-0,03	27,38	1020,23	95	0
4			2021-09-12	7:49	71,2901318	-97,6918842	Moonpool TM	Recovery	134	283	6,3	-2	-0,06	27,20	1020,25	97	0
4			2021-09-12	8:03	71,2909165	-97,6940035	Monster	Deployment	132	311	8	-1,9	-0,08	27,45	1020,15	96	0
4			2021-09-12	8:11	71,2908193	-97,6946955	Monster	Recovery	131	265	4,8	-2,1	-0,11	27,67	1020,15	98	0
4			2021-09-12	8:38	71,2919395	-97,7004967	Moonpool TM	Deployment	130	284	8	-2,1	-0,09	27,40	1019,90	99	0
4			2021-09-12	8:48	71,2912195	-97,7011233	Moonpool TM	Bottom	129	289	6,9	-2,2	-0,10	27,30	1019,85	99	0
4			2021-09-12	8:56	71,2910258	-97,7010238	Moonpool TM	Recovery	129	257	4,6	-2,3	-0,08	27,39	1019,78	99	0
4			2021-09-12	9:16	71,2917928	-97,7022558	Box Core	Deployment	130	292	6,3	-2,2	-0,12	26,35	1019,54	99	0
4			2021-09-12	9:20	71,29163	-97,7028105	Box Core	Bottom	130	285	6,1	-2,3	-0,20	26,17	1019,52	99	0
4			2021-09-12	9:24	71,291563	-97,7025152	Box Core	Recovery	129	288	4,6	-2,4	-0,20	26,19	1019,50	99	0
4	Nutrient C009 (2	Nutrient	2021-09-12	13:50	70,7053297	-98,9665368	CTD Rosette	Deployment	202	291	8,6	-2,3	-0,27	24,08	1017,38	99	0
4	Nutrient C009 (2	Nutrient	2021-09-12	13:55	70,704895	-98,9665645	CTD Rosette	Bottom	202	339	3,4	-2,3	-0,10	24,46	1017,45	99	0
4	Nutrient C009 (2	Nutrient	2021-09-12	14:43	70,7021152	-98,96545	CTD Rosette	Recovery	202	311	7,4	-2,9	-0,42	23,54	1016,95	99	0
4	312	Basic	2021-09-12	23:21	69,1721345	-100,68904	Zodiac	Deployment	65	145	5,3	0,8	0,94	26,03	1012,51	100	0
4	312	Basic	2021-09-12	23:32	69,1712738	-100,690243	Tucker Net	Deployment	65	181	4,2	0,9	1,01	26,01	1012,46	100	0
4	312	Basic	2021-09-12	23:38	69,1683683	-100,695609	Tucker Net	Bottom	62	184	5,3	1	1,06	26,03	1012,42	100	0
4	312	Basic	2021-09-12	23:44	69,1670722	-100,688425	Tucker Net	Recovery	60	182	2,7	1,2	1,06	26,03	1012,37	100	0
4	312	Basic	2021-09-12	23:48	69,1682607	-100,68278	Tucker Net	Bottom	72	240	2,1	0,9	1,05	26,03	1012,36	100	0
4	312	Basic	2021-09-12	23:52	69,1706488	-100,68246	Tucker Net	Recovery	73	223	2,9	0,8	1,02	26,01	1012,34	100	0
4	312	Basic	2021-09-13	0:02	69,1732775	-100,685247	Zodiac	Recovery	66	197	3,2	0,8	0,98	26,07	1012,27	100	0
4	312	Basic	2021-09-13	0:20	69,1716245	-100,700996	Moonpool TM	Deployment	70	190	1,3	1	1,06	26,03	1012,12	100	0
4	312	Basic	2021-09-13	0:27	69,1730453	-100,698807	Moonpool TM	Bottom	68	196	1,5	0,9	0,80	26,35	1012,02	100	0
4	312	Basic	2021-09-13	0:33	69,1741123	-100,696477	Moonpool TM	Recovery	67	179	2,1	0,7	0,77	26,40	1011,99	100	0
4	312	Basic	2021-09-13	0:57	69,1707693	-100,70116	CTD Rosette	Deployment	70	214	1,5	0,8	0,92	25,96	1011,73	100	0
4	312	Basic	2021-09-13	1:00	69,1712017	-100,700251	CTD Rosette	Bottom	69	197	1,9	0,8	0,90	25,99	1011,68	100	0
4	312	Basic	2021-09-13	1:14	69,1735415	-100,694681	CTD Rosette	Recovery	67	99	1,9	0,7	0,81	26,21	1011,58	100	0
4	312	Basic	2021-09-13	1:30	69,1701698	-100,700034	Monster	Deployment	68	172	6,9	0,9	1,07	25,81	1011,39	100	0
4	312	Basic	2021-09-13	1:34	69,1709882	-100,698456	Monster	Bottom	67	170	7,6	0,9	1,09	25,81	1011,37	100	0
4	312	Basic	2021-09-13	1:35	69,1712672	-100,69833	Monster	Recovery	67	169	6,1	0,9	1,00	25,90	1011,39	100	0
4	312	Basic	2021-09-13	1:55	69,1699787	-100,701794	Box Core	Deployment	67	159	6,3	0,8	1,02	25,78	1011,28	100	0
4	312	Basic	2021-09-13	1:56	69,1701725	-100,702332	Box Core	Bottom	68	154	6,5	0,9	1,00	25,80	1011,28	100	0
4	312	Basic	2021-09-13	1:59	69,1703788	-100,702803	Box Core	Recovery	70	138	7,6	0,8	0,99	25,82	1011,25	100	0
4	312	Basic	2021-09-13	2:23	69,1665477	-100,707357	Beam Trawl	Deployment	63	143	3,6	1,5	0,97	25,80	1011,12	100	0
4	312	Basic	2021-09-13	2:29	69,1702442	-100,704465	Beam Trawl	Bottom	66	157	6,9	0,9	0,95	25,79	1011,11	100	0
4	312	Basic	2021-09-13	2:38	69,1759598	-100,707452	Beam Trawl	Recovery	66	148	6,5	0,8	0,96	25,78	1010,93	99	0
4	312	Basic	2021-09-13	2:44	69,1790053	-100,710538	Beam Trawl	Deployment	66	149	6,7	1,5	0,91	25,79	1010,97	100	0
4	312	Basic	2021-09-13	2:50	69,1826232	-100,714912	Beam Trawl	Bottom	68				0,89	25,82			0
4	312	Basic	2021-09-13	3:00	69,1866767	-100,73074	Beam Trawl	Recovery	77	168	9,5	0,5	0,90	25,81	1010,74	100	0
4	C010	Basic	2021-09-13	8:36	68,24797	-101,646724	Tucker Net	Deployment	111	134	10,5	2,7	2,61	23,98	1006,66	100	0
4	C010	Basic	2021-09-13	8:45	68,2455355	-101,653313	Tucker Net	Bottom	110	137	13,7	3	2,58	24,05	1006,57	100	0
4	C010	Basic	2021-09-13	9:04	68,2464165	-101,633853	Tucker Net	Recovery	108	149	10,3	3,5	2,50	24,19	1006,46	100	0
4	C010	Basic	2021-09-13	9:32	68,2475533	-101,636068	Moonpool TM	Deployment	110	145	14,9	3,6	2,53	24,12	1006,24	100	0
4	C010	Basic	2021-09-13	9:40	68,247651	-101,633852	Moonpool TM	Bottom	113	135	13,5	3,4	2,52	24,15	1005,97	100	0
4	C010	Basic	2021-09-13	9:47	68,248001	-101,632236	Moonpool TM	Recovery	116	133	13,3	3,4	2,52	24,17	1005,90	100	0
4	C010	Basic	2021-09-13	10:13	68,2512328	-101,629897	CTD Rosette	Deployment	105	120	6,7	3,8	2,47	24,17	1006,01	100	0
4	C010	Basic	2021-09-13	10:17	68,2513052	-101,628399	CTD Rosette	Bottom	108	159	7,2	3,8	2,29	24,86	1006,01	100	0
4	C010	Basic	2021-09-13	10:42	68,2524917	-101,61813	CTD Rosette	Recovery	113	216	4	3	2,49	24,22	1005,86	100	0
4	C010	Basic	2021-09-13	11:07	68,250642	-101,638508	Monster	Deployment	115	130	14,5	3	2,47	24,18	1005,49	100	0
4	C010	Basic	2021-09-13	11:10	68,2506307	-101,638019	Monster	Bottom	116	126	13,9	2,9	2,46	24,18	1005,51	100	0

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						
4	C010	Basic	2021-09-13	11:24	68,2501443	-101,637791	Zodiac		116	121	12,6	2,9	2,46	24,16	1005,50	100	0
4	C010	Basic	2021-09-13	12:08	68,248122	-101,639903	Moonpool TM	Deployment	111	124	9,9	2,9	2,43	24,15	1005,55	100	0
4	C010	Basic	2021-09-13	12:16	68,2479305	-101,638846	Moonpool TM	Bottom	108	110	13,5	3,1	2,55	24,18	1005,26	100	0
4	C010	Basic	2021-09-13	12:18	68,2480422	-101,63844	Moonpool TM	Recovery	112	122	14,1	3,3	2,47	24,28	1005,33	100	0
4	C010	Basic	2021-09-13	12:42	68,2437102	-101,646542	Beam Trawl	Deployment	111	124	15	3,6	2,43	24,17	1005,41	100	0
4	C010	Basic	2021-09-13	12:50	68,2460478	-101,639135	Beam Trawl	Bottom	112				2,42	24,15			0
4	C010	Basic	2021-09-13	13:05	68,2547362	-101,648534	Beam Trawl	Recovery	115	130	10,3	3,4	2,29	24,20	1005,31	100	0
4	QMG4-Y3	Basic	2021-09-13	19:07	68,485663	-103,432076	Zodiac	Deployment	70	70	10,9	3,7	1,32	24,37	1004,12	100	0
4	QMG4-Y3	Basic	2021-09-13	19:26	68,4840848	-103,456064	Tucker Net	Deployment	71	76	7,4	3,5	3,34	21,87	1004,19	100	0
4	QMG4-Y3	Basic	2021-09-13	19:32	68,4827042	-103,465975	Tucker Net	Bottom	69	73	9,3	3,5	3,28	22,11	1004,08	100	0
4	QMG4-Y3	Basic	2021-09-13	19:35	68,4815397	-103,470821	Tucker Net	Recovery	67	86	8,9	3,5	3,29	22,01	1004,07	100	0
4	QMG4-Y3	Basic	2021-09-13	19:36	68,4813612	-103,47161	Tucker Net	Deployment	67	80	8,6	3,5	3,31	22,01	1004,07	100	0
4	QMG4-Y3	Basic	2021-09-13	19:39	68,4803078	-103,475614	Tucker Net	Bottom	71	87	8,2	3,6	3,25	22,02	1004,06	100	0
4	QMG4-Y3	Basic	2021-09-13	19:42	68,4791407	-103,479418	Tucker Net	Recovery	67	81	9,1	3,6	3,36	21,73	1004,09	100	0
4	QMG4-Y3	Basic	2021-09-13	19:54	68,4771017	-103,488596	Zodiac	Recovery	72	82	9,7	4,1	2,53	24,59	1004,10	100	0
4	QMG4-Y3	Basic	2021-09-13	20:14	68,4843923	-103,438347	Moonpool TM	Deployment	78	68	8,8	3,7	3,31	22,38	1004,13	100	0
4	QMG4-Y3	Basic	2021-09-13	20:24	68,4844117	-103,442018	Moonpool TM	Bottom	82	65	8,4	3,5	3,36	23,10	1004,08	100	0
4	QMG4-Y3	Basic	2021-09-13	20:34	68,4843917	-103,445331	Moonpool TM	Recovery	80	64	8,4	3,5	3,32	23,50	1004,09	100	0
4	QMG4-Y3	Basic	2021-09-13	21:00	68,4857633	-103,440293	CTD Rosette	Deployment	77	72	9,3	3,7	3,31	23,64	1004,18	100	0
4	QMG4-Y3	Basic	2021-09-13	21:16	68,4866382	-103,448862	CTD Rosette	Bottom	80	104	3,2	4,6	3,10	24,09	1004,24	100	0
4	QMG4-Y3	Basic	2021-09-13	21:23	68,4870048	-103,452324	CTD Rosette	Recovery	72	71	3,8	4,5	3,17	23,85	1004,22	100	0
4	QMG4-Y3	Basic	2021-09-13	21:45	68,4848768	-103,43471	Monster	Deployment	73	86	12,2	3,8	2,88	24,63	1004,20	100	0
4	QMG4-Y3	Basic	2021-09-13	21:46	68,4849887	-103,435535	Monster	Bottom	74	74	11,2	3,6	3,05	24,46	1004,24	100	0
4	QMG4-Y3	Basic	2021-09-13	21:49	68,485066	-103,435813	Monster	Recovery	76	68	10,5	3,6	3,17	24,13	1004,22	100	0
4	QMG4-Y3	Basic	2021-09-13	22:06	68,4848005	-103,430615	Box Core	Deployment	68	82	10,5	3,6	3,20	24,02	1004,22	100	0
4	QMG4-Y3	Basic	2021-09-13	22:09	68,4847867	-103,430782	Box Core	Bottom	69	68	9,1	3,6	3,20	24,02	1004,21	100	0
4	QMG4-Y3	Basic	2021-09-13	22:11	68,4847432	-103,431062	Box Core	Recovery	69	70	10,1	3,7	3,19	24,04	1004,24	100	0
4	QMG4-Y3	Basic	2021-09-13	22:34	68,4826468	-103,43726	Beam Trawl	Deployment	78	67	7,2	3,4	3,18	24,07	1004,29	100	0
4	QMG4-Y3	Basic	2021-09-13	22:40	68,4801423	-103,443768	Beam Trawl	Bottom	80	60	8,2	3,5	3,17	24,12	1004,25	100	0
4	QMG4-Y3	Basic	2021-09-13	22:49	68,4752375	-103,450104	Beam Trawl	Recovery	69	72	7,6	3,5	3,12	24,21	1004,29	100	0
4	QMW	Nutrient	2021-09-14	2:02	68,7086905	-104,667245	CTD Rosette	Deployment	85	51	17,3	3,7	4,14	21,06	1004,56	100	0
4	QMW	Nutrient	2021-09-14	2:05	68,7082908	-104,669156	CTD Rosette	Bottom	83	33	14,7	3,7	4,15	21,06	1004,54	100	0
4	QMW	Nutrient	2021-09-14	2:30	68,705568	-104,680655	CTD Rosette	Recovery	81	49	11,8	3,4	4,14	21,05	1004,57	100	0
4	314	Basic	2021-09-14	23:27	68,9748672	-105,479417	Tucker Net	Deployment	80	86	14,5	6,5	3,90	21,42	1005,51	90	0
4	314	Basic	2021-09-14	23:34	68,9754735	-105,494399	Tucker Net	Bottom	79	72	13,1	2,4	3,87	21,16	1005,58	99	0
4	314	Basic	2021-09-14	23:45	68,9710497	-105,508419	Tucker Net	Bottom	82	60	15,4	1,6	3,83	21,27	1005,59	99	0
4	314	Basic	2021-09-14	23:52	68,9670092	-105,510784	Tucker Net	Recovery	79	82	15,2	1,6	3,81	21,33	1005,56	99	0
4	314	Basic	2021-09-15	0:15	68,9706537	-105,478485	Moonpool TM	Deployment	75	82	14,7	1,8	3,88	21,12	1005,65	99	0
4	314	Basic	2021-09-15	0:24	68,9711073	-105,480336	Moonpool TM	Bottom	75	58	16,4	1,7	3,88	21,16	1005,56	99	0
4	314	Basic	2021-09-15	0:31	68,9713193	-105,481683	Moonpool TM	Recovery	74	64	17,5	1,7	3,88	21,13	1005,70	99	0
4	314	Basic	2021-09-15	0:54	68,9724693	-105,478551	CTD Rosette	Deployment	79	66	16,2	1,5	3,88	21,27	1005,63	99	0
4	314	Basic	2021-09-15	0:58	68,9726003	-105,480009	CTD Rosette	Bottom	77	71	19	1,6	3,89	21,37	1005,63	99	0
4	314	Basic	2021-09-15	1:18	68,9730062	-105,483032	CTD Rosette	Recovery	75	65	19	1,3	3,87	21,32	1005,62	99	0
4	314	Basic	2021-09-15	1:31	68,9704865	-105,478122	Monster	Deployment	75	73	17,7	1,1	3,81	21,32	1005,61	99	0
4	314	Basic	2021-09-15	1:35	68,9707472	-105,478851	Monster	Bottom	75	76	18,1	1	3,81	21,32	1005,68	99	0
4	314	Basic	2021-09-15	1:37	68,9709962	-105,479643	Monster	Recovery	75	70	14,3	1	3,81	21,32	1005,71	99	0
4	314	Basic	2021-09-15	1:59	68,971322	-105,474377	Box Core	Deployment	82	48	17,1	0,5	3,79	21,34	1005,74	99	0
4	314	Basic	2021-09-15	2:02	68,9710957	-105,475913	Box Core	Bottom	78	55	16,6	0,6	3,79	21,34	1005,80	99	0
4	314	Basic	2021-09-15	2:05	68,9708065	-105,476505	Box Core	Recovery	77	64	16,8	0,6	3,78	21,34	1005,62	99	0
4	C011	Nutrient	2021-09-15	4:40	69,0179022	-106,618906	CTD Rosette	Deployment	112	92	15,4	0,4	3,07	24,82	1005,79	99	0
4	C011	Nutrient	2021-09-15	4:45	69,0179062	-106,621485	CTD Rosette	Bottom	113	88	15,8	0,4	2,95	24,92	1005,85	99	0
4	C011	Nutrient	2021-09-15	5:06	69,0172708	-106,631147	CTD Rosette	Recovery	113	80	12,6	0,3	3,17	24,71	1006,09	99	0
4	C011	Nutrient	2021-09-15	5:25	69,0129647	-106,62343	Beam Trawl	Deployment	114	63	10,7	-0,4	3,09	24,76	1006,23	99	0
4	C011	Nutrient	2021-09-15	5:31	69,0105797	-106,63219	Beam Trawl	Bottom	107	71	12	-0,3	2,99	24,86	1005,97	99	0
4	C011	Nutrient	2021-09-15	5:41	69,0066435	-106,645233	Beam Trawl	Recovery	106	61	12,8	-0,6	2,63	25,13	1006,08	99	0
4	C011	Basic	2021-09-15	5:50	69,0029137	-106,654831	Beam Trawl	Bottom	104	73	12,9	-0,5	2,64	25,11	1006,03	99	0
4	C011	Basic	2021-09-15	6:03	68,9956148	-106,667549	Beam Trawl	Recovery	106	61	14,3	-0,8	2,53	25,20	1005,91	99	0
4	C012	Nutrient	2021-09-15	13:53	68,328798	-110,271512	CTD Rosette	Deployment	296	44	9,7	1,9	2,22	25,18	1005,81	99	0
4	C012	Nutrient	2021-09-15	13:59	68,3281987	-110,273829	CTD Rosette	Bottom	295	43	12,9	4,1	2,29	25,25	1005,82	99	0
4	C012	Nutrient	2021-09-15	14:45	68,3237203	-110,290649	CTD Rosette	Recovery		65	8,8	3,1	2,23	25,16	1006,06	99	0
4	C012	Nutrient	2021-09-15	15:09	68,3238968	-110,273989	Beam Trawl	Deployment		61	15,6	-1,1	2,22	25,16	1006,12	100	0
4	C012	Nutrient	2021-09-15	15:23	68,3163777	-110,285573	Beam Trawl	Bottom		63	15,2	-1,2	2,37	25,16	1006,06	100	0
4	C012	Nutrient	2021-09-15	15:49	68,299992	-110,309742	Beam Trawl	Recovery		67	12,8	-1,6	2,23	25,35	1006,35	100	0
4	316	Basic	2021-09-15	19:48	68,3886993	-112,124747	Zodiac	Deployment	176	75	13,7	0	4,17	23,15	1007,54	99	0
4	316	Basic	2021-09-15	20:04	68,3844033	-112,128812	Tucker Net	Deployment		85	16	-0,1	4,16	23,17	1007,32	99	0
4	316	Basic	2021-09-15	20:13	68,3803483	-112,138645	Tucker Net	Bottom	177	82	14,1	-0,1	4,13	23,20	1007,45	99	0
4	316	Basic	2021-09-15	20:22	68,3761572	-112,145229	Tucker Net	Recovery	180	80	14,3	0	4,16	23,19	1007,45	99	0
4	316	Basic	2021-09-15	20:35	68,3764252	-112,152589	Zodiac	Recovery	182	97	17,3	0,3	4,15	23,20	1007,52	99	0
4	316	Basic	2021-09-15	21:03	68,389051	-112,120009	Moonpool TM	Deployment	173	106	18,8	0,1	4,17	23,18	1007,59	99	0
4	316	Basic	2021-09-15	21:16	68,3879392	-112,120676	Moonpool TM	Bottom	172	103	18,7	0,2	4,21	23,17	1007,69	99	0
4	316	Basic	2021-09-15	21:24	68,3875832	-112,122224	Moonpool TM	Recovery	174	110	15,8	0,1	4,39	23,20	1007,81	99	0
4	316	Basic	2021-09-15	21:52	68,387352	-112,123966	CTD Rosette	Deployment	174	100	15,6	0,3	4,11	23,24	1007,90	99	0
4	316	Basic	2021-09-15	21:58	68,387007	-112,124802	CTD Rosette	Bottom	175	106	13,7	0,5	4,15	23,29	1007,93	99	0
4	316	Basic	2021-09-15	22:30	68,3852937	-112,124615	CTD Rosette	Recovery	178	100	16	0,3	4,16	23,21	1008,19	99	0
4	316	Basic	2021-09-15	22:47	68,3896757	-112,121329	Monster	Deployment	176	99	13,1	0,6	4,24	23,16	1008,30	99	0
4	316	Basic	2021-09-15	22:51	68,3893885	-112,121056	Monster	Bottom	175	110	15,2	0,5	4,29	23,27	1008,29	99	0
4	316	Basic	2021-09-15	22:57	68,3887948	-112,122688	Monster	Recovery	173	109	13,5	0,4	4,58	23,18	1008,36	99	0
4	316	Basic	2021-09-15	23:19	68,3882863	-112,119473	Moonpool TM	Deployment	172	110	11,8	0,5	4,31	23,17	1008,69	99	0
4	316	Basic	2021-09-15	23:31	68,38725	-112,119809	Moonpool TM	Bottom	175	122	13,3	0,7	4,20	23,24	1008,68	99	0
4	316	Basic	2021-09-15	23:41	68,3872027	-112,119528	Moonpool TM	Recovery	175	121	11,6	0,8	4,29	23,12	1008,70	99	0
4	316	Basic	2021-09-15	23:59	68,3897018	-112,120178	Box Core	Deployment	175	119	13,3	0,6	4,18	23,31	1008,96	99	0
4	316	Basic	2021-09-16	0:04	68,3892803	-112,12005	Box Core	Bottom	172	96	12,4	0,5	4,44	23,21	1009,08	99	0
4	316	Basic	2021-09-16	0:09	68,3888593	-112,119677	Box Core	Recovery	173	101	10,3	0,6	4,25	23,18	1009,15	99	0
4	316	Basic	2021-09-16	0:27	68,3893682	-112,119506	Beam Trawl	Deployment	176	94	9,1	1,6	4,36	23,02	1009,29	99	0
4	316	Basic	2021-09-16	0:36	68,3892082	-112,133571	Beam Trawl	Bottom	178	91	9,7	0,3	4,35	22,66	1009,31	99	0
4	316	Basic	2021-09-16	0:56	68,3757848	-112,137861	Beam Trawl	Recovery	182	113	12	0,2	4,15	23,17	1009,50	99	0

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						
4	CG13	Nutrient	2021-09-16	3:20	68,3855787	-113,160352	Beam Trawl	Deployment	173	90	6,5	1,2	4,44	22,89	1010,36	97	0
4	CG13	Nutrient	2021-09-16	3:28	68,3838782	-113,170275	Beam Trawl	Bottom	143	86	7,2	0,9	4,42	22,91	1010,34	99	0
4	CG13	Nutrient	2021-09-16	3:46	68,3750523	-113,162298	Beam Trawl	Recovery	140	84	10,9	0,8	4,46	22,86	1010,31	99	0
4	400-C013	Nutrient	2021-09-16	8:48	69,0555455	-114,784292	CTD Rosette	Deployment	93	111	9,3	1,7	5,04	23,26	1011,79	97	0
4	400-C013	Nutrient	2021-09-16	8:55	69,056182	-114,784896	CTD Rosette	Bottom	92	111	7,8	1,6	5,05	23,25	1011,86	97	0
4	400-C013	Nutrient	2021-09-16	9:12	69,0567095	-114,786064	CTD Rosette	Recovery	91	109	8,8	1,6	5,06	23,41	1012,00	97	0
4	MCTL	Coring	2021-09-16	10:39	69,1141813	-115,047192	MultiCorer	Deployment	171	106	10,1	1,8	5,08	23,41	1012,24	98	0
4	MCTL	Coring	2021-09-16	10:43	69,1141798	-115,047194	MultiCorer	Bottom	171	113	10,1	1,7	5,07	23,40	1012,15	98	0
4	MCTL	Coring	2021-09-16	10:51	69,114265	-115,046815	MultiCorer	Recovery	170	121	11	1,8	5,08	23,38	1012,15	98	0
4	C014	Nutrient	2021-09-16	18:02	69,6187973	-118,603038	CTD Rosette	Deployment	519	143	16,2	2,9	3,16	29,22	1011,83	99	0
4	C014	Nutrient	2021-09-16	18:14	69,6204302	-118,603091	CTD Rosette	Bottom	522	149	16,6	2,8	4,17	28,75	1011,86	99	0
4	C014	Nutrient	2021-09-16	19:07	69,6297427	-118,600349	CTD Rosette	Recovery	518	136	16,9	2,6	4,15	28,78	1011,92	99	0
4	403	Basic	2021-09-16	23:24	70,1076643	-120,124572	Tucker Net	Deployment	412	130	16,6	3,9	1,64	30,25	1010,75	99	0
4	403	Basic	2021-09-16	23:39	70,109656	-120,147214	Tucker Net	Bottom	411	126	15,2	2,3	1,81	29,88	1010,50	99	0
4	403	Basic	2021-09-16	23:43	70,1098068	-120,15381	Tucker Net	Recovery	411	135	17,5	2,4	1,88	29,84	1010,28	99	0
4	403	Basic	2021-09-17	0:16	70,0972118	-120,109513	Moonpool TM	Deployment	412	135	19,4	2,6			1010,66	99	0
4	403	Basic	2021-09-17	0:24	70,0971413	-120,106727	Moonpool TM	Bottom	412	136	17,3	2,5			1010,64	99	0
4	403	Basic	2021-09-17	0:30	70,097265	-120,10531	Moonpool TM	Recovery	411	130	17,1	2,5			1010,71	99	0
4	403	Basic	2021-09-17	0:53	70,0967227	-120,100719	CTD Rosette	Deployment	411	131	18,5	2,3			1010,46	99	0
4	403	Basic	2021-09-17	1:01	70,0965317	-120,099376	CTD Rosette	Bottom	411	129	16,2	2,2			1010,51	99	0
4	403	Basic	2021-09-17	1:41	70,094887	-120,091755	CTD Rosette	Recovery	413	127	18,3	2,2			1010,27	99	0
4	403	Basic	2021-09-17	2:01	70,0993472	-120,110147	Monster	Deployment	410	127	19,4	2,2			1010,28	99	0
4	403	Basic	2021-09-17	2:12	70,0984728	-120,108712	Monster	Bottom	410	128	17,3	2,2			1010,22	99	0
4	403	Basic	2021-09-17	2:26	70,0973997	-120,108479	Monster	Recovery	412	135	20	2,2			1010,07	99	0
4	403	Basic	2021-09-17	2:50	70,0992455	-120,109538	Moonpool TM	Deployment	410	131	18,5	2,3			1010,13	99	0
4	403	Basic	2021-09-17	3:08	70,0988135	-120,106301	Moonpool TM	Bottom	410	131	18,1	2,2			1009,92	99	0
4	403	Basic	2021-09-17	3:25	70,098637	-120,104316	Moonpool TM	Recovery	410	142	17,5	2,3			1010,06	98	0
4	403	Basic	2021-09-17	3:47	70,0998667	-120,111531	Box Core	Deployment	410	135	20,6	2,1			1009,65	97	0
4	403	Basic	2021-09-17	3:56	70,0997908	-120,112	Box Core	Bottom	412	138	21,1	2,2			1009,66	97	0
4	403	Basic	2021-09-17	4:06	70,1003057	-120,112636	Box Core	Recovery	411								0
4	403	Basic	2021-09-17	4:28	70,1016493	-120,105546	Beam Trawl	Deployment	412	131	16,8	1,8			1009,52	97	0
4	403	Basic	2021-09-17	4:39	70,1046207	-120,121737	Beam Trawl	Bottom	412	133	15	1,7			1009,49	97	0
4			2021-09-17	4:55	70,1057878	-120,160296		Bottom	407	133	16,8	1,8			1009,17	96	0
4	403	Basic	2021-09-17	5:10	70,1032778	-120,190592	Beam Trawl	Recovery	407	134	16,9	1,9			1009,09	94	0
4	405-C015	Basic	2021-09-17	10:34	70,6623205	-122,61654	Tucker Net	Deployment	567	128	12,8	6,8			1007,34	91	0
4	405-C015	Basic	2021-09-17	10:43	70,6642915	-122,630196	Tucker Net	Bottom	576	113	16,6	2,1			1006,99	99	0
4	405-C015	Basic	2021-09-17	10:51	70,66459	-122,645159	Tucker Net	Recovery	581	111	17,5	1,7			1006,86	99	0
4	405-C015	Basic	2021-09-17	11:17	70,6658267	-122,634001	Moonpool TM	Deployment	585	121	16,4	2			1007,00	99	0
4	405-C015	Basic	2021-09-17	11:28	70,665905	-122,636057	Moonpool TM	Bottom	585	121	18,3	2			1007,02	99	0
4	405-C015	Basic	2021-09-17	11:37	70,6666613	-122,636699	Moonpool TM	Recovery	589	120	16,4	1,9			1007,01	99	0
4	405-C015	Basic	2021-09-17	11:59	70,6668887	-122,622693	CTD Rosette	Deployment	587	114	18,8	2,1			1006,86	99	0
4	405-C015	Basic	2021-09-17	12:10	70,6671318	-122,621626	CTD Rosette	Bottom	587	114	16,8	1,9			1006,94	99	0
4	405-C015	Basic	2021-09-17	13:01	70,6653893	-122,634332	CTD Rosette	Recovery	580	125	16,6	1,9			1006,56	99	0
4	405-C015	Basic	2021-09-17	13:45	70,6641098	-122,630674	Monster	Deployment	576	127	17,9	1,7			1006,37	99	0
4	405-C015	Basic	2021-09-17	14:00	70,6628712	-122,637619	Monster	Bottom	572								0
4	405-C015	Basic	2021-09-17	14:19	70,6607127	-122,644183	Monster	Recovery	560	116	20	1,2			1006,23	99	0
4	405-C015	Basic	2021-09-17	14:41	70,6654512	-122,629309	Moonpool TM	Deployment	577	118	20,4	1,3			1006,14	99	0
4	405-C015	Basic	2021-09-17	15:02	70,6650688	-122,632307	Moonpool TM	Bottom	577	128	18,5	1,3			1006,03	99	0
4	405-C015	Basic	2021-09-17	15:26	70,664768	-122,633642	Moonpool TM	Recovery	578	126	17,7	1,5			1005,88	99	0
4	405-C015	Basic	2021-09-17	15:42	70,665154	-122,625658	Box Core	Deployment	577	120	14,1	1,6			1005,82	99	0
4	405-C015	Basic	2021-09-17	15:55	70,6640222	-122,632575	Box Core	Bottom	575	132	17,1	1,8			1005,78	99	0
4	405-C015	Basic	2021-09-17	16:08	70,6617682	-122,638306	Box Core	Recovery	570	121	15	2,1			1005,66	99	0
4	405-C015	Basic	2021-09-17	17:24	70,671791	-122,640398	IKMT	Deployment	600	140	16,9	2,2			1005,67	99	0
4	405-C015	Basic	2021-09-17	17:45	70,6761058	-122,67433	IKMT	Bottom	596	141	14,5	2,2			1005,45	99	0
4	405-C015	Basic	2021-09-17	18:31	70,6759372	-122,772971	IKMT	Recovery	598	137	17,7	2,1	2,95	27,92	1005,30	99	0
4	PCB-01	PCB Basic	2021-09-18	0:29	71,2328753	-125,598447	CTD Rosette	Deployment	411	119	17,7	3,1	3,49	27,93	1003,47	99	0
4	PCB-01	PCB Basic	2021-09-18	0:30	71,232923	-125,598478	Optics	Deployment	411	120	21,1	3,1	3,47	27,93	1003,46	99	0
4	PCB-01	PCB Basic	2021-09-18	0:40	71,2336407	-125,597892	CTD Rosette	Bottom	415	124	18,5	3	3,47	27,93	1003,50	99	0
4	PCB-01	PCB Basic	2021-09-18	1:08	71,2355485	-125,598657	Optics	Recovery	413	125	20,2	3,2	3,49	27,92	1003,23	99	0
4	PCB-01	PCB Basic	2021-09-18	1:25	71,2366077	-125,599572	CTD Rosette	Recovery	408	123	21,7	3,3	3,48	27,93	1003,14	99	0
4	PCB-01	PCB Basic	2021-09-18	2:37	71,2340413	-125,590247	CTD Rosette	Deployment	412	127	18,5	3,5	3,47	27,89	1002,83	99	0
4	PCB-01	PCB Basic	2021-09-18	2:45	71,2341253	-125,592804	CTD Rosette	Recovery	414	126	19,6	3,5	3,51	27,89	1002,88	99	0
4	PCB-01	PCB Basic	2021-09-18	3:02	71,2340422	-125,588977	MultiCorer	Deployment	412	124	22,7	3,5	3,38	27,91	1002,73	99	0
4	PCB-01	PCB Basic	2021-09-18	3:12	71,2341198	-125,590636	MultiCorer	Bottom	412	124	21,5	3,5	3,48	27,93	1002,70	99	0
4	PCB-01	PCB Basic	2021-09-18	3:23	71,234232	-125,591176	MultiCorer	Recovery	412	125	18,8	3,5	3,51	27,94	1002,74	99	0
4	407	Basic	2021-09-18	5:37	71,0103068	-126,076245	Tucker Net	Deployment	390	119	16,6	3,8	2,37	27,93	1001,94	99	0
4	407	Basic	2021-09-18	5:47	71,0123537	-126,090806	Tucker Net	Bottom	396	114	15,8	3	2,42	27,97	1001,79	99	0
4	407	Basic	2021-09-18	5:52	71,013268	-126,098378	Tucker Net	Recovery	391	110	16	3	2,43	27,98	1001,70	99	0
4	407	Basic	2021-09-18	6:17	71,0051095	-126,074493	Moonpool TM	Deployment	390	121	18,1	3,5	2,37	27,86	1001,76	99	0
4	407	Basic	2021-09-18	6:26	71,0054455	-126,077258	Moonpool TM	Bottom	390	121	16,4	3,4	2,41	27,87	1001,79	99	0
4	407	Basic	2021-09-18	6:33	71,0056262	-126,079021	Moonpool TM	Recovery	391	123	16	3,5	2,38	27,87	1001,81	99	0
4	407	Basic	2021-09-18	6:50	71,0040042	-126,075077	CTD Rosette	Deployment	394	127	17,1	3,6	2,40	27,84	1001,73	99	0
4	407	Basic	2021-09-18	6:58	71,004308	-126,077269	CTD Rosette	Bottom	393	129	15	3,5	2,38	27,85	1001,78	99	0
4	407	Basic	2021-09-18	7:52	71,0046173	-126,088294	CTD Rosette	Recovery	393	147	15,2	3,9	2,38	27,92	1001,71	99	0
4	407	Basic	2021-09-18	8:04	71,0041242	-126,077614	Monster	Deployment	392	145	16,9	3,9	2,36	27,82	1001,62	99	0
4	407	Basic	2021-09-18	8:15	71,003738	-126,079361	Monster	Bottom	395	142	15	3,9	2,35	27,82	1001,66	99	0
4	407	Basic	2021-09-18	8:27	71,0037122	-126,082491	Monster	Recovery	394	147	14,5	3,8	2,35	27,83	1001,86	99	0
4	407	Basic	2021-09-18	8:44	71,004375	-126,069112	Moonpool TM	Deployment	390	147	16,6	3,9	2,35	27,75	1001,82	99	0
4	407	Basic	2021-09-18	9:06	71,0043633	-126,071988	Moonpool TM	Bottom	391	143	16,6	3,8	2,39	27,77	1001,95	99	0
4	407	Basic	2021-09-18	9:23	71,0041013	-126,073949	Moonpool TM	Recovery	392	141	13,7	3,7	2,34	27,77	1001,92	99	0
4	407	Basic	2021-09-18	9:43	71,002882	-126,075596	Box Core	Deployment	393	147	13,9	3,7	2,32	27,76	1001,94	99	0
4	407	Basic	2021-09-18	9:52	71,0017858	-126,077707	Box Core	Bottom	394	145	12,9	3,7	2,31	27,77	1001,89	99	0
4	407	Basic	2021-09-18	10:01	71,0007843	-126,080437	Box Core	Recovery	392	150	13,1	3,6	2,34	27,79	1001,96	99	0
4	407	Basic	2021-09-18	10:27	71,0034142	-126,078775	Beam Trawl	Deployment	394	124	5,3	4,3	2,33	27,77	1001,98	99	0
4	407	Basic	2021-09-18	10:48	71,0074825	-126,11206	Beam Trawl	Bottom	388	147	9,9	3,2	2,38	27,97	1001,67	99	0
4	407	Basic	2021-09-18	11:39	70,9817552	-126,180912	Beam Trawl	Recovery	386	150	14,3	3,5	2,65	28,13	1001,75	99	0

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						
4	409	Basic	2021-09-18	17:27	71,8735458	-125,903968	Tucker Net	Deployment	112	131	17,5	3,6	2,34	27,57	1002,40	99	0
4	409	Basic	2021-09-18	17:36	71,8755442	-125,917215	Tucker Net	Bottom	101	134	15,6	2,7	2,35	27,57	1002,16	99	0
4	409	Basic	2021-09-18	17:44	71,8771402	-125,930971	Tucker Net	Recovery	98	132	14,1	2,7	2,35	27,57	1002,20	99	0
4	409	Basic	2021-09-18	18:27	71,8695378	-125,868195	Moonpool TM	Deployment	124	132	17,1	2,8	2,49	27,58	1002,37	99	0
4	409	Basic	2021-09-18	18:36	71,8694782	-125,866617	Moonpool TM	Bottom	120	145	17,3	2,9	2,58	27,61	1002,37	99	0
4	409	Basic	2021-09-18	18:42	71,869289	-125,865379	Moonpool TM	Recovery	117	142	16,4	3	2,63	27,64	1002,31	99	0
4	409	Basic	2021-09-18	19:05	71,8689083	-125,867444	CTD Rosette	Deployment	106	140	16,8	3	2,42	27,58	1002,41	99	0
4	409	Basic	2021-09-18	19:15	71,8686433	-125,865839	CTD Rosette	Bottom	104	158	17,7	3,1	2,53	27,63	1002,42	99	0
4	409	Basic	2021-09-18	19:36	71,8675293	-125,864804	CTD Rosette	Recovery	112	144	14,7	3	2,40	27,58	1002,59	99	0
4	409	Basic	2021-09-18	19:50	71,8667478	-125,866754	Monster	Deployment	123	147	16,2	3,1	2,39	27,58	1002,66	99	0
4	409	Basic	2021-09-18	19:53	71,866559	-125,867279	Monster	Bottom	127	155	15	3,2	2,44	27,58	1002,69	99	0
4	409	Basic	2021-09-18	19:57	71,8662625	-125,865907	Monster	Recovery	116	157	16,2	3,4	2,40	27,59	1002,70	99	0
4	409	Basic	2021-09-18	20:11	71,8666575	-125,863407	Moonpool TM	Deployment	110	158	16	3,3	2,60	27,67	1002,72	99	0
4	409	Basic	2021-09-18	20:17	71,8662117	-125,861729	Moonpool TM	Bottom	125	160	16,2	3,2	2,49	27,69	1002,78	99	0
4	409	Basic	2021-09-18	20:23	71,8659683	-125,860275	Moonpool TM	Recovery	115	154	15,6	3,3	2,42	27,59	1002,82	99	0
4	409	Basic	2021-09-18	20:44	71,8683555	-125,865824	Box Core	Deployment	107	162	16,9	3,2	2,47	27,58	1002,87	99	0
4	409	Basic	2021-09-18	20:47	71,8680288	-125,866674	Box Core	Bottom	108	163	18,1	3,2	2,42	27,58	1002,97	100	0
4	409	Basic	2021-09-18	20:51	71,867769	-125,867045	Box Core	Recovery	116	160	18,5	3,1	2,41	27,58	1002,95	100	0
4	409	Basic	2021-09-18	21:15	71,8727315	-125,863599	Beam Trawl	Deployment	100	149	15	5,8	2,41	27,58	1003,03	93	0
4	409	Basic	2021-09-18	21:21	71,8746993	-125,871133	Beam Trawl	Bottom	83	156	14,1	3,4	2,41	27,58	1002,69	99	0
4	409	Basic	2021-09-18	21:26	71,8759403	-125,880048	Beam Trawl	Recovery	80	153	13,9	3	2,42	27,58	1002,92	99	0
4	409	Basic	2021-09-18	21:28	71,8763078	-125,882591	Beam Trawl	Deployment	94	161	11,8	3	2,42	27,58	1002,97	99	0
4	409	Basic	2021-09-18	21:34	71,8771553	-125,892291	Beam Trawl	Bottom	97	155	15,4	3	2,46	27,60	1002,89	99	0
4	409	Basic	2021-09-18	21:45	71,87921	-125,91234	Beam Trawl	Recovery	82	152	14,5	3	2,53	27,63	1002,87	99	0
4	410	Nutrient	2021-09-18	23:43	71,6987875	-126,487051	CTD Rosette	Deployment	405	162	14,7	1,9	0,06	26,67	1003,10	99	0
4	410	Nutrient	2021-09-18	23:52	71,698652	-126,490228	CTD Rosette	Bottom	409	156	14,9	1,8	0,06	26,69	1003,12	99	0
4	410	Nutrient	2021-09-19	0:28	71,7020542	-126,500975	CTD Rosette	Recovery	407	154	14,1	2,4	0,10	26,72	1003,00	99	0
4	411	CTD	2021-09-19	1:20	71,6296748	-126,710118	CTD Rosette	Deployment	436	134	14,1	2	0,14	26,84	1002,88	99	0
4	411	CTD	2021-09-19	1:28	71,6296112	-126,711679	CTD Rosette	Bottom	436	142	14,1	1,8	0,12	26,57	1002,74	99	0
4	411	CTD	2021-09-19	1:39	71,6292802	-126,713409	CTD Rosette	Recovery	437	141	14,1	1,8	0,22	26,95	1002,80	99	0
4	412	Nutrient	2021-09-19	2:30	71,5646225	-126,918917	CTD Rosette	Deployment	420	125	13,7	2,1	0,24	27,27	1002,58	99	0
4	412	Nutrient	2021-09-19	2:39	71,5646212	-126,919349	CTD Rosette	Bottom	419	130	14,7	2,1	0,04	27,40	1002,51	99	0
4	412	Nutrient	2021-09-19	3:16	71,5636147	-126,925314	CTD Rosette	Recovery	419	135	14,7	2,2	0,12	27,25	1002,52	99	0
4	413	CTD	2021-09-19	4:17	71,4953697	-127,141616	CTD Rosette	Deployment	373	128	18,5	2,1	-0,68	27,60	1002,20	99	0
4	413	CTD	2021-09-19	4:24	71,4940442	-127,144261	CTD Rosette	Bottom	372	128	19,4	1,7	-0,65	27,61	1002,21	99	0
4	413	CTD	2021-09-19	4:32	71,4930142	-127,145504	CTD Rosette	Recovery	371	131	19,8	2	-0,62	27,65	1002,27	99	0
4	414	Basic	2021-09-19	5:30	71,4235965	-127,374262	Tucker Net	Deployment	305	112	10,5	4,9	-0,17	27,60	1001,97	99	0
4	414	Basic	2021-09-19	5:40	71,425001	-127,391398	Tucker Net	Bottom	300	114	12,4	1,3	-0,09	27,60	1001,70	99	0
4	414	Basic	2021-09-19	5:46	71,4246013	-127,401324	Tucker Net	Recovery	298	108	12,8	1	0,05	27,67	1001,68	99	0
4	414	Basic	2021-09-19	6:28	71,4236423	-127,373084	CTD Rosette	Deployment	305	123	14,5	1,2	-0,16	27,75	1001,54	99	0
4	414	Basic	2021-09-19	6:33	71,4236297	-127,373571	CTD Rosette	Bottom	305	117	16	1,2	0,02	27,67	1001,55	99	0
4	414	Basic	2021-09-19	7:20	71,4211312	-127,379163	CTD Rosette	Recovery	303				1,02	27,86			0
4	414	Basic	2021-09-19	7:33	71,4217127	-127,363534	Moonpool TM	Deployment	308	119	16,6	1,2	0,91	27,75	1001,19	99	0
4	414	Basic	2021-09-19	7:41	71,4213377	-127,36331	Moonpool TM	Bottom	307	117	17,1	1,3	1,07	27,82	1001,22	100	0
4	414	Basic	2021-09-19	7:46	71,4211888	-127,362428	Moonpool TM	Recovery	308	121	17,3	1,4	1,17	27,87	1001,18	99	0
4	414	Basic	2021-09-19	7:58	71,4217655	-127,363151	Monster	Deployment	308	119	16,6	1,3	0,56	27,97	1001,18	99	0
4	414	Basic	2021-09-19	8:09	71,4212478	-127,362016	Monster	Bottom	308	115	16	1,2	1,08	27,85	1001,08	100	0
4	414	Basic	2021-09-19	8:17	71,4207522	-127,36171	Monster	Recovery	305	114	16,9	1,1	0,78	27,85	1001,04	100	0
4	414	Basic	2021-09-19	8:31	71,4214832	-127,363436	Moonpool TM	Deployment	308	117	16,9	1,2	0,63	27,91	1000,89	100	0
4	414	Basic	2021-09-19	8:41	71,4211255	-127,36238	Moonpool TM	Bottom	307	115	16,6	1,2	1,02	27,86	1000,82	100	0
4	414	Basic	2021-09-19	8:52	71,4203282	-127,362059	Moonpool TM	Recovery	305	107	16	1,1	1,06	27,84	1000,77	100	0
4	414	Basic	2021-09-19	9:08	71,4211435	-127,365049	Box Core	Deployment	304	114	17,1	1,1	1,44	27,82	1000,59	100	0
4	414	Basic	2021-09-19	9:16	71,421767	-127,366246	Box Core	Bottom	306	115	18,1	1,2	1,03	27,82	1000,45	100	0
4	414	Basic	2021-09-19	9:23	71,422508	-127,367521	Box Core	Recovery	308	117	16,6	1,2	0,94	27,82	1000,53	100	0
4	414	Basic	2021-09-19	9:45	71,4232868	-127,365511	Beam Trawl	Deployment	309	110	15,2	1,6	0,74	27,84	1000,14	99	0
4	414	Basic	2021-09-19	9:59	71,4202055	-127,389767	Beam Trawl	Bottom	299	110	14,5	0,9	0,87	27,76	1000,03	100	0
4	414	Basic	2021-09-19	10:20	71,4129405	-127,422113	Beam Trawl	Recovery	289	120	13,7	1,2	1,00	27,76	1000,03	100	0
4	415	CTD	2021-09-19	11:07	71,3629647	-127,548159	CTD Rosette	Deployment	249	130	14,9	3	2,67	28,09	999,61	99	0
4	415	CTD	2021-09-19	11:12	71,3634615	-127,546789	CTD Rosette	Bottom	246	125	16,6	3,1	2,73	28,05	999,48	99	0
4	415	CTD	2021-09-19	11:20	71,363608	-127,545023	CTD Rosette	Recovery	246	133	15,6	3	2,63	28,11	999,61	99	0
4	416	Nutrient	2021-09-19	12:15	71,2921557	-127,769555	CTD Rosette	Deployment	158	143	13,5	2,9	2,93	27,86	999,02	99	0
4	416	Nutrient	2021-09-19	12:23	71,2921997	-127,772139	CTD Rosette	Bottom	156	139	12,6	2,9	2,95	27,87	998,94	99	0
4	416	Nutrient	2021-09-19	12:49	71,2915277	-127,778336	CTD Rosette	Recovery	156				3,01	27,89			0
4	417	CTD	2021-09-19	13:39	71,2245015	-127,970356	CTD Rosette	Deployment	85	146	13,5	2,9	2,39	27,95	998,53	99	0
4	417	CTD	2021-09-19	13:44	71,2250352	-127,969741	CTD Rosette	Bottom	86	147	12,6	2,8	2,75	27,91	998,50	99	0
4	417	CTD	2021-09-19	13:48	71,2254378	-127,969046	CTD Rosette	Recovery	86	145	12,8	2,8	2,75	27,91	998,43	99	0
4	418	Nutrient	2021-09-19	14:40	71,1631053	-128,167263	CTD Rosette	Deployment	66	155	10,7	3	2,44	27,84	998,25	99	0
4	418	Nutrient	2021-09-19	14:43	71,1638958	-128,167314	CTD Rosette	Bottom	66	153	10,3	3	2,45	28,11	998,26	99	0
4	418	Nutrient	2021-09-19	15:02	71,1668185	-128,165601	CTD Rosette	Recovery	66	151	11,4	3,1	2,66	27,84	998,14	99	0
4	419	CTD	2021-09-19	15:58	71,106456	-128,344677	CTD Rosette	Deployment	57	162	9,1	3	2,11	28,37	997,87	99	0
4	419	CTD	2021-09-19	16:01	71,1071173	-128,345721	CTD Rosette	Bottom	57	171	11,2	3	2,12	28,38	997,83	99	0
4	419	CTD	2021-09-19	16:02	71,1072158	-128,346039	CTD Rosette	Recovery	57	170	10,1	3,1	2,10	28,42	997,91	99	0
4	420	Basic	2021-09-19	17:29	71,0541255	-128,533702	Tucker Net	Deployment	43	158	9,9	3,1	-0,66	31,08	997,85	99	0
4	420	Basic	2021-09-19	17:33	71,0558727	-128,5372	Tucker Net	Bottom	44	164	9,9	2,1	-0,66	31,07	997,63	99	0
4	420	Basic	2021-09-19	17:36	71,0561727	-128,540962	Tucker Net	Recovery	44	175	9,3	2	-0,64	31,08	997,76	100	0
4			2021-09-19	17:38	71,056352	-128,544671		Deployment	43	169	9,1	1,9	-0,63	31,11	997,76	100	0
			2021-09-19	17:40	71,0559103	-128,548665		Recovery	43	179	11,6	1,8	-0,67	31,13	997,80	100	0
4	420	Basic	2021-09-19	18:28	71,0517435	-128,513968	CTD Rosette	Deployment	42	211	10,7	2	-0,65	31,10	998,05	100	0
4	420	Basic	2021-09-19	18:30	71,0521862	-128,514541	CTD Rosette	Bottom	42	216	11,8	2	-0,64	31,05	997,98	100	0
4	420	Basic	2021-09-19	18:39	71,0534212	-128,516335	CTD Rosette	Recovery	41	220	11,2	1,9	-0,62	31,04	997,92	100	0
4	420	Basic	2021-09-19	18:52	71,0545057	-128,520529	Moonpool TM	Deployment	41	236	3,8	2,7	-0,64	31,04	998,20	100	0
4	420	Basic	2021-09-19	18:56	71,0547413	-128,520372	Moonpool TM	Bottom	40	226	7,2	2,2	-0,73	31,07	998,21	100	0
4	420	Basic	2021-09-19	18:59	71,054936	-128,520367	Moonpool TM	Recovery	41	244	7	2,1	-0,74	31,12	998,24	100	0
4	420	Basic	2021-09-19	19:15	71,0521257	-128,514525	Monster	Deployment	41	231	4,4	2	-0,49	31,71	998,37	100	0
4	420	Basic	2021-09-19	19:16	71,0521787	-128,514036	Monster	Bottom	43	235	6,9	2,1	-0,54	31,70	998,41	100	0
4	420	Basic	2021-09-19	19:19	71,0522302	-128,513155	Monster	Recovery	43	235	5	2,2	-0,61	31,44	998,37	100	0

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						
4	420	Basic	2021-09-19	19:34	71,0503005	-128,510689	Box Core	Deployment	43	221	9,5	1,9	-0,32	31,56	998,53	100	0
4	420	Basic	2021-09-19	19:36	71,0503783	-128,509983	Box Core	Bottom	43	257	6,1	2,3	-0,44	31,65	998,53	100	0
4	420	Basic	2021-09-19	19:39	71,0505693	-128,509622	Box Core	Recovery	43	253	5,3	3,7	-0,47	31,75	998,58	100	0
4	420	Basic	2021-09-19	20:01	71,0515192	-128,500086	Beam Trawl	Deployment	43	266	8,8	2,1	-0,61	31,05	998,66	100	0
4	420	Basic	2021-09-19	20:04	71,0521783	-128,494351	Beam Trawl	Bottom	41	272	8,9	2,2	-0,62	31,07	998,51	100	0
4	420	Basic	2021-09-19	20:21	71,059389	-128,509139	Beam Trawl	Recovery	43	261	8,4	2,4	-0,58	31,01	998,59	100	0
4	JET1	Nutrient	2021-09-19	23:27	70,913703	-127,764106	CTD Rosette	Deployment	118				3,02	28,29			0
4	JET1	Nutrient	2021-09-19	23:32	70,9133525	-127,763452	CTD Rosette	Bottom	117	238	12	3,3	2,96	27,91	1000,43	100	0
4	JET1	Nutrient	2021-09-19	23:57	70,9120065	-127,762052	CTD Rosette	Recovery	118	228	10,1	3,1	2,96	27,86	1000,69	100	0
4	JET2	CTD	2021-09-20	0:41	70,9152408	-128,052599	CTD Rosette	Deployment	88	231	12	3,4	2,89	27,95	1000,96	99	0
4	JET2	CTD	2021-09-20	0:46	70,9152705	-128,05154	CTD Rosette	Bottom	88	223	10,9	3,4	2,93	28,14	1001,02	99	0
4	JET2	CTD	2021-09-20	0:49	70,9152383	-128,051528	CTD Rosette	Recovery	88	229	13,1	3,4	2,90	27,97	1001,00	99	0
4	JET3	CTD	2021-09-20	1:33	70,9158305	-128,343105	CTD Rosette	Deployment	50	230	14,9	3	1,09	29,85	1001,15	99	0
4	JET3	CTD	2021-09-20	1:35	70,9160973	-128,343697	CTD Rosette	Bottom	50				1,09	29,80			0
4	JET3	CTD	2021-09-20	1:38	70,9167058	-128,344377	CTD Rosette	Recovery	50	233	15,4	3,1	0,43	30,24	1001,24	99	0
4	JET4	CTD	2021-09-20	2:24	70,9139233	-128,629105	CTD Rosette	Deployment	42	236	9,3	4,2	0,57	30,85	1001,88	99	0
4	JET4	CTD	2021-09-20	2:25	70,9138543	-128,628687	CTD Rosette	Bottom	42	241	10,5	4,2	0,12	31,00	1001,84	99	0
4	JET4	CTD	2021-09-20	2:27	70,9137867	-128,628121	CTD Rosette	Recovery	42	233	9,5	4,2	0,03	31,22	1001,88	99	0
4	JET5	Nutrient	2021-09-20	3:18	70,9141758	-128,921061	CTD Rosette	Deployment	36	244	0,6	2,8	1,10	28,99	1002,27	99	0
4	JET5	Nutrient	2021-09-20	3:21	70,9138815	-128,920188	CTD Rosette	Bottom	35				0,98	28,84			0
4	JET5	Nutrient	2021-09-20	3:26	70,913539	-128,919889	CTD Rosette	Recovery	35	261	2,1	2,4	1,09	28,92	1002,32	99	0
4	JET6	Nutrient	2021-09-20	5:00	71,0519957	-129,461372	CTD Rosette	Deployment	41	216	5,9	2,3	1,27	25,59	1002,49	99	0
4	JET6	Nutrient	2021-09-20	5:04	71,0520458	-129,460409	CTD Rosette	Bottom	41	178	3,8	2,8	1,17	25,19	1002,53	99	0
4	JET6	Nutrient	2021-09-20	5:11	71,0519208	-129,45906	CTD Rosette	Recovery	41	199	0,2	2,5	1,18	25,54	1002,69	99	0
4	JET7	Nutrient	2021-09-20	6:57	71,0531397	-130,400257	CTD Rosette	Deployment	46	178	5,1	3	1,58	26,32	1002,34	99	0
4	JET7	Nutrient	2021-09-20	6:59	71,0530703	-130,399714	CTD Rosette	Bottom	46	157	11,6	2,7	1,08	26,68	1002,36	99	0
4	JET7	Nutrient	2021-09-20	7:08	71,0538048	-130,397094	CTD Rosette	Recovery	46	147	11,4	3,7	0,67	26,83	1002,31	99	0
4			2021-09-20	7:23	71,0536427	-130,403484	Moonpool TM	Deployment	46	124	12,4	2,3	0,91	27,89	1002,15	99	0
4			2021-09-20	7:28	71,0538462	-130,402783	Moonpool TM	Bottom	46	129	12,2	2,3	1,91	25,27	1002,16	99	0
4			2021-09-20	7:30	71,0538722	-130,40271	Moonpool TM	Recovery	46	122	12,4	2,3	1,13	25,04	1002,18	99	0
4	PCB-05	PCB Basic	2021-09-20	9:38	71,2029417	-131,351892	CTD Rosette	Deployment	75	159	19,4	3,4	0,31	26,96	1001,12	98	0
4	PCB-05	PCB Basic	2021-09-20	9:45	71,2033115	-131,350007	CTD Rosette	Bottom	75	160	20,6	3,5	0,03	27,13	1001,07	96	0
4	PCB-05	PCB Basic	2021-09-20	10:01	71,204104	-131,346808	CTD Rosette	Recovery	76	163	18,8	3,5	0,28	26,63	1001,15	97	0
4	PCB-05	PCB Basic	2021-09-20	10:19	71,202889	-131,35277	MultiCorer	Deployment	75	163	21,3	3,7	0,36	26,73	1000,99	94	0
4	PCB-05	PCB Basic	2021-09-20	10:22	71,203192	-131,352053	MultiCorer	Bottom	75	170	18,8	3,8	-0,04	26,82	1001,05	94	0
4	PCB-05	PCB Basic	2021-09-20	10:26	71,2036515	-131,35123	MultiCorer	Recovery	75	174	21,9	3,8	0,89	26,24	1000,96	94	0
4	PCB-04	PCB Full	2021-09-20	13:18	71,4510997	-131,294204	CTD Rosette	Deployment	531	156	19,8	2,2	-0,62	27,40	999,90	99	0
4	PCB-04	PCB Full	2021-09-20	13:29	71,450994	-131,295316	CTD Rosette	Bottom	534	150	19,2	2,2	-0,62	27,34	999,80	99	0
4	PCB-04	PCB Full	2021-09-20	14:14	71,4509127	-131,297804	CTD Rosette	Recovery	535	152	18,5	2	-0,52	27,29	999,34	99	0
4	PCB-04	PCB Full	2021-09-20	14:29	71,450069	-131,298232	Optics	Deployment	534	152	18,1	2	-0,50	27,50	999,18	99	0
4	PCB-04	PCB Full	2021-09-20	15:48	71,451011	-131,293606	CTD Rosette	Deployment	534	160	12,4	9	-0,37	27,37	998,73	81	0
4	PCB-04	PCB Full	2021-09-20	15:52	71,4514525	-131,294634	CTD Rosette	Bottom	535	159	12	8,7	-0,50	27,35	998,62	85	0
4	PCB-04	PCB Full	2021-09-20	16:07	71,4531578	-131,296664	CTD Rosette	Recovery	537	137	8,9	5,4	-0,55	27,48	998,66	96	0
4	PCB-04	PCB Full	2021-09-20	16:20	71,4515165	-131,296523	MultiCorer	Deployment	536				-0,50	27,37			0
4	PCB-04	PCB Full	2021-09-20	16:30	71,4529723	-131,295461	MultiCorer	Bottom	537	124	15,6	7,7	-0,56	27,41	998,59	83	0
4	PCB-04	PCB Full	2021-09-20	16:41	71,4533265	-131,296081	MultiCorer	Recovery	537	188	12,6	7,9	-0,41	27,37	998,46	79	0
4	PCB-04	PCB Full	2021-09-20	18:48	71,4516425	-131,285627	Piston Core	Deployment	530	171	19,2	2,2	-0,56	27,46	998,67	99	0
4	PCB-04	PCB Full	2021-09-20	18:59	71,4519443	-131,285288	Piston Core	Bottom	529	174	17,9	2,2	-0,61	27,45	998,67	99	0
4	PCB-04	PCB Full	2021-09-20	19:09	71,4523233	-131,284273	Piston Core	Recovery	529	179	17,9	2	-0,61	27,50	998,70	99	0
4	PCB-02	PCB Basic	2021-09-21	1:35	71,6219965	-128,105989	CTD Rosette	Deployment	314	223	10,3	2,6	1,15	29,54	1002,01	99	0
4	PCB-02	PCB Basic	2021-09-21	1:36	71,6224013	-128,105956	Optics	Deployment	313	228	9,1	2,7	1,37	29,31	1001,96	99	0
4	PCB-02	PCB Basic	2021-09-21	1:44	71,6233418	-128,107428	CTD Rosette	Bottom	317	246	12,4	2,4	1,02	29,77	1002,03	99	0
4	PCB-02	PCB Basic	2021-09-21	2:14	71,6270975	-128,114168	CTD Rosette	Recovery	318	290	10,3	1,3	1,08	29,49	1002,23	99	0
4	PCB-02	PCB Basic	2021-09-21	3:10	71,6208145	-128,097006	CTD Rosette	Deployment	313	318	9,3	3,2	2,07	28,41	1002,77	99	0
4	PCB-02	PCB Basic	2021-09-21	3:16	71,6212957	-128,097387	CTD Rosette	Recovery	313	306	10,3	3,3	2,10	28,43	1002,85	99	0
4	PCB-02	PCB Basic	2021-09-21	3:33	71,6202182	-128,09883	MultiCorer	Deployment	313	330	11	2,1	2,05	28,43	1002,90	100	0
4	PCB-02	PCB Basic	2021-09-21	3:41	71,6202572	-128,09912	MultiCorer	Bottom	313	330	9,5	3,7	2,11	28,40	1003,06	95	0
4	PCB-02	PCB Basic	2021-09-21	3:50	71,6202783	-128,099679	MultiCorer	Recovery	313				2,14	28,37			0
4	PCB-03	PCB Full	2021-09-21	13:22	72,1118265	-131,04685	CTD Rosette	Deployment	1044	205	8,8	-0,4	-1,25	26,67	1004,30	99	2
4	PCB-03	PCB Full	2021-09-21	13:42	72,1120557	-131,045168	CTD Rosette	Bottom	1041	215	5,7	0	-1,27	26,65	1004,22	99	2
4	PCB-03	PCB Full	2021-09-21	14:48	72,1147243	-131,040151	CTD Rosette	Recovery	1043	190	2,5	0	-1,26	26,66	1004,39	99	1
4	PCB-03	PCB Full	2021-09-21	14:59	72,1146028	-131,045281	Optics	Deployment	1045	155	1	0	-1,27	26,65	1004,48	99	1
4	PCB-03	PCB Full	2021-09-21	16:07	72,1131	-131,046755	CTD Rosette	Deployment	1044	213	5,7	0,1	-1,24	26,68	1004,64	99	1
4	PCB-03	PCB Full	2021-09-21	16:26	72,1143238	-131,047571	CTD Rosette	Bottom	1046	236	3,2	0,1	-1,27	26,66	1004,62	99	1
4	PCB-03	PCB Full	2021-09-21	16:58	72,1157277	-131,042653	CTD Rosette	Recovery	1048	213	9,7	0,4	-1,25	26,67	1004,59	99	1
4	PCB-03	PCB Full	2021-09-21	18:37	72,112854	-131,044148	Moonpool DCM sam	Deployment	1043	218	10,5	0,1	-1,20	26,72	1004,51	99	1
4	PCB-03	PCB Full	2021-09-21	18:48	72,1126665	-131,043816	Moonpool DCM sam	Bottom	1043	214	10,3	-0,1	-1,26	26,75	1004,57	99	1
4	PCB-03	PCB Full	2021-09-21	18:50	72,1125667	-131,043697	Moonpool DCM sam	Recovery	1045				-1,25	26,73			1
4			2021-09-21	18:52	72,1125413	-131,043477		Deployment	1042	213	9,3	-0,2	-1,25	26,72	1004,53	99	1
4			2021-09-21	18:54	72,1125138	-131,043442		Bottom	1043	211	9,7	-0,2	-1,26	26,72	1004,58	99	1
4			2021-09-21	18:56	72,1124693	-131,043403		Recovery	1043	211	10,1	-0,2	-1,24	26,71	1004,57	99	1
4			2021-09-21	18:58	72,1124188	-131,043479		Deployment	1043	208	10,1	-0,1	-1,26	26,73	1004,58	99	1
4			2021-09-21	19:00	72,1123813	-131,043558		Bottom	1044				-1,26	26,74			1
4			2021-09-21	19:01	72,1123785	-131,043572		Recovery	1043	202	9,7	-0,2	-1,26	26,75	1004,60	99	1
4			2021-09-21	19:04	72,1123823	-131,043659		Deployment	1043	200	9,1	-0,2	-1,25	26,73	1004,64	99	1
4			2021-09-21	19:05	72,1123867	-131,043692		Bottom	1043	198	9,1	-0,3	-1,24	26,71	1004,62	99	1
4			2021-09-21	19:07	72,1123663	-131,043741		Recovery	1043	201	9,7	-0,2	-1,25	26,73	1004,64	99	1
4			2021-09-21	19:10	72,1123485	-131,043347		Deployment	1043	206	8,4	-0,2	-1,24	26,74	1004,71	99	1
4			2021-09-21	19:12	72,1122805	-131,043228		Bottom	1042	204	9,3	-0,1	-1,25	26,73	1004,68	99	1
4			2021-09-21	19:13	72,1122333	-131,043203		Recovery	1043	212	9,9	0	-1,25	26,73	1004,70	99	1
4			2021-09-21	19:15	72,1121938	-131,043205		Deployment	1042	204	10,1	0	-1,25	26,73	1004,72	99	1
4			2021-09-21	19:17	72,1121652	-131,043094		Bottom	1042	219	9,9	0,2	-1,25	26,73	1004,71	99	1
4			2021-09-21	19:19	72,1121258	-131,042862		Recovery	1042	216	9,1	0,2	-1,26	26,74	1004,72	99	1
4			2021-09-21	19:20	72,1121105	-131,04259		Deployment	1041	225	10,3	0,2	-1,22	26,74	1004,76	99	1
4			2021-09-21	19:22	72,1121013	-131,042344		Bottom	1042	220	10,5	0,2	-1,23	26,74	1004,75	99	1
4			2021-09-21	19:24	72,1119955	-131,041975		Recovery	1042	218	9,3	0,2	-1,26	26,73	1004,79	99	1

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						
4			2021-09-21	19:27	72,1119565	-131,041707		Deployment	1041	211	8,9	0	-1,26	26,73	1004,79	99	1
4			2021-09-21	19:28	72,1119565	-131,041649		Bottom	1041	214	9,1	0	-1,25	26,73	1004,81	99	1
4			2021-09-21	19:31	72,1118878	-131,041509		Recovery	1041	216	8,9	-0,1	-1,25	26,73	1004,85	99	1
4	PCB-03	PCB Full	2021-09-21	19:57	72,1125422	-131,043124	MultiCorer	Deployment	1043	226	7,4	-0,1	-1,24	26,76	1004,92	99	1
4	PCB-03	PCB Full	2021-09-21	20:16	72,1122522	-131,043076	MultiCorer	Bottom	1044	238	7,2	-0,1	-1,23	26,71	1004,94	99	1
4	PCB-03	PCB Full	2021-09-21	20:36	72,1120772	-131,043847	MultiCorer	Recovery	1044	248	4,8	-0,2	-1,23	26,69	1004,96	99	1
4	PCB-03	PCB Full	2021-09-21	21:39	72,1125173	-131,0437	Piston Core	Deployment	1043	261	5	0	-1,21	26,68	1005,24	99	1
4	PCB-03	PCB Full	2021-09-21	21:52	72,1125205	-131,042309	Piston Core	Bottom	1041	277	5,1	-0,1	-1,16	26,69	1005,08	99	1
4	PCB-03	PCB Full	2021-09-21	22:09	72,1121892	-131,041295	Piston Core	Recovery	1041	267	4,2	-0,1	-1,24	26,76	1005,15	99	1
4	PCB-06	PCB Full	2021-09-22	7:17	70,7618287	-131,429856	CTD Rosette	Deployment	50	335	14,1	0,5	2,45	27,78	1006,75	94	1
4	PCB-06	PCB Full	2021-09-22	7:21	70,761955	-131,428568	CTD Rosette	Bottom	50	343	15	0,6	2,49	27,88	1006,64	95	1
4	PCB-06	PCB Full	2021-09-22	7:34	70,761305	-131,423591	CTD Rosette	Recovery	50	333	12,6	0,6	2,50	28,49	1006,84	95	1
4	PCB-06	PCB Full	2021-09-22	9:04	70,7624698	-131,430497	CTD Rosette	Deployment	50	327	12	0,5	2,81	28,10	1007,08	96	1
4	PCB-06	PCB Full	2021-09-22	9:08	70,762634	-131,428681	CTD Rosette	Bottom	50	309	12	0,5	2,93	27,68	1007,10	96	1
4	PCB-06	PCB Full	2021-09-22	9:17	70,762358	-131,423732	CTD Rosette	Recovery	50	321	13,1	0,5	2,75	28,06	1007,20	95	1
4	PCB-06	PCB Full	2021-09-22	9:57	70,7627545	-131,434115	MultiCorer	Deployment	50	317	13,3	0,7	2,78	27,59	1007,48	96	1
4	PCB-06	PCB Full	2021-09-22	9:58	70,7627378	-131,434064	MultiCorer	Bottom	50	325	14,1	0,8	2,77	27,59	1007,53	97	1
4	PCB-06	PCB Full	2021-09-22	10:03	70,7625592	-131,434551	MultiCorer	Recovery	50	327	14,5	0,7	2,72	27,53	1007,39	96	0
4	PCB-06		2021-09-22	10:08	70,7624775	-131,434541	MultiCorer	Deployment	50	325	12,9	0,7	2,70	27,51	1007,40	96	0
4	PCB-06	PCB Full	2021-09-22	10:12	70,7624858	-131,434046	MultiCorer	Bottom	50				2,80	27,56			0
4	PCB-06	PCB Full	2021-09-22	10:15	70,7624307	-131,433591	MultiCorer	Recovery	50	320	15,8	0,8	2,74	27,53	1007,27	98	0
4	PCB-06	PCB Full	2021-09-22	10:59	70,7627143	-131,434324	Piston Core	Deployment	50	311	12,6	0,8	2,77	27,50	1007,56	97	0
4	PCB-06	PCB Full	2021-09-22	11:01	70,7626522	-131,434292	Piston Core	Bottom	50	302	12,2	0,8	2,77	27,49	1007,63	97	0
4	PCB-06	PCB Full	2021-09-22	11:05	70,7624902	-131,434224	Piston Core	Recovery	50	311	13,7	0,8	2,80	27,49	1007,66	96	0
4	PCB-07	PCB Basic	2021-09-22	14:22	70,534833	-131,495279	CTD Rosette	Deployment	52	328	11,4	1	2,15	29,51	1008,43	95	0
4	PCB-07	PCB Basic	2021-09-22	14:24	70,5349137	-131,495255	CTD Rosette	Bottom	52	345	12	1,1	2,86	29,46	1008,47	98	0
4	PCB-07	PCB Basic	2021-09-22	14:39	70,5351835	-131,492458	CTD Rosette	Recovery	50	325	11,8	0,7	2,27	29,96	1008,61	99	0
4	PCB-07	PCB Basic	2021-09-22	16:35	70,5349173	-131,494706	CTD Rosette	Deployment	52	321	12,8	0,7	2,76	29,47	1009,41	99	0
4	PCB-07	PCB Basic	2021-09-22	16:36	70,534935	-131,494682	Optics	Deployment	52	329	14,7	0,8	2,16	29,44	1009,33	99	0
4	PCB-07	PCB Basic	2021-09-22	16:37	70,5349613	-131,494647	CTD Rosette	Bottom	53	334	14,3	0,8	2,31	29,76	1009,37	99	0
4	PCB-07	PCB Basic	2021-09-22	16:51	70,535398	-131,492478	CTD Rosette	Recovery	50	317	12,9	0,9	2,64	29,31	1009,39	96	0
4	PCB-07	PCB Basic	2021-09-22	17:54	70,5348062	-131,494349	MultiCorer	Deployment	52	328	14,7	1	3,12	28,29	1009,81	87	0
4	PCB-07	PCB Basic	2021-09-22	17:56	70,5348385	-131,494107	MultiCorer	Bottom	52	313	12,9	1	3,13	28,22	1009,90	86	0
4	PCB-07	PCB Basic	2021-09-22	17:59	70,5347773	-131,493941	MultiCorer	Recovery	52	319	14,3	1,1	3,13	28,22	1009,89	86	0
4	PCB-06	PCB Basic	2021-09-22	18:32	70,5347762	-131,494439	Piston Core	Deployment	52	309	13,7	1,2	3,09	28,21	1010,24	84	0
4	PCB-06	PCB Basic	2021-09-22	18:33	70,5347803	-131,494317	Piston Core	Bottom	52	306	10,7	1,2	3,06	28,22	1010,17	85	0
4	PCB-06	PCB Basic	2021-09-22	18:38	70,5347828	-131,494009	Piston Core	Recovery	52	300	12,6	1,3	3,07	28,22	1010,10	88	0
4	434	Basic	2021-09-22	23:29	70,1726145	-133,539992	Tucker Net	Deployment	46	308	11,8	1,1	5,36	18,33	1014,21	83	0
4	434	Basic	2021-09-22	23:32	70,1719193	-133,536491	Tucker Net	Bottom	45	311	12,4	1,2	5,36	18,36	1014,16	85	0
4	434	Basic	2021-09-22	23:34	70,1713747	-133,533949	Tucker Net	Recovery	45	314	12,4	1,1	5,36	18,38	1014,24	86	0
4	434	Basic	2021-09-23	0:09	70,176473	-133,555123	CTD Rosette	Deployment	46	312	15,2	1,6	5,27	20,32	1014,41	80	0
4	434	Basic	2021-09-23	0:14	70,1764948	-133,554669	CTD Rosette	Bottom	46	330	18,7	1,6	4,23	24,44	1014,41	83	0
4	434	Basic	2021-09-23	0:38	70,1772015	-133,555046	CTD Rosette	Recovery	46	334	10,7	1,5	4,85	20,56	1014,60	81	0
4	434	Basic	2021-09-23	1:00	70,1779398	-133,559394	Moonpool TM	Deployment	46	309	12,9	1,8	3,79	22,31	1014,69	77	0
4	434	Basic	2021-09-23	1:05	70,1780377	-133,559593	Moonpool TM	Bottom	46	316	11	1,8	5,12	20,19	1014,80	74	0
4	434	Basic	2021-09-23	1:07	70,1780802	-133,559505	Moonpool TM	Recovery	46	298	14,5	1,8	5,17	19,73	1014,72	79	0
4	434	Basic	2021-09-23	1:23	70,1788047	-133,555722	Monster	Deployment	46	313	9,7	1,5	5,02	21,27	1015,01	80	0
4	434	Basic	2021-09-23	1:26	70,1789823	-133,555655	Monster	Bottom	46	325	7,4	1,4	4,90	20,82	1015,03	81	0
4	434	Basic	2021-09-23	1:28	70,1792123	-133,555583	Monster	Recovery	46	292	11,4	1,5	4,68	20,06	1015,04	81	0
4	434	Basic	2021-09-23	1:43	70,1792488	-133,55429	Box Core	Deployment	46	295	13,5	1,9	5,06	20,69	1015,13	78	0
4	434	Basic	2021-09-23	1:45	70,179218	-133,554272	Box Core	Bottom	46	302	16,9	1,9	5,22	18,86	1014,99	74	0
4	434	Basic	2021-09-23	1:47	70,1791842	-133,554197	Box Core	Recovery	46	301	17,3	1,9	5,26	18,73	1014,92	74	0
4	434	Basic	2021-09-23	2:05	70,1795615	-133,554271	Gravity Core	Deployment	46	315	15,2	1,9	3,49	20,06	1015,26	74	0
4	434	Basic	2021-09-23	2:07	70,1795965	-133,5541	Gravity Core	Bottom	46	306	12	1,9	4,90	20,49	1015,26	74	0
4	434	Basic	2021-09-23	2:10	70,1796085	-133,554097	Gravity Core	Recovery	46	308	16,9	2	4,71	20,52	1015,23	77	0
4	434	Basic	2021-09-23	2:27	70,1779665	-133,559671	Beam Trawl	Deployment	46	299	8,8	1,3	5,33	18,30	1015,45	84	0
4	434	Basic	2021-09-23	2:32	70,1786222	-133,551518	Beam Trawl	Recovery	46	325	10,3	1,3	5,32	18,32	1015,45	83	0
4	434	Basic	2021-09-23	2:32	70,1787548	-133,550966	Beam Trawl	Deployment	46	320	10,3	1,4	5,33	18,31	1015,40	84	0
4	434	Basic	2021-09-23	2:36	70,1805535	-133,546981	Beam Trawl	Bottom	46	311	12,8	1,3	5,33	18,31	1015,39	83	0
4	434	Basic	2021-09-23	2:43	70,1858213	-133,54779	Beam Trawl	Recovery	47	302	13,5	1,4	5,35	18,28	1015,42	81	0
4	433	CTD	2021-09-23	3:37	70,288021	-133,575729	CTD Rosette	Deployment	55	278	11,4	1,4	3,87	22,81	1015,56	93	0
4	433	CTD	2021-09-23	3:38	70,2881408	-133,575691	CTD Rosette	Bottom	55	299	12,2	1,5	4,07	21,96	1015,47	93	0
4	433	CTD	2021-09-23	3:41	70,2883925	-133,575383	CTD Rosette	Recovery	55	287	12,2	1,6	5,03	19,77	1015,49	90	0
4	432	Nutrient	2021-09-23	4:33	70,3943362	-133,607332	CTD Rosette	Deployment	63	309	14,9	1,4	4,20	23,37	1015,73	96	0
4	432	Nutrient	2021-09-23	4:35	70,394041	-133,606593	CTD Rosette	Bottom	63	276	13,7	1,4	4,21	23,48	1015,78	94	0
4	432	Nutrient	2021-09-23	4:51	70,3941615	-133,60303	CTD Rosette	Recovery	62	288	13,3	1,2	3,66	25,88	1015,88	97	0
4	431/PCB-8	PCB Basic	2021-09-23	6:11	70,524856	-133,613482	CTD Rosette	Deployment	69	307	14,5	6,7	3,48	24,69	1015,62	75	0
4	431/PCB-8	PCB Basic	2021-09-23	6:12	70,52487	-133,612429	CTD Rosette	Bottom	68	311	14,5	7,1	3,09	25,35	1015,89	76	0
4	431/PCB-8	PCB Basic	2021-09-23	6:35	70,5248697	-133,594581	CTD Rosette	Recovery	69	293	9,1	5,4	3,47	24,95	1015,95	76	0
4	431/PCB-8	PCB Basic	2021-09-23	7:42	70,5217703	-133,629777	CTD Rosette	Deployment	69	268	9,7	6,5	3,35	25,80	1016,34	68	0
4	431/PCB-8	PCB Basic	2021-09-23	7:45	70,5215863	-133,627331	CTD Rosette	Bottom	68	262	6,1	6,3	3,35	24,95	1016,34	67	0
4	431/PCB-8	PCB Basic	2021-09-23	7:46	70,521499	-133,626696	CTD Rosette	Recovery	68	278	8	6,8	3,35	24,91	1016,38	73	0
4	431/PCB-8	PCB Basic	2021-09-23	8:04	70,522456	-133,627664	MultiCorer	Deployment	69	272	12,8	3	3,36	25,28	1016,46	81	0
4	431/PCB-8	PCB Basic	2021-09-23	8:06	70,5223503	-133,627502	MultiCorer	Bottom	68	282	12,9	2,2	3,36	25,10	1016,47	84	0
4	431/PCB-8	PCB Basic	2021-09-23	8:09	70,522045	-133,627067	MultiCorer	Recovery	68	266	16,8	1,5	3,38	25,18	1016,38	87	0
4	430	Nutrient	2021-09-23	9:06	70,598214	-133,641786	CTD Rosette	Deployment	71	270	12	-0,3	3,11	26,17	1016,66	99	0
4	430	Nutrient	2021-09-23	9:10	70,5982738	-133,640371	CTD Rosette	Bottom	70				3,20	24,89			0
4	430	Nutrient	2021-09-23	9:19	70,598933	-133,63781	CTD Rosette	Recovery	72	296	16,8	-0,5	2,35	25,74	1016,49	99	0
4	430	Basic	2021-09-23	9:38	70,5985378	-133,644932	Moonpool TM	Deployment	70	271	10,5	0,1	3,08	25,63	1016,51	99	0
4	430	Basic	2021-09-23	9:47	70,5984068	-133,64403	Moonpool TM	Bottom	71	256	16,8	0,2	3,08	24,92	1016,34	99	0
4	430	Basic	2021-09-23	9:54	70,5986888	-133,641978	Moonpool TM	Recovery	71	236	11,2	0	3,04	24,82	1016,50	99	0
4	429	CTD	2021-09-23	10:44	70,6961023	-133,672242	CTD Rosette	Deployment	69	266	11,2	0,7	3,06	25,71	1016,38	96	0
4	429	CTD	2021-09-23	10:49	70,695903	-133,670926	CTD Rosette	Bottom	69	264	13,1	0,8	3,07	25,72	1016,30	88	0
4	429	CTD	2021-09-23	10:54	70,6960478	-133,670966	CTD Rosette	Recovery	69	272	11	1,2	2,90	27,06	1016,28	86	0
4	428	Nutrient	2021-09-23	11:54	70,7895818	-133,698717	CTD Rosette	Deployment	75	260	14,5	0,6	3,52	24,26	1016,04	92	0
4	428	Nutrient	2021-09-23	11:55	70,7895807	-133,698791	CTD Rosette	Bottom	74	264	13,7	0,7	3,52	24,25	1016,10	92	0

Leg	Station ID	Station Type	UTC Date	UTC time	Latitude	Longitude	Activity	Event	Depth (m)	Wind Dir	Wind Speed	Air (°C)	Water (°C)	Surface Salinity	Pr Baro	Hum (%)	Ice
4	428	Nutrient	2021-09-23	12:11	70,7891975	-133,701408	CTD Rosette	Recovery	74	284	12	0,8	3,46	23,97	1016,01	94	0
4	427	CTD	2021-09-23	13:06	70,879471	-133,720249	CTD Rosette	Deployment	81	259	10,3	0,1	2,33	25,26	1015,87	99	0
4	427	CTD	2021-09-23	13:08	70,8793433	-133,720434	CTD Rosette	Bottom	80	251	9,9	0,2	2,37	24,97	1015,83	98	0
4	427	CTD	2021-09-23	13:12	70,8793315	-133,720252	CTD Rosette	Recovery	81	250	10,7	0,2	2,45	25,34	1015,80	97	0
4	426	Nutrient	2021-09-23	14:01	70,9764062	-133,744968	CTD Rosette	Deployment	95	238	6,1	0,5	0,17	25,93	1015,66	91	0
4	426	Nutrient	2021-09-23	14:04	70,9765498	-133,744795	CTD Rosette	Bottom	94	239	7,4	0,5	1,18	25,15	1015,68	91	0
4	426	Nutrient	2021-09-23	14:23	70,9759627	-133,748758	CTD Rosette	Recovery	94	308	10,9	-0,1	1,35	25,41	1015,72	99	0
4	435	Basic	2021-09-23	15:10	71,077105	-133,775866	Zodiac	Deployment	303				1,82	24,13			0
4	435	Basic	2021-09-23	15:29	71,0817548	-133,760935	Tucker Net	Deployment	314	230	5,9	0,7	2,37	23,60	1015,50	95	0
4	435	Basic	2021-09-23	15:37	71,0851265	-133,754396	Tucker Net	Bottom	319	230	6,1	0,5	2,39	23,59	1015,40	96	0
4	435	Basic	2021-09-23	15:42	71,0877435	-133,754304	Tucker Net	Recovery	327	245	8,9	0,5	2,39	23,58	1015,44	96	0
4	435	Basic	2021-09-23	15:56	71,0929073	-133,753217	Zodiac	Recovery	338	293	8,9	-0,6	2,37	23,61	1015,43	99	0
4	435	Basic	2021-09-23	16:24	71,0783465	-133,772098	Moonpool TM	Deployment	306	274	8	-0,3	2,21	23,77	1015,37	99	0
4	435	Basic	2021-09-23	16:31	71,0785707	-133,772356	Moonpool TM	Bottom	306	229	4,6	-0,2	2,33	23,59	1015,36	99	0
4	435	Basic	2021-09-23	16:39	71,0787993	-133,771378	Moonpool TM	Recovery	307	225	6,5	-0,1	2,32	23,63	1015,36	99	0
4	435	Basic	2021-09-23	17:40	71,078079	-133,776875	CTD Rosette	Deployment	302	274	6,9	0,5	2,34	23,61	1015,37	99	0
4	435	Basic	2021-09-23	17:47	71,0780407	-133,776222	CTD Rosette	Bottom	302	273	5	0,7	2,34	23,61	1015,33	96	0
4	435	Basic	2021-09-23	18:42	71,0775167	-133,778281	CTD Rosette	Recovery	301	253	4	0	2,05	23,92	1015,14	98	0
4	435	Basic	2021-09-23	18:54	71,0776907	-133,77834	Monster	Deployment	301	254	3,2	0,1	2,10	23,97	1015,18	98	0
4	435	Basic	2021-09-23	19:01	71,0777917	-133,777345	Monster	Bottom	302	278	5,1	0,2	2,09	23,87	1015,18	98	0
4	435	Basic	2021-09-23	19:11	71,0778498	-133,77512	Monster	Recovery	302	320	8,6	-0,1	2,30	23,56	1015,06	99	0
4	435	Basic	2021-09-23	19:25	71,077787	-133,77436	Moonpool TM	Deployment	303	302	2,7	-0,6	1,75	24,59	1015,12	99	0
4	435	Basic	2021-09-23	19:42	71,0784277	-133,773874	Moonpool TM	Bottom	305	305	4,6	-0,8	2,10	23,53	1015,11	99	0
4	435	Basic	2021-09-23	19:58	71,0792342	-133,772283	Moonpool TM	Recovery	308	295	3,8	-0,9	2,02	23,52	1015,07	99	0
4	435	Basic	2021-09-23	20:12	71,078189	-133,776308	Box Core	Deployment	304	302	3	-0,9	1,88	23,69	1015,03	99	0
4	435	Basic	2021-09-23	20:19	71,0782738	-133,776544	Box Core	Bottom	303	285	3,2	-0,8	1,91	23,79	1014,99	99	0
4	435	Basic	2021-09-23	20:26	71,0784943	-133,776726	Box Core	Recovery	304	297	1,7	-0,9	1,54	23,57	1014,95	99	0
4	435	Basic	2021-09-23	20:47	71,0825988	-133,771833	Beam Trawl	Deployment	316	36	2,1	-0,7	1,99	23,50	1014,91	99	0
4	435	Basic	2021-09-23	21:04	71,0827468	-133,778823	Beam Trawl	Bottom	314	111	3,4	-0,6	1,98	23,50	1014,85	99	0
4	435	Basic	2021-09-23	21:30	71,080791	-133,792066	Beam Trawl	Recovery	308	157	0,2	-0,6	1,97	23,51	1014,78	99	0
4	424	Nutrient	2021-09-23	23:15	71,1754957	-133,82445	CTD Rosette	Deployment	584	204	4,4	-1,1	2,09	23,67	1014,29	99	0
4	424	Nutrient	2021-09-23	23:27	71,176253	-133,824189	CTD Rosette	Bottom	586	273	4,2	-1,2	2,35	23,46	1014,20	99	0
4	424	Nutrient	2021-09-24	0:01	71,1783048	-133,821156	CTD Rosette	Recovery	591	254	3,6	-1	2,34	23,50	1013,96	99	0
4	423	CTD	2021-09-24	1:11	71,2708245	-133,853537	CTD Rosette	Deployment	798	295	2,1	-0,6	1,90	23,43	1013,47	99	0
4	423	CTD	2021-09-24	1:28	71,271493	-133,853142	CTD Rosette	Bottom	800	269	4,2	-0,8	1,87	23,54	1013,39	99	0
4	423	CTD	2021-09-24	1:44	71,2722403	-133,853666	CTD Rosette	Recovery	802	249	4,6	-0,7	1,89	23,43	1013,30	99	0
4	422	Nutrient	2021-09-24	2:39	71,3802723	-133,892608	CTD Rosette	Deployment	1103	221	5,1	-0,9	1,31	24,19	1013,03	99	0
4	422	Nutrient	2021-09-24	3:00	71,3808393	-133,893223	CTD Rosette	Bottom	1103	237	6,1	-0,7	1,36	23,94	1012,74	99	0
4	422	Nutrient	2021-09-24	4:01	71,3819578	-133,897013	CTD Rosette	Recovery	1107	219	7,2	-0,8	0,98	24,61	1012,40	98	0
4	421	Basic	2021-09-24	4:39	71,4680262	-133,898267	Tucker Net	Deployment	1133	237	3,4	-0,2	1,06	24,12	1012,27	96	0
4	421	Basic	2021-09-24	4:52	71,4703753	-133,908029	Tucker Net	Recovery	1163	216	8,2	-0,8	1,03	24,26	1012,07	99	0
4	421	Basic	2021-09-24	5:48	71,4696605	-133,909303	CTD Rosette	Deployment	1159	243	4,2	0,9	0,03	24,58	1011,84	92	0
4	421	Basic	2021-09-24	6:10	71,4707883	-133,915389	CTD Rosette	Bottom	1181	199	4,8	-0,7	-0,27	26,86	1011,69	94	0
4	421	Basic	2021-09-24	7:13	71,4735273	-133,927864	CTD Rosette	Recovery	1183	251	4,6	-0,4	-0,05	25,32	1011,29	91	0
4	421	Basic	2021-09-24	7:34	71,4682807	-133,903273	Moonpool TM	Deployment	1149	207	5	-0,6	-0,32	26,33	1011,29	94	0
4	421	Basic	2021-09-24	7:41	71,4692433	-133,905173	Moonpool TM	Bottom	1154	242	3,6	-0,6	-0,20	25,22	1011,19	95	0
4	421	Basic	2021-09-24	7:46	71,4699923	-133,906712	Moonpool TM	Recovery	1166	254	2,7	-0,5	-0,24	24,95	1011,20	94	0
4	421	Basic	2021-09-24	7:57	71,4705058	-133,906584	Monster	Deployment	1161	216	3	-0,6	-0,29	25,28	1011,14	92	0
4	421	Basic	2021-09-24	8:25	71,4722252	-133,913222	Monster	Bottom	1173	222	2,9	-0,6	-0,05	25,71	1010,99	91	0
4	421	Basic	2021-09-24	9:00	71,4750222	-133,925279	Monster	Recovery	1179	35	1	-0,4	-0,23	25,09	1010,74	85	0
4	421	Basic	2021-09-24	9:17	71,4705512	-133,90995	Moonpool TM	Deployment	1166	32	0,8	-0,5	-0,22	25,35	1010,65	88	0
4	421	Basic	2021-09-24	9:32	71,471976	-133,912861	Moonpool TM	Bottom	1171	124	2,7	-0,5	-0,19	25,07	1010,50	91	0
4	421	Basic	2021-09-24	9:45	71,4728017	-133,915596	Moonpool TM	Recovery	1178	114	2,9	-0,7	-0,15	25,29	1010,48	92	0
4	421	Basic	2021-09-24	10:15	71,4713868	-133,893533	IKMT	Deployment	1139	21	1,1	-0,5	-0,09	24,59	1010,26	90	0
4	421	Basic	2021-09-24	10:36	71,4699543	-133,929375	IKMT	Bottom	1198	187	5,1	-0,8	-0,13	24,46	1009,99	94	0
4	421	Basic	2021-09-24	11:22	71,4546185	-133,89805	IKMT	Recovery	1162	359	1,5	-0,8	0,04	24,33	1009,65	92	0
4	421	Basic	2021-09-24	11:49	71,4688133	-133,907164	Box Core	Deployment	1151	46	4,2	-1	-0,16	25,15	1009,58	91	0
4	421	Basic	2021-09-24	12:10	71,4700498	-133,909058	Box Core	Bottom	1161	69	4	-0,9	0,01	24,49	1009,49	87	0
4	421	Basic	2021-09-24	12:33	71,4717383	-133,912462	Box Core	Recovery	1172	49	5,3	-1	-0,04	24,99	1009,51	87	0
4	546	Nutrient	2021-09-24	14:40	71,74243	-133,947437	CTD Rosette	Deployment	1612	93	7,8	-1,7	2,78	20,98	1008,96	94	1
4	546	Nutrient	2021-09-24	15:10	71,7426778	-133,947003	CTD Rosette	Bottom	1611				1,92	22,04			1
4	546	Nutrient	2021-09-24	16:12	71,743209	-133,946683	CTD Rosette	Recovery	1615	58	11,4	-1,9	2,26	21,27	1008,41	96	1
4	546	Nutrient	2021-09-24	17:24	71,7417292	-133,94894	CTD Rosette	Deployment	1610	66	12,4	-1,7	1,39	22,27	1008,22	99	1
4	546	Nutrient	2021-09-24	17:58	71,7401828	-133,950391	CTD Rosette	Bottom	1606	69	12,4	-1,7	1,33	21,89	1008,13	99	1
4	546	Nutrient	2021-09-24	18:28	71,7393088	-133,951874	CTD Rosette	Recovery	1608	70	14,1	-1,6	1,91	22,24	1008,16	98	1
4	PCB-09	PCB Full	2021-09-24	23:48	71,1022105	-135,142989	Piston Core	Deployment	674	17	18,3	-2,2	1,40	23,05	1007,14	99	0
4	PCB-09	PCB Full	2021-09-25	0:00	71,1015363	-135,144892	Piston Core	Bottom	676	30	20	-2,2	1,55	24,53	1007,38	99	0
4	PCB-09	PCB Full	2021-09-25	0:22	71,1022667	-135,149405	Piston Core	Recovery	678	35	19,8	-2,4	1,76	23,57	1007,41	99	0
4	PCB-09	PCB Full	2021-09-25	1:02	71,1024253	-135,144491	MultiCorer	Deployment	674	33	16,6	-2,8	1,35	23,54	1007,43	99	0
4	PCB-09	PCB Full	2021-09-25	1:18	71,1019775	-135,143753	MultiCorer	Bottom	675	42	16,8	-2,7	1,54	22,93	1007,40	99	0
4	PCB-09	PCB Full	2021-09-25	1:32	71,1017803	-135,14352	MultiCorer	Recovery	675	25	15	-2,9	1,53	22,91	1007,28	99	0
4	PCB-21	PCB Full	2021-09-25	12:09	70,3402392	-140,02577	Piston Core	Deployment	442	14	8,2	-2,6	2,25	21,88	1009,99	95	0
4	PCB-21	PCB Full	2021-09-25	12:20	70,3409435	-140,023139	Piston Core	Bottom	443	6	8,2	-2,6	1,86	23,46	1009,86	95	0
4	PCB-21	PCB Full	2021-09-25	12:32	70,341647	-140,021901	Piston Core	Recovery	443	9	8,8	-2,4	2,00	22,35	1009,84	96	0
4	PCB-21	PCB Full	2021-09-25	14:08	70,354771	-139,983158	CTD Rosette	Deployment	458	20	10,3	-2,5	2,04	21,70	1010,07	99	0
4	PCB-21	PCB Full	2021-09-25	14:18	70,3549087	-139,981768	CTD Rosette	Bottom	460	6	10,1	-2,5	1,85	22,29	1010,07	99	0
4	PCB-21	PCB Full	2021-09-25	15:02	70,353599	-139,979002	CTD Rosette	Recovery	458	20	8,9	-2,4	1,86	21,95	1010,14	96	0
4	PCB-21	PCB Full	2021-09-25	16:11	70,3541468	-139,984645	Optics	Deployment	459	21	11,2	-2	1,98	22,13	1010,13	97	0
4	PCB-21	PCB Full	2021-09-25	16:20	70,3539282	-139,984477	CTD Rosette	Deployment	458	30	10,7	-2,1	2,07	21,82	1010,14	98	0
4	PCB-21	PCB Full	2021-09-25	16:25	70,3539333	-139,984497	CTD Rosette	Bottom	458	34	12,9	-2	2,00	21,78	1010,08	96	0
4	PCB-21	PCB Full	2021-09-25	16:44	70,3536043	-139,984043	CTD Rosette	Recovery	457	28	12	-1,9	2,07	21,79	1010,08	97	0
4	PCB-21	PCB Full	2021-09-25	17:34	70,3395278	-140,021321	MultiCorer	Deployment	441	10	11	-2,1	2,26	21,62	1010,31	97	0
4	PCB-21	PCB Full	2021-09-25	17:44	70,339833	-140,019256	MultiCorer	Bottom	441	359	11,2	-2,2	2,25	23,62	1010,19	98	0
4	PCB-21	PCB Full	2021-09-25	17:55	70,3395272	-140,019015	MultiCorer	Recovery	441	355	10,3	-2,2	2,25	22,55	1010,27	97	0
4	PCB-22	PCB Full	2021-09-25	21:38	70,1227675	-140,245773	CTD Rosette	Deployment	48	355	7,2	-2,2	1,15	23,91	1010,51	96	0
4	PCB-22	PCB Full	2021-09-25	21:41	70,1227177	-140,245563	CTD Rosette	Bottom	49	11	7,8	-2,3	1,06	23,79	1010,58	96	0

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						
4	PCB-22	PCB Full	2021-09-25	21:56	70,1223755	-140,247738	CTD Rosette	Recovery	48	334	6,7	-2,3	1,10	23,78	1010,49	94	0
4	PCB-22	PCB Full	2021-09-25	23:16	70,1213625	-140,244877	CTD Rosette	Deployment	48	330	4,6	-2,4	1,39	23,79	1010,75	95	0
4	PCB-22	PCB Full	2021-09-25	23:22	70,1213985	-140,245385	CTD Rosette	Bottom	48	295	5,5	-2,5	1,27	23,78	1010,82	96	0
4	PCB-22	PCB Full	2021-09-25	23:33	70,1209882	-140,248602	CTD Rosette	Recovery	49	356	5	-2,4	1,49	23,82	1010,75	96	0
4	PCB-22	PCB Full	2021-09-26	0:14	70,1219682	-140,243675	Piston Core	Deployment	49	337	5,1	-2,5	1,35	23,80	1010,82	96	0
4	PCB-22	PCB Full	2021-09-26	0:17	70,1219793	-140,243284	Piston Core	Bottom	48	320	5,1	-2,4	1,34	23,79	1010,76	95	0
4	PCB-22	PCB Full	2021-09-26	0:18	70,1219567	-140,243356	Piston Core	Recovery	48	307	4,4	-2,4	1,48	23,77	1010,74	95	0
4	PCB-22	PCB Full	2021-09-26	1:01	70,1223307	-140,240038	MultiCorer	Deployment	48	329	5,9	-2,3	1,53	23,84	1010,79	95	0
4	PCB-22	PCB Full	2021-09-26	1:04	70,1222752	-140,23983	MultiCorer	Bottom	48	325	5,1	-2,3	1,63	23,68	1010,84	95	0
4	PCB-22	PCB Full	2021-09-26	1:07	70,1221472	-140,239555	MultiCorer	Recovery	49	337	5,7	-2,3	1,78	23,76	1010,76	96	0
4	PCB-22	PCB Full	2021-09-26	1:12	70,1220015	-140,239073	MultiCorer	Deployment	49	332	5,9	-2,2	1,83	23,72	1010,82	96	0
4	PCB-22	PCB Full	2021-09-26	1:14	70,1219068	-140,239082	MultiCorer	Bottom	49	341	4,2	-2,1	1,92	23,65	1010,81	96	0
4	PCB-22	PCB Full	2021-09-26	1:17	70,1218292	-140,238859	MultiCorer	Recovery	48	320	5,5	-2,2	1,82	23,79	1010,75	96	0
4	PCB-23	PCB Basic	2021-09-26	4:22	69,8103258	-140,548515	CTD Rosette	Deployment	33	333	7,8	-1,5	3,32	23,91	1010,11	92	0
4	PCB-23	PCB Basic	2021-09-26	4:23	69,810352	-140,548604	CTD Rosette	Bottom	33	336	7,4	-1,4	3,14	23,84	1010,22	92	0
4	PCB-23	PCB Basic	2021-09-26	4:42	69,8100603	-140,549772	CTD Rosette	Recovery	33	338	6,7	-1,5	3,11	23,46	1010,25	91	0
4	PCB-23	PCB Basic	2021-09-26	5:06	69,8100188	-140,551399	MultiCorer	Deployment	33	329	6,9	-1,5	3,17	23,95	1010,18	91	0
4	PCB-23	PCB Basic	2021-09-26	5:08	69,8099758	-140,551535	MultiCorer	Bottom	33	302	6,9	-1,6	3,15	23,69	1010,09	91	0
4	PCB-23	PCB Basic	2021-09-26	5:11	69,8099915	-140,551668	MultiCorer	Recovery	33	315	5,5	-1,5	3,13	23,80	1010,24	91	0
4	2121	GSC coring	2021-09-26	11:29	69,7686622	-139,646387	Piston Core	Deployment	36	277	11	-1,1	2,32	22,96	1008,92	87	0
4	2121	GSC coring	2021-09-26	11:31	69,7686728	-139,646361	Piston Core	Bottom	36	278	11,4	-1,1	2,32	22,96	1008,95	87	0
4	2121	GSC coring	2021-09-26	11:34	69,7687197	-139,6464	Piston Core	Recovery	38	286	11,2	-1,1	2,33	22,97	1008,99	87	0
4	PCB-20	PCB Basic	2021-09-26	17:22	70,5499128	-139,820381	CTD Rosette	Deployment	783	312	12,9	-2	0,09	24,21	1007,80	98	0
4	PCB-20	PCB Basic	2021-09-26	17:37	70,5495425	-139,820353	CTD Rosette	Bottom	781	316	12,8	-2	-0,01	24,09	1007,71	98	0
4	PCB-20	PCB Basic	2021-09-26	18:27	70,548028	-139,819288	CTD Rosette	Recovery	779	309	13,9	-2	0,14	23,93	1007,70	99	0
4	PCB-20	PCB Basic	2021-09-26	19:45	70,5491977	-139,81988	CTD Rosette	Deployment	781	290	12,8	-1,9	0,22	23,96	1007,64	99	0
4	PCB-20	PCB Basic	2021-09-26	19:47	70,54906	-139,819886	CTD Rosette	Bottom	781	299	13,3	-1,8	0,02	24,52	1007,61	99	0
4	PCB-20	PCB Basic	2021-09-26	19:58	70,5486123	-139,820421	CTD Rosette	Recovery	780	292	12,8	-1,8	0,20	24,10	1007,52	99	0
4	PCB-20	PCB Basic	2021-09-26	20:24	70,5500203	-139,819531	MultiCorer	Deployment	783				-0,08	25,94			0
4	PCB-20	PCB Basic	2021-09-26	20:38	70,5498637	-139,818703	MultiCorer	Bottom	782	297	10,9	-1,8	0,19	24,25	1007,54	95	0
4	PCB-20	PCB Basic	2021-09-26	20:56	70,5498132	-139,816968	MultiCorer	Recovery	782				0,20	24,17			0
4	482	Basic	2021-09-26	23:25	70,5207852	-139,370806	Tucker Net	Deployment	825	300	15,6	-2	1,06	21,42	1007,09	99	0
4	482	Basic	2021-09-26	23:35	70,522889	-139,354964	Tucker Net	Bottom	837	285	13,3	-2	1,29	21,27	1007,15	98	0
4	482	Basic	2021-09-26	23:41	70,5259313	-139,348732	Tucker Net	Recovery	839	290	14,9	-2	1,32	21,27	1007,23	98	0
4	482	Basic	2021-09-27	0:05	70,5242565	-139,378717	Moonpool TM	Deployment	828	303	14,9	-1,7	0,95	21,53	1007,34	98	0
4	482	Basic	2021-09-27	0:31	70,5243117	-139,379976	CTD Rosette	Deployment	825	298	15,4	-2	0,81	21,70	1007,24	97	
4	482	Basic	2021-09-27	0:48	70,5243027	-139,380732	CTD Rosette	Bottom	824	289	16,9	-1,9	0,71	22,93	1007,27	99	
4	482	Basic	2021-09-27	1:43	70,524759	-139,377089	CTD Rosette	Recovery	826	291	14,1	-1,9	0,91	21,79	1007,31	99	
4	482	Basic	2021-09-27	1:58	70,5246475	-139,375858	Monster	Deployment	826	294	14,3	-2	1,02	21,70	1007,20	99	
4	482	Basic	2021-09-27	2:19	70,5243328	-139,375253	Monster	Bottom	825	300	15,4	-1,8	1,09	21,86	1007,07	99	
4	482	Basic	2021-09-27	2:43	70,524019	-139,374911	Monster	Recovery	827				1,01	21,93			
4	482	Basic	2021-09-27	2:59	70,5245488	-139,380667	Moonpool TM	Deployment	824	299	14,5	-2	0,85	22,42	1007,22	99	
4	482	Basic	2021-09-27	3:12	70,5246068	-139,380477	Moonpool TM	Bottom	825	311	13,1	-2	0,92	21,65	1007,17	99	
4	482	Basic	2021-09-27	3:25	70,524614	-139,380354	Moonpool TM	Recovery	825	311	14,5	-2,1	0,94	21,74	1007,12	99	
4	482	Basic	2021-09-27	4:04	70,5236212	-139,335991	IKMT	Bottom	841	285	14,7	-2,5	1,24	21,30	1006,85	99	
4	482	Basic	2021-09-27	4:54	70,5579537	-139,318201	IKMT	Recovery	1283	299	16,8	-2,1	0,95	21,47	1006,79	99	
4	482	Basic	2021-09-27	5:57	70,5244033	-139,379849	Box Core	Deployment	825	297	16,9	-2	0,91	21,70	1006,45	99	
4	482	Basic	2021-09-27	6:13	70,5243798	-139,37984	Box Core	Bottom	826	292	15,2	-2,2	0,88	21,59	1006,57	99	
4	482	Basic	2021-09-27	6:28	70,5244325	-139,379256	Box Core	Recovery	825	292	16	-2,3	0,74	21,57	1006,47	99	
4	PCB-16	PCB Full	2021-09-27	9:13	70,5035005	-138,831075	CTD Rosette	Deployment	795	290	15,6	-2,3	0,60	22,07	1006,02	99	
4	PCB-16	PCB Full	2021-09-27	9:28	70,5022893	-138,833668	CTD Rosette	Bottom	797	283	12	-2,2	0,82	22,28	1006,02	99	
4	PCB-16	PCB Full	2021-09-27	10:09	70,4988132	-138,838381	CTD Rosette	Recovery	790	293	12,9	-2,3	1,57	21,32	1005,82	99	
4	PCB-16	PCB Full	2021-09-27	11:19	70,504644	-138,832031	CTD Rosette	Deployment	800	291	15,2	-1,9	1,29	21,82	1005,51	99	
4	PCB-16	PCB Full	2021-09-27	11:21	70,5043273	-138,832908	CTD Rosette	Bottom	800	282	15,8	-2	1,43	21,51	1005,54	99	
4	PCB-16	PCB Full	2021-09-27	11:29	70,5035832	-138,833767	CTD Rosette	Recovery	799	288	15,6	-2	0,99	21,68	1005,45	98	
4	PCB-16	PCB Full	2021-09-27	12:10	70,4992162	-138,797162	Piston Core	Deployment	777	274	13,7	-2	1,35	21,35	1005,41	97	
4	PCB-16	PCB Full	2021-09-27	12:24	70,4992597	-138,797534	Piston Core	Bottom	776	269	12,9	-1,9	1,44	21,14	1005,43	97	
4	PCB-16	PCB Full	2021-09-27	12:41	70,4991102	-138,79776	Piston Core	Recovery	775	268	13,5	-1,8	1,29	21,94	1005,28	98	
4	PCB-16	PCB Full	2021-09-27	13:56	70,4993763	-138,797801	Gravity Core	Deployment	777	284	11	-2	1,34	21,19	1005,12	99	
4	PCB-16	PCB Full	2021-09-27	14:12	70,4991133	-138,797609	Gravity Core	Bottom	776	283	11,8	-2	1,34	21,19	1005,10	99	
4	PCB-16	PCB Full	2021-09-27	14:26	70,4991528	-138,797646	Gravity Core	Recovery	777	279	13,3	-2,1	1,30	21,20	1004,89	97	
4	PCB-16	PCB Full	2021-09-27	14:56	70,4992825	-138,798807	MultiCorer	Deployment	775	272	12,6	-2,1	1,26	21,29	1004,88	99	
4	PCB-16	PCB Full	2021-09-27	15:11	70,499138	-138,797843	MultiCorer	Bottom	777	272	10,9	-2,1	1,24	21,22	1004,76	99	
4	480	Nutrient	2021-09-27	17:15	70,3344708	-139,150148	CTD Rosette	Deployment	560	300	13,5	-1,6	0,97	21,73	1004,94	98	
4	480	Nutrient	2021-09-27	17:27	70,3332647	-139,152669	CTD Rosette	Bottom	558	292	11,6	-1,7	0,93	21,53	1004,85	99	
4	480	Nutrient	2021-09-27	18:27	70,3282028	-139,16691	CTD Rosette	Recovery	551	286	11	-1,3	1,05	21,53	1004,66	99	
4	476/PCB-18	Full	2021-09-27	21:07	69,9841968	-138,665016	Zodiac	Deployment	267	269	9,1	-1,1	2,50	24,23	1004,92	91	
4	476/PCB-18	Full	2021-09-27	21:16	69,9832032	-138,656119	Tucker Net	Deployment	267				3,14	19,73			
4	476/PCB-18	Full	2021-09-27	21:27	69,9841128	-138,637427	Tucker Net	Bottom	267				3,14	19,81			
4	476/PCB-18	Full	2021-09-27	21:37	69,9865742	-138,621482	Tucker Net	Recovery	268	278	9,3	-1,2	3,17	19,90	1004,86	92	
4	476/PCB-18	Full	2021-09-27	21:48	69,9859998	-138,604705	Zodiac	Recovery	267				3,18	19,90			
4	476/PCB-18	Full	2021-09-27	23:25	69,983302	-138,667915	Piston Core	Deployment	268	249	7,4	-1,6	3,13	21,06	1004,96	99	
4	476/PCB-18	Full	2021-09-27	23:30	69,9834007	-138,667792	Piston Core	Bottom	268	236	8,4	-1,7	3,30	19,72	1004,94	99	
4	476/PCB-18	Full	2021-09-27	23:40	69,9833682	-138,667345	Piston Core	Recovery	268	245	7,6	-1,4	3,16	20,76	1004,97	96	
4	476/PCB-18	Full	2021-09-28	1:10	69,9984437	-138,628929	CTD Rosette	Deployment	272	240	4,6	-1,5	3,12	20,50	1005,02	95	
4	476/PCB-18	Full	2021-09-28	1:16	69,9985183	-138,62919	CTD Rosette	Bottom	272				3,21	20,48			
4	476/PCB-18	Full	2021-09-28	1:57	69,9984652	-138,628093	CTD Rosette	Recovery	271	240	8,6	-1,8	3,15	20,64	1004,97	99	
4	476/PCB-18	Full	2021-09-28	2:17	69,9984767	-138,628219	Moonpool TM	Deployment	272	267	8	-1,8	3,10	20,81	1004,80	99	
4	476/PCB-18	Full	2021-09-28	2:22	69,9985063	-138,628032	Moonpool TM	Bottom	271	261	8,2	-1,7	3,25	20,56	1004,80	99	
4	476/PCB-18	Full	2021-09-28	2:27	69,9984842	-138,627911	Moonpool TM	Recovery	272				3,38	20,06			
4	476/PCB-18	Full	2021-09-28	2:51	69,998386	-138,62824	CTD Rosette	Deployment	271	252	4	-1,5	3,19	21,23	1004,92	95	
4	476/PCB-18	Full	2021-09-28	2:56	69,9984252	-138,628261	CTD Rosette	Bottom	271	239	5,5	-1,3	3,21	20,12	1004,94	96	
4	476/PCB-18	Full	2021-09-28	2:59	69,9984675	-138,628207	CTD Rosette	Recovery	272				3,19	21,14			
4	476/PCB-18	Full	2021-09-28	3:19	69,9985528	-138,628615	Monster	Deployment	272	327	8	-1,4	2,95	21,00	1004,99	93	
4	476/PCB-18	Full	2021-09-28	3:26	69,9985468	-138,628565	Monster	Bottom	272	279	2,5	-1,4	3,25	20,74	1004,95	94	
4	476/PCB-18	Full	2021-09-28	3:35	69,9986578	-138,62841	Monster	Recovery	272	218	4	-1,6	3,08	21,20	1005,02	94	

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						
4	476/PCB-18	Full	2021-09-28	3:48	69,9985498	-138,628337	Moonpool TM	Deployment	271	251	5,7	-1,7	2,94	21,06	1004,86	97	
4	476/PCB-18	Full	2021-09-28	3:59	69,9985208	-138,62757	Moonpool TM	Bottom	272	304	6,5	-1,6	3,42	20,28	1004,80	99	
4	476/PCB-18	Full	2021-09-28	4:10	69,9984072	-138,627381	Moonpool TM	Recovery	272				3,33	20,14			
4	476/PCB-18	Full	2021-09-28	5:05	69,9987145	-138,628927	CTD Rosette	Deployment	272	309	6,3	-1,5	3,28	20,23	1004,67	93	
4	476/PCB-18	Full	2021-09-28	5:13	69,998363	-138,628571	CTD Rosette	Bottom	271	315	5,9	-1,5	3,42	19,52	1004,62	92	
4	476/PCB-18	Full	2021-09-28	5:51	69,9978377	-138,622368	CTD Rosette	Recovery	272	271	4	-1,6	3,50	19,97	1004,71	91	
4	476/PCB-18	Full	2021-09-28	6:13	69,9836248	-138,663559	MultiCorer	Deployment	266	314	4,4	-1,3	3,14	19,53	1004,85	91	
4	476/PCB-18	Full	2021-09-28	6:20	69,9834915	-138,663493	MultiCorer	Bottom	266	306	4,8	-1,3	2,82	21,31	1004,91	91	
4	476/PCB-18	Full	2021-09-28	6:28	69,9834267	-138,663409	MultiCorer	Recovery	267	312	5,1	-1,4	2,82	21,33	1004,90	92	
4	476/PCB-18	Full	2021-09-28	6:49	69,9835808	-138,664236	Box Core	Deployment	267	296	2,5	-1,3	3,35	19,53	1004,94	91	
4	476/PCB-18	Full	2021-09-28	6:56	69,9835402	-138,664567	Box Core	Bottom	267	231	1,7	-1,6	3,37	19,55	1004,98	99	
4	476/PCB-18	Full	2021-09-28	7:02	69,9834033	-138,663874	Box Core	Recovery	267	315	7,4	-1,5	3,33	19,98	1004,91	95	
4	476/PCB-18	Full	2021-09-28	7:23	69,9830043	-138,651425	Beam Trawl	Deployment	267	330	3,6	-1,9	3,33	19,55	1004,98	93	
4	476/PCB-18	Full	2021-09-28	7:35	69,9866923	-138,637434	Beam Trawl	Bottom	268	341	8,4	-1,5	3,35	19,53	1004,90	93	
4	476/PCB-18	Full	2021-09-28	7:59	69,9848632	-138,658765	Beam Trawl	Recovery	268	333	1,1	-1,7	3,38	19,57	1005,06	91	
4	478/PCB-19	PCB Basic	2021-09-28	10:22	70,166343	-138,901381	CTD Rosette	Deployment	375	218	3,4	-2,3	3,03	20,60	1005,15	93	
4	478/PCB-19	PCB Basic	2021-09-28	10:30	70,1650325	-138,899741	CTD Rosette	Bottom	375				3,08	21,13			
4	478/PCB-19	PCB Basic	2021-09-28	11:08	70,1606397	-138,888769	CTD Rosette	Recovery	374	137	0	-2,4	3,15	19,78	1005,14	90	
4	478/PCB-19	PCB Basic	2021-09-28	12:27	70,1637897	-138,907825	CTD Rosette	Deployment	372	46	0	-1,8	3,15	21,86	1005,14	92	
4	478/PCB-19	PCB Basic	2021-09-28	12:29	70,1635128	-138,90836	CTD Rosette	Bottom	373	51	0	-1,7	3,16	22,18	1005,14	93	
4	478/PCB-19	PCB Basic	2021-09-28	12:31	70,1631395	-138,908913	CTD Rosette	Recovery	373	261	0,2	-1,9	3,16	22,31	1005,10	93	
4	478/PCB-19	PCB Basic	2021-09-28	13:20	70,1660455	-138,907072	MultiCorer	Deployment	374	295	0,8	-2,3	3,12	20,43	1005,06	92	
4	478/PCB-19	PCB Basic	2021-09-28	13:29	70,1660168	-138,906995	MultiCorer	Bottom	374	351	2,5	-2,2	3,07	19,87	1005,15	95	
4	478/PCB-19	PCB Basic	2021-09-28	13:38	70,1660148	-138,907315	MultiCorer	Recovery	373	5	2,7	-2,2	3,14	19,92	1005,21	98	
4	474	Nutrient	2021-09-28	17:30	69,7985268	-138,433038	CTD Rosette	Deployment	173	357	6,9	-0,8	1,50	21,87	1004,38	90	
4	474	Nutrient	2021-09-28	17:35	69,7983958	-138,432844	CTD Rosette	Bottom	173	11	3,6	-0,7	1,34	22,20	1004,41	92	
4	474	Nutrient	2021-09-28	18:08	69,7976645	-138,43303	CTD Rosette	Recovery	173	7	7,2	-0,6	1,20	22,46	1004,42	91	
4	472	Nutrient	2021-09-28	20:14	69,6097535	-138,221304	CTD Rosette	Deployment	125	12	14,3	-1,2	1,81	22,35	1003,87	99	
4	472	Nutrient	2021-09-28	20:21	69,6090773	-138,221038	CTD Rosette	Bottom	124	5	13,9	-1,2	1,83	22,25	1003,85	99	
4	472	Nutrient	2021-09-28	20:47	69,6072202	-138,218495	CTD Rosette	Recovery	124	3	14,9	-1,2	1,96	22,39	1003,70	99	
4	470/PCB-17	PCB Full	2021-09-28	23:57	69,4290052	-138,000758	Piston Core	Deployment	54	348	18,8	-1	2,08	22,83	1002,48	99	
4	470/PCB-17	PCB Full	2021-09-28	23:58	69,4289392	-138,000907	Piston Core	Bottom	54	342	20,2	-1	2,05	22,64	1002,43	99	
4	470/PCB-17	PCB Full	2021-09-29	0:03	69,429102	-138,001142	Piston Core	Recovery	54	354	20,4	-1	2,07	21,87	1002,45	99	
4	470/PCB-17	PCB Full	2021-09-29	1:25	69,4269038	-137,985681	Tucker Net	Deployment	52	319	16,9	-1,5	2,29	21,03	1002,17	99	
4	470/PCB-17	PCB Full	2021-09-29	1:33	69,4240468	-137,974049	Tucker Net	Bottom	52	311	14,7	-1,5	2,03	20,52	1002,28	99	
4	470/PCB-17	PCB Full	2021-09-29	1:41	69,4199258	-137,968168	Tucker Net	Recovery	51	304	14,9	0,4	1,97	20,51	1002,45	99	
4	470/PCB-17	PCB Full	2021-09-29	2:13	69,4311347	-137,998931	CTD Rosette	Deployment	54				2,20	22,39			
4	470/PCB-17	PCB Full	2021-09-29	2:15	69,4310802	-137,998728	CTD Rosette	Bottom	54	317	17,1	-1,4	2,31	22,25	1002,07	99	
4	470/PCB-17	PCB Full	2021-09-29	2:30	69,4309253	-137,997723	CTD Rosette	Recovery	54	318	19,2	-1,2	2,34	21,41	1002,09	99	
4	470/PCB-17	PCB Full	2021-09-29	2:46	69,4315118	-137,997199	Moonpool TM	Deployment	54	308	19,6	-1,1	2,18	22,26	1001,70	99	
4	470/PCB-17	PCB Full	2021-09-29	2:52	69,4315522	-137,996952	Moonpool TM	Bottom	54	307	21,1	-1,2	1,97	23,17	1001,69	99	
4	470/PCB-17	PCB Full	2021-09-29	2:58	69,4314722	-137,996962	Moonpool TM	Recovery	54				2,29	21,91			
4			2021-09-29	3:00	69,4314745	-137,996976	Moonpool TM	Deployment	54	305	19,8	-1,1	2,35	21,67	1001,71	99	
4			2021-09-29	3:02	69,4314602	-137,996813	Moonpool TM	Bottom	54	313	20,4	-1	2,36	21,50	1001,77	99	
4			2021-09-29	3:03	69,4314273	-137,996759	Moonpool TM	Recovery	54	313	20	-1,1	2,36	21,49	1001,84	99	
4	470/PCB-17	PCB Full	2021-09-29	3:20	69,4325082	-137,997631	Monster	Deployment	54	296	19,6	-1,1	2,11	24,52	1001,60	99	
4	470/PCB-17	PCB Full	2021-09-29	3:24	69,4325615	-137,997304	Monster	Bottom	54	310	18,5	-1,2	2,30	22,35	1001,67	99	
4	470/PCB-17	PCB Full	2021-09-29	3:26	69,4325025	-137,99718	Monster	Recovery	54	305	19,2	-1,2	1,65	21,48	1001,58	99	
4	470/PCB-17	PCB Full	2021-09-29	3:47	69,429561	-137,998893	MultiCorer	Deployment	54	320	20,2	-1	2,14	24,33	1001,57	99	
4	470/PCB-17	PCB Full	2021-09-29	3:49	69,4294982	-137,999508	MultiCorer	Bottom	53	316	22,1	-1	2,07	23,45	1001,58	99	
4	470/PCB-17	PCB Full	2021-09-29	3:52	69,429562	-137,99938	MultiCorer	Recovery	54	310	18,1	-1,1	2,11	23,72	1001,57	99	
4	470/PCB-17	PCB Full	2021-09-29	4:22	69,4290785	-137,999151	Box Core	Deployment	53	321	21,7	-1	2,37	21,76	1001,26	99	
4	470/PCB-17	PCB Full	2021-09-29	4:25	69,4289827	-137,999045	Box Core	Bottom	54	316	20,6	-0,9	2,26	22,90	1001,23	99	
4	470/PCB-17	PCB Full	2021-09-29	4:27	69,4290323	-137,998853	Box Core	Recovery	54	312	17,1	-0,9	2,38	21,93	1001,20	99	
4	470/PCB-17	PCB Full	2021-09-29	4:51	69,4270342	-138,026739	Beam Trawl	Deployment	54	314	19	-0,8	2,36	21,56	1001,23	99	
4	470/PCB-17	PCB Full	2021-09-29	4:56	69,4250847	-138,02107	Beam Trawl	Bottom	54	310	19,2	-0,9	2,36	21,50	1000,92	99	
4	470/PCB-17	PCB Full	2021-09-29	4:59	69,424203	-138,018227	Beam Trawl	Recovery	54	313	21,1	-1	2,35	21,46	1001,22	99	
4			2021-09-29	5:03	69,4222018	-138,01533	Moonpool TM	Bottom	53	305	14,1	1,5	2,33	21,44	1001,25	99	
4			2021-09-29	5:11	69,4181038	-138,010895	Moonpool TM	Recovery	53	304	16	2,7	2,31	21,17	1001,20	98	
4	PCB-17A	PCB Basic	2021-09-29	8:58	69,2878232	-137,279269	CTD Rosette	Deployment		320	24,4	-0,3	2,93	23,32	998,98	99	
4	PCB-17A	PCB Basic	2021-09-29	9:03	69,2880668	-137,27867	CTD Rosette	Recovery	19	315	20,6	-0,2	2,98	23,36	998,95	99	
4	PCB-17A	PCB Basic	2021-09-29	9:19	69,2883655	-137,27587	Moonpool TM	Deployment	19	317	26,1	-0,2	3,06	22,59	999,03	99	
4	PCB-17A	PCB Basic	2021-09-29	9:26	69,2878898	-137,27532	Moonpool TM	Bottom	19	321	26,1	-0,2	2,96	22,60	998,83	99	
4	PCB-17A	PCB Basic	2021-09-29	9:29	69,2877092	-137,274796	Moonpool TM	Recovery	19	318	26,8	-0,2	3,03	23,32	998,92	99	
4	PCB-17A	PCB Basic	2021-09-29	9:49	69,2890097	-137,279042	MultiCorer	Deployment	19	325	22,8	0	2,83	20,79	999,00	99	
4	PCB-17A	PCB Basic	2021-09-29	9:50	69,288991	-137,279286	MultiCorer	Bottom	20	319	25,3	-0,1	2,74	21,26	998,77	99	
4	PCB-17A	PCB Basic	2021-09-29	9:52	69,2889787	-137,278983	MultiCorer	Recovery		323	26,3	-0,1	2,93	23,34	999,10	99	
4	PCB-17A	PCB Basic	2021-09-29	10:16	69,288213	-137,275692	Gravity Core	Deployment	19	314	26,8	-0,2	2,84	22,23	998,85	99	
4	PCB-17A	PCB Basic	2021-09-29	10:17	69,288203	-137,27562	Gravity Core	Bottom	19	305	24,4	-0,2	2,84	22,49	999,02	99	
4	PCB-17A	PCB Basic	2021-09-29	10:18	69,2881783	-137,275329	Gravity Core	Recovery	20	303	24,2	-0,2	2,95	23,08	998,96	99	
4	PCB-11	PCB Full	2021-09-29	21:12	70,5474777	-136,009515	CTD Rosette	Deployment	74	277	22,3	0,1	1,65	23,35	995,13	99	
4	PCB-11	PCB Full	2021-09-29	21:14	70,5474122	-136,009529	CTD Rosette	Bottom	74	281	22,3	0,1	1,58	24,73	995,40	99	
4	PCB-11	PCB Full	2021-09-29	21:38	70,546863	-136,008387	CTD Rosette	Recovery	73	284	25,3	0	1,61	23,61	995,26	99	
4	PCB-11	PCB Full	2021-09-29	23:08	70,5498177	-136,008593	CTD Rosette	Recovery	76				1,67	24,72			
4	PCB-11	PCB Full	2021-09-30	0:07	70,5476623	-136,007595	Piston Core	Deployment	74	275	22,7	-0,4	1,28	25,05	996,33	97	
4	PCB-11	PCB Full	2021-09-30	0:09	70,5476815	-136,007525	Piston Core	Bottom	74	284	23,2	-0,4	1,55	23,12	996,27	98	
4	PCB-11	PCB Full	2021-09-30	0:13	70,5477732	-136,007247	Piston Core	Recovery	74	277	23,4	-0,4	1,75	23,10	996,16	96	
4	PCB-11	PCB Full	2021-09-30	0:56	70,5474887	-136,008846	MultiCorer	Deployment	74	274	24	-0,4	1,32	25,31	996,50	98	
4	PCB-11	PCB Full	2021-09-30	0:58	70,5473822	-136,008147	MultiCorer	Bottom	73	278	26,1	-0,5	1,67	24,03	996,38	95	
4	PCB-11	PCB Full	2021-09-30	1:02	70,54748	-136,008056	MultiCorer	Recovery	73	281	26,3	-0,6	1,74	22,78	996,40	97	
4	PCB-11	PCB Full	2021-09-30	2:10	70,5476278	-136,009967	Piston Core	Deployment	74				1,70	22,41			
4	PCB-11	PCB Full	2021-09-30	2:12	70,5476802	-136,009935	Piston Core	Bottom	74				1,72	22,38			
4	PCB-11	PCB Full	2021-09-30	2:17	70,5477367	-136,009552	Piston Core	Recovery	74				1,46	22,61			
4	PCB-13	PCB Full	2021-09-30	9:23	69,9916265	-135,445774	CTD Rosette	Deployment	32				2,04	22,86			
4	PCB-13	PCB Full	2021-09-30	9:24	69,9916868	-135,44539	CTD Rosette	Bottom	32				1,75	26,83			
4	PCB-13	PCB Full	2021-09-30	9:35	69,9901438	-135,442126	CTD Rosette	Recovery	33				2,33	24,95			

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						
4	PCB-13	PCB Full	2021-09-30	9:55	69,9917058	-135,443177	MultiCorer	Deployment	33				2,54	24,00			
4	PCB-13	PCB Full	2021-09-30	9:57	69,9915275	-135,442297	MultiCorer	Bottom	33				2,32	23,52			
4	PCB-13	PCB Full	2021-09-30	10:00	69,991553	-135,442314	MultiCorer	Recovery	33				2,59	23,64			
4	PCB-13	PCB Full	2021-09-30	10:15	69,9927552	-135,443763	MultiCorer	Deployment	33				1,99	25,90			
4	PCB-13	PCB Full	2021-09-30	10:19	69,9926193	-135,442963	MultiCorer	Bottom	33				2,26	26,56			
4	PCB-13	PCB Full	2021-09-30	10:21	69,9925195	-135,442542	MultiCorer	Recovery	33				2,03	25,32			
4	PCB-13	PCB Full	2021-09-30	10:38	69,9924068	-135,444487	MultiCorer	Deployment	33	276	22,3	0	1,95	26,27	1000,93	91	
4	PCB-13	PCB Full	2021-09-30	10:40	69,9922192	-135,443948	MultiCorer	Bottom	33	280	22,8	0,2	1,95	25,92	1000,85	91	
4	PCB-13	PCB Full	2021-09-30	10:42	69,9922043	-135,443971	MultiCorer	Recovery	33	275	21,3	0	1,96	26,78	1000,70	91	
4	PCB-13	PCB Full	2021-09-30	11:25	69,9918768	-135,444727	Piston Core	Deployment	33	270	20,9	-0,4	2,49	26,41	1001,11	89	
4	PCB-13	PCB Full	2021-09-30	11:27	69,9918552	-135,444689	Piston Core	Bottom	33	271	19,4	-0,3	2,17	23,78	1001,06	91	
4	PCB-13	PCB Full	2021-09-30	11:40	69,9913818	-135,444001	Piston Core	Recovery	33				2,11	26,29			
4	PCB-12	PCB Basic	2021-09-30	16:29	70,2798583	-135,775621	CTD Rosette	Deployment	57	275	17,1	-1,3	1,14	25,45	1001,89	93	
4	PCB-12	PCB Basic	2021-09-30	16:31	70,2797882	-135,775576	CTD Rosette	Bottom	57	286	12,6	-1,2	1,09	24,52	1001,93	95	
4	PCB-12	PCB Basic	2021-09-30	16:49	70,2792397	-135,777509	CTD Rosette	Recovery	56	272	15,6	-1,4	1,20	24,34	1001,96	94	
4	PCB-12	PCB Basic	2021-09-30	18:17	70,277094	-135,775093	CTD Rosette	Deployment	55	254	13,9	-1,3	1,06	24,31	1002,54	97	
4	PCB-12	PCB Basic	2021-09-30	18:20	70,2767723	-135,773905	CTD Rosette	Bottom	55	253	14,7	-1	1,17	24,62	1002,48	92	
4	PCB-12	PCB Basic	2021-09-30	18:34	70,2751302	-135,772589	CTD Rosette	Recovery	55	260	11,8	-0,9	1,25	24,20	1002,56	92	
4	PCB-12	PCB Basic	2021-09-30	19:06	70,2796572	-135,776599	MultiCorer	Deployment	55	239	6,5	0	1,08	27,13	1002,81	94	
4	PCB-12	PCB Basic	2021-09-30	19:09	70,279576	-135,776386	MultiCorer	Bottom	56	334	2,5	0	1,05	24,35	1002,81	97	
4	PCB-12	PCB Basic	2021-09-30	19:13	70,2795637	-135,775722	MultiCorer	Recovery	56	263	2,9	-0,3	1,06	24,24	1002,82	99	
4	PCB-12	PCB Basic	2021-09-30	19:33	70,279458	-135,773199	Gravity Core	Deployment	56	300	9,1	-0,6	1,04	24,13	1002,77	92	
4	PCB-12	PCB Basic	2021-09-30	19:35	70,2794642	-135,772728	Gravity Core	Bottom	55	264	9,1	-0,6	1,04	24,13	1002,76	92	
4	PCB-12	PCB Basic	2021-09-30	19:37	70,2794402	-135,772221	Gravity Core	Recovery	55	257	13,9	-0,6	1,09	24,13	1002,83	92	
4	PCB-10	PCB Basic	2021-10-01	0:06	70,9095063	-136,282126	CTD Rosette	Deployment	955	290	9,3	-2,4	0,38	21,29	1003,22	99	
4	PCB-10	PCB Basic	2021-10-01	0:24	70,9093008	-136,284784	CTD Rosette	Bottom	956	253	4,8	-2,5	0,32	21,60	1003,34	95	
4	PCB-10	PCB Basic	2021-10-01	1:11	70,9089715	-136,293415	CTD Rosette	Recovery	959	248	5,5	-2,5	0,30	21,32	1003,50	97	
4	PCB-10	PCB Basic	2021-10-01	2:27	70,9106437	-136,278585	CTD Rosette	Deployment	956				0,53	22,72			
4	PCB-10	PCB Basic	2021-10-01	2:34	70,9108342	-136,279387	CTD Rosette	Bottom	956				0,42	23,08			
4	PCB-10	PCB Basic	2021-10-01	2:54	70,9115968	-136,279266	CTD Rosette	Recovery	957	221	2,7	-1,8	0,59	22,28	1003,94	99	
4	PCB-10	PCB Basic	2021-10-01	3:10	70,911137	-136,278524	MultiCorer	Deployment	955				0,52	23,86			
4	PCB-10	PCB Basic	2021-10-01	3:26	70,9111488	-136,278763	MultiCorer	Bottom	955	224	0	-2,2	0,59	22,78	1004,12	99	
4	PCB-10	PCB Basic	2021-10-01	3:47	70,9113327	-136,278882	MultiCorer	Recovery	957	256	2,9	-2,1	0,74	22,61	1004,13	98	
4	PCB-14	PCB Basic	2021-10-01	8:28	70,2387003	-137,181052	CTD Rosette	Deployment	57	92	12,2	-0,9	1,50	24,16	1003,59	86	
4	PCB-14	PCB Basic	2021-10-01	8:35	70,2379032	-137,181257	CTD Rosette	Bottom	58	85	12,8	-0,9	1,69	25,70	1003,58	86	
4	PCB-14	PCB Basic	2021-10-01	8:45	70,237094	-137,181573	CTD Rosette	Recovery	57	84	12,6	-0,8	1,40	24,08	1003,54	86	
4	PCB-14	PCB Basic	2021-10-01	9:04	70,2391163	-137,183012	MultiCorer	Deployment	57	78	10,9	-0,5	1,66	23,49	1003,42	86	
4	PCB-14	PCB Basic	2021-10-01	9:06	70,2390515	-137,183464	MultiCorer	Bottom	58	93	14,7	-0,5	1,77	22,54	1003,37	87	
4	PCB-14	PCB Basic	2021-10-01	9:09	70,2389923	-137,183881	MultiCorer	Recovery	57	84	12,4	-0,5	1,59	23,40	1003,38	87	
4	546	Nutrient	2021-10-01	19:02	71,7420578	-133,948631	CTD Rosette	Deployment	1612	60	18,5	-3,3	-0,96	24,66	1005,15	99	
4	546	Nutrient	2021-10-01	19:34	71,7417475	-133,953344	CTD Rosette	Bottom	1609	64	20,4	-2,7	-0,99	25,12	1004,90	99	
4	546	Nutrient	2021-10-01	20:48	71,7406983	-133,964518	CTD Rosette	Recovery	1615	73	18,3	-1,6	-0,83	24,63	1005,03	99	
4	516	Basic	2021-10-03	4:26	74,8405442	-121,461111	Tucker Net	Deployment	509	44	7,2	-7,9	-1,33	28,05	1014,08	99	
4	516	Basic	2021-10-03	4:34	74,8383298	-121,448797	Tucker Net	Bottom	509	59	9,1	-7,5	-1,33	28,05	1014,06	99	
4	516	Basic	2021-10-03	4:42	74,8414833	-121,439023	Tucker Net	Recovery	509	44	10,3	-7,4	-1,33	28,03	1014,14	99	2
4	516	Basic	2021-10-03	5:14	74,8427447	-121,390216	CTD Rosette	Deployment	500	63	8,6	-7,6	-1,23	28,04	1014,38	99	2
4	516	Basic	2021-10-03	5:25	74,8433895	-121,387602	CTD Rosette	Bottom	498	59	7,6	-7,8	-1,21	28,03	1014,24	99	2
4	516	Basic	2021-10-03	6:06	74,8462548	-121,386444	CTD Rosette	Recovery	493	135	0,6	-6,9	-1,29	28,02	1014,40	99	2
4	516	Basic	2021-10-03	6:22	74,8480065	-121,386296	Moonpool TM	Deployment	490	109	2,3	-6,9	-1,31	28,02	1014,51	99	2
4	516	Basic	2021-10-03	6:28	74,8485078	-121,38614	Moonpool TM	Bottom	491	78	3,4	-6,9	-1,29	28,02	1014,51	99	2
4	516	Basic	2021-10-03	6:35	74,84894	-121,386106	Moonpool TM	Recovery	488	359	2,1	-7,2	-1,33	28,02	1014,53	99	2
4	516	Basic	2021-10-03	6:51	74,8502985	-121,38777	Monster	Deployment	488	63	2,1	-7	-1,32	28,03	1014,62	99	2
4	516	Basic	2021-10-03	7:02	74,8504515	-121,385129	Monster	Bottom	486	49	6,5	-6,9	-1,29	28,03	1014,70	99	2
4	516	Basic	2021-10-03	7:17	74,851673	-121,384859	Monster	Recovery	486	47	3,4	-6,8	-1,33	28,05	1014,55	99	2
4	516	Basic	2021-10-03	7:32	74,8531777	-121,38748	Moonpool TM	Deployment	488	41	4	-6,7	-1,35	28,05	1014,52	99	2
4	516	Basic	2021-10-03	7:45	74,8534902	-121,388149	Moonpool TM	Bottom	488				-1,33	28,06			2
4	516	Basic	2021-10-03	7:58	74,853685	-121,388998	Moonpool TM	Recovery	488	84	3,6	-6,5	-1,37	28,06	1014,69	99	2
4	516	Basic	2021-10-03	8:55	74,8451157	-121,412218	CTD Rosette	Deployment	496	43	1,5	-6,4	-1,36	28,06	1014,97	99	2
4	516	Basic	2021-10-03	9:05	74,8456242	-121,413812	CTD Rosette	Bottom	496	193	1	-6,6	-1,38	28,06	1014,94	99	2
4	516	Basic	2021-10-03	9:35	74,8468388	-121,417649	CTD Rosette	Recovery	492	307	0,8	-5,9	-1,35	28,06	1015,10	99	2
4	516	Basic	2021-10-03	9:50	74,8471452	-121,417297	MultiCorer	Deployment	492	37	8,2	-6,4	-1,35	28,08	1015,14	99	2
4	516	Basic	2021-10-03	10:00	74,8470372	-121,417033	MultiCorer	Bottom	492	48	8,2	-6,3	-1,33	28,04	1015,06	99	2
4	516	Basic	2021-10-03	10:11	74,8470393	-121,416751	MultiCorer	Recovery	492	38	8,9	-6,2	-1,31	28,05	1015,03	99	2
4	518N	Coring	2021-10-03	12:11	74,679869	-121,451775	Piston Core	Deployment	525	51	8,6	-5,6	-1,29	28,69	1014,88	99	2
4	518N	Coring	2021-10-03	12:19	74,6798393	-121,45244	Piston Core	Bottom	525	46	7,2	-5,5	-1,34	28,72	1014,91	99	2
4	518N	Coring	2021-10-03	12:22	74,6798017	-121,452551	Piston Core	Bottom	525	44	7,8	-5,5	-1,29	28,68	1014,91	99	2
4	518N	Coring	2021-10-03	12:33	74,6795002	-121,453372	Piston Core	Recovery	524	36	5,5	-5,5	-1,36	28,63	1014,94	99	2
4	518N	Coring	2021-10-03	13:35	74,6814837	-121,449795	Box Core	Deployment	527	45	8,9	-5,1	-1,34	28,62	1014,95	99	2
4	518N	Coring	2021-10-03	13:45	74,6811807	-121,449028	Box Core	Bottom	527	41	10,3	-5	-1,30	28,65	1015,01	99	2
4	518N	Coring	2021-10-03	13:55	74,6811017	-121,448534	Box Core	Recovery	527	42	9,1	-5,2	-1,35	28,74	1015,09	99	2
4	518N	Coring	2021-10-03	14:12	74,6801237	-121,451222	MultiCorer	Deployment	525	50	11,2	-5,4	-1,38	28,70	1015,07	99	2
4	518N	Coring	2021-10-03	14:24	74,6800458	-121,450993	MultiCorer	Bottom	526	39	11,2	-5,4	-1,37	28,68	1015,12	99	2
4	518N	Coring	2021-10-03	14:38	74,67996	-121,451437	MultiCorer	Recovery	524	48	10,9	-5,3	-1,36	28,69	1015,23	99	2
4	516	Basic	2021-10-03	15:48	74,8451287	-121,389939	Box Core	Deployment	493	36	11,8	-6,3	-1,18	27,93	1015,84	99	2
4	516	Basic	2021-10-03	15:59	74,8450627	-121,38955	Box Core	Bottom	492	42	14,3	-6,3	-1,19	27,95	1015,71	99	2
4	516	Basic	2021-10-03	16:07	74,8452585	-121,389773	Box Core	Recovery	492	42	13,5	-6,2	-1,19	27,94	1015,68	99	2
4	516	Basic	2021-10-03	17:40	74,846789	-121,431005	IKMT	Deployment	496				-1,26	27,95			2
4	516	Basic	2021-10-03	17:56	74,8418088	-121,410979	IKMT	Bottom	504	27	11,6	-6,8	-1,24	27,92	1016,09	99	2
4	516	Basic	2021-10-03	18:24	74,8422615	-121,346849	IKMT	Recovery	499	32	11,8	-6,9	-1,20	27,90	1016,03	99	2
4	515	Nutrient	2021-10-04	0:02	75,0255692	-121,35572	Ice sample	Deployment	476	351	8,9	-11,4	3,30	28,26	1017,57	96	2
4	515	Nutrient	2021-10-04	5:42	75,0113142	-121,36145	CTD Rosette	Deployment	485	23	13,1	-14,7	2,38	28,30	1018,78	92	2
4	515	Nutrient	2021-10-04	5:51	75,0109402	-121,363678	CTD Rosette	Bottom	486	25	15	-14,8	2,44	28,35	1018,84	92	2
4	515	Nutrient	2021-10-04	6:31	75,0095252	-121,372602	CTD Rosette	Recovery	484	21	15,8	-14,8	1,00	28,38	1018,82	92	2
4	515	Nutrient	2021-10-04	7:31	75,0075902	-121,388858	CTD Rosette	Deployment	491	24	6,7	-15	0,82	28,40	1018,98	91	2
4	515	Nutrient	2021-10-04	7:41	75,0072415	-121,391554	CTD Rosette	Bottom	490	28	6,9	-14,9	0,73	28,41	1019,02	91	2
4	515	Nutrient	2021-10-04	8:21	75,005823	-121,403241	CTD Rosette	Recovery	493	7	14,1	-15,2	0,47	28,43	1019,18	91	2

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						
4	515	Nutrient	2021-10-04	8:36	75,0052463	-121,407429	Box Core	Deployment	493	14	11	-15,1	0,48	28,44	1019,33	91	2
4	515	Nutrient	2021-10-04	8:46	75,004817	-121,410071	Box Core	Bottom	493	18	15,8	-15,1	0,40	28,42	1019,13	91	2
4	515	Nutrient	2021-10-04	8:56	75,004219	-121,411805	Box Core	Recovery	493	9	12,4	-15,3	0,41	28,42	1019,46	91	2
4	518	Nutrient	2021-10-04	14:02	74,5951968	-121,469305	CTD Rosette	Deployment	420	56	7,4	-10,8	1,01	28,34	1020,08	96	10
4	518	Nutrient	2021-10-04	14:14	74,5946028	-121,476709	CTD Rosette	Bottom	418	68	4,2	-10,8			1020,17	96	10
4	518	Nutrient	2021-10-04	15:05	74,5926393	-121,508482	CTD Rosette	Recovery	410	23	9,5	-10,7			1020,46	96	10
4	518	Nutrient	2021-10-04	16:03	74,5972843	-121,455922	Moonpool TM	Deployment	431	8	10,3	-10,3	-1,38	28,88	1020,46	96	10
4	518	Nutrient	2021-10-04	16:12	74,5970435	-121,460642	Moonpool TM	Bottom	431	8	9,1	-10	-1,39	28,43	1020,64	97	10
4	518	Nutrient	2021-10-04	16:19	74,596916	-121,462992	Moonpool TM	Recovery	431	15	6,5	-9,8	-1,39	28,44	1020,75	97	10
4	518	Nutrient	2021-10-04	17:21	74,5992478	-121,451837	CTD Rosette	Deployment	436	37	14,9	-9,2	-1,39	28,50	1020,19	98	10
4	518	Nutrient	2021-10-04	17:30	74,5990288	-121,457394	CTD Rosette	Bottom	436				-1,38	28,47			10
4	518	Nutrient	2021-10-04	18:19	74,5971393	-121,488141	CTD Rosette	Recovery	427	20	16	-8,5	-1,19	28,48	1020,44	99	10
4	518	Nutrient	2021-10-04	18:42	74,5967542	-121,465661	Moonpool TM	Deployment	429	3	12,6	-8	-1,36	28,50	1020,59	99	10
4	518	Nutrient	2021-10-04	18:59	74,5961618	-121,467032	Moonpool TM	Bottom	422	6	14,7	-7,7	-1,43	28,48	1020,57	99	10
4	518	Nutrient	2021-10-04	20:08	74,5926652	-121,513822	Moonpool TM	Recovery	412	359	14,1	-8,1	-1,26	28,61	1021,02	99	10
4	PKC_UluBluff-21	Mooring	2021-10-06	9:24	70,7083173	-117,8754	CTD Rosette	Deployment	118	229	3,4	-3,7	3,06	25,72	1017,94	81	10
4	PKC_UluBluff-21	Mooring	2021-10-06	9:26	70,708291	-117,875576	CTD Rosette	Bottom	118	86	1,1	-4,1	3,05	25,70	1017,94	82	10
4	PKC_UluBluff-21	Mooring	2021-10-06	9:32	70,7081768	-117,875366	CTD Rosette	Recovery	118	236	0,8	-3,9	3,07	25,72	1017,92	84	10
4	PKC_UluBluff-21	Mooring	2021-10-06	9:56	70,7097645	-117,85433	Mooring	Deployment	37	283	0,6	-4,2	3,07	25,71	1017,91	82	10
4	PKC_UluBluff-21	Mooring	2021-10-06	10:02	70,7097233	-117,853977	Mooring	Bottom	35	240	1	-4	3,06	25,72	1017,88	81	10
4	PKC_UluBluff-21	Mooring	2021-10-06	10:02	70,7097228	-117,853886	Mooring	Recovery	34	215	1,5	-3,3	3,09	25,72	1017,89	81	10
Leg 5																	
5	DE110	Open water	2021-10-12	14:43	76,0608588	-77,1256327	CTD Rosette	Deployment	314	10	4,4	-2,2	-1,50	30,70	1012,36	97	
5	DE110	Open water	2021-10-12	14:58	76,0585053	-77,1332393	CTD Rosette	Bottom	308	20	10,7	0,3	-1,54	30,70	1012,51	87	
5	DE110	Open water	2021-10-12	15:45	76,049785	-77,1548892	CTD Rosette	Recovery		35	4	-2	-1,52	30,69	1012,34	96	
5	DE110	Open water	2021-10-12	16:03	76,0472175	-77,1765107	C-OPS	Deployment		23	15,4	-2,8	-1,51	30,68	1012,65	98	
5	DE110	Open water	2021-10-12	17:14	76,0363355	-77,2356882	CTD Rosette	Deployment		3	13,1	-2,8	-1,48	30,67	1012,66	95	
5	DE110	Open water	2021-10-12	17:24	76,0345572	-77,2417598	CTD Rosette	Bottom		25	8,4	-1,3	-1,42	30,68	1012,77	93	
5	DE110	Open water	2021-10-12	17:44	76,0313435	-77,2603947	CTD Rosette	Recovery		10	13,1	-2,2	-1,46	30,68	1012,60	94	
5	DE110	Open water	2021-10-12	18:07	76,021269	-77,2961003	IKMT	Deployment	283	353	11,6	-2,7	-1,44	30,70	1012,56	97	
5	DE110	Open water	2021-10-12	18:51	76,0034517	-77,226246	IKMT	Bottom	234	359	12,2	-2,6	-1,41	30,71	1012,72	96	
5	DE110	Open water	2021-10-12	19:08	76,0040563	-77,1888227	IKMT	Recovery	228	12	16,8	-2,7	-1,43	30,70	1012,69	95	
5	DE110	Open water	2021-10-12	23:07	76,0342812	-77,2595218	Hydrobios	Deployment	287	2	16,2	-2,7	-1,59	30,73	1012,70	96	
5	DE110	Open water	2021-10-12	23:18	76,0320598	-77,2669687	Hydrobios	Bottom	289	337	10,7	-0,8	-1,58	30,72	1012,71	93	
5	DE110	Open water	2021-10-12	23:32	76,0298323	-77,2684792	Hydrobios	Recovery	286	24	12,9	0,3	-1,52	30,73	1012,46	82	
5	DE110	Open water	2021-10-12	23:52	76,0233797	-77,279718	Tucker Net	Deployment	284	342	9,1	2,1	-1,58	30,72	1012,52	83	
5	DE110	Open water	2021-10-13	0:00	76,0198118	-77,2934135	Tucker Net	Bottom	282				-1,58	30,71			
5	DE110	Open water	2021-10-13	0:08	76,015201	-77,305671	Tucker Net	Recovery	274	348	9,9	2,5	-1,58	30,71	1012,43	82	
5	DE110	Open water	2021-10-13	0:46	75,9824065	-77,306614	IKMT	Deployment	238	11	13,7	-2,8	-1,51	30,70	1011,84	99	
5	DE110	Open water	2021-10-13	0:56	75,9748308	-77,3005415	IKMT	Bottom	226	0	17,3	-3,2	-1,53	30,71	1011,78	99	
5	DE110	Open water	2021-10-13	1:12	75,9678953	-77,2963445	IKMT	Recovery	214	3	14,5	-3	-1,50	30,71	1011,87	99	
5	DE110	Open water	2021-10-13	4:16	76,037976	-77,2286207	CTD Rosette	Deployment	288	13	14,9	-1	-1,52	30,73	1009,47	99	
5	DE110	Open water	2021-10-13	4:28	76,036373	-77,2331817	CTD Rosette	Bottom	284	8	27,6	-0,7	-1,51	30,73	1008,95	95	
5	DE110	Open water	2021-10-13	4:47	76,0345773	-77,2452833	CTD Rosette	Recovery	281	25	15	-1	-1,54	30,73	1008,95	94	
5	DE120	Sea Ice	2021-10-13	16:22	76,26983	-78,902566	CTD Rosette	Deployment	105	11	24,8	-3,6	-1,47	30,90	1001,68	99	
5	DE120	Sea Ice	2021-10-13	16:31	76,267051	-78,9107107	CTD Rosette	Bottom	104	38	19	-3,4	-1,46	30,91	1001,63	98	
5	DE120	Sea Ice	2021-10-13	16:46	76,2622627	-78,9237948	CTD Rosette	Recovery	103	23	8,6	-3,3	-1,48	30,91	1001,86	99	
5	DE120	Sea Ice	2021-10-13	18:12	76,2355697	-78,9477198	CTD Rosette	Deployment	137	30	6,3	-3,2	-1,51	30,85	1001,25	99	
5	DE120	Sea Ice	2021-10-13	18:21	76,232253	-78,951278	CTD Rosette	Bottom	131	28	13,3	-3,2	-1,52	30,85	1001,10	99	
5	DE120	Sea Ice	2021-10-13	18:34	76,2267893	-78,9574783	CTD Rosette	Recovery	125	25	5,1	-3,3	-1,53	30,86	1001,04	99	
5	DE120	Sea Ice	2021-10-13	19:11	76,2156913	-78,9900157	Hydrobios	Deployment	114	7	21,3	-3,7	-1,53	30,84	1000,70	99	
5	DE120	Sea Ice	2021-10-13	19:14	76,2152545	-78,993037	Hydrobios	Bottom	116	15	17,9	-3,6	-1,52	30,85	1001,07	99	
5	DE120	Sea Ice	2021-10-13	19:18	76,2140135	-78,9954992	Hydrobios	Recovery	117	10	17,3	-3,7	-1,44	30,85	1001,01	99	
5	DE120	Sea Ice	2021-10-14	1:56	76,4122742	-78,6977178	Hydrobios	Deployment	200	355	8,2	-2,2	-1,57	30,64	999,51	83	
5	DE120	Sea Ice	2021-10-14	2:03	76,4119637	-78,6985933	Hydrobios	Bottom	200	355	9,9	-1,5	-1,57	30,64	999,49	81	
5	DE120	Sea Ice	2021-10-14	2:11	76,4107723	-78,6993222	Hydrobios	Recovery	195	13	4	-0,4	-1,58	30,65	999,33	81	
5	DE120	Sea Ice	2021-10-14	4:06	76,4229687	-78,6752352	CTD Rosette	Deployment	223	337	15,4	-2,1	-1,54	30,61	999,61	74	
5	DE120	Sea Ice	2021-10-14	4:34	76,4217698	-78,6593057	CTD Rosette	Bottom	213	355	22,7	-2,1	-1,52	30,61	999,71	73	
5	DE120	Sea Ice	2021-10-14	4:51	76,4212622	-78,652937	CTD Rosette	Recovery	217	357	19,6	-2,2	-1,52	30,61	999,95	74	
5	DE130	Sea Ice	2021-10-14	13:03	76,3868822	-78,2395397	Canoe	Deployment	147	306	15,2	-4,5	-1,58	30,83	1006,21	62	
5	DE130	Sea Ice	2021-10-14	16:34	76,3582697	-78,276125	CTD Rosette	Deployment	141	260	27,8	-6,9	-1,53	30,82	1010,17	66	
5	DE130	Sea Ice	2021-10-14	16:45	76,355077	-78,2783987	CTD Rosette	Bottom	157	275	28	-6,9	-1,55	30,82	1010,49	62	
5	DE130	Sea Ice	2021-10-14	17:01	76,3536802	-78,2910795	CTD Rosette	Recovery	143	260	17,7	-6,9	-1,54	30,83	1010,96	68	
5	DE130	Sea Ice	2021-10-14	17:35	76,346608	-78,3264955	Hydrobios	Deployment	132	257	21,1	-6,8	-1,50	30,85	1011,40	65	
5	DE130	Sea Ice	2021-10-14	17:40	76,3462793	-78,3254432	Hydrobios	Bottom	133	259	23,8	-6,8	-1,47	30,85	1011,40	67	
5	DE130	Sea Ice	2021-10-14	17:46	76,3460447	-78,3230083	Hydrobios	Recovery	133	256	20,2	-6,8	-1,48	30,85	1011,60	66	
5	DE130		2021-10-14	17:52	76,3462208	-78,3237707	C-OPS	Deployment	135	250	24,9	-6,8	-1,55	30,86	1011,48	67	
5	DE130	Sea Ice	2021-10-14	18:01	76,3452088	-78,3248122	C-OPS	Deployment					-1,56	30,85			
5	DE130	Sea Ice	2021-10-14	18:29	76,342025	-78,3086598	C-OPS	Recovery	126				-1,54	30,82			
5	DE210		2021-10-15	13:48	76,7668187	-75,0580377	CDT	Deployment	466	20	2,3	-2,9	-1,07	31,42	1021,71	99	
5	DE210		2021-10-15	13:58	76,763398	-75,0665878	CDT	Bottom	465	354	3,4	-1,9	-0,76	31,61	1021,81	98	
5	DE210		2021-10-15	14:12	76,7611898	-75,0746862	CDT	Recovery	458	113	1	-3	-1,02	31,53	1021,96	99	
5	DE210		2021-10-15	15:41	76,7025087	-75,1276835	C-Node	Deployment		3	3,6	-3,3	-1,21	31,65	1022,47	99	
5	DE210		2021-10-15	15:41	76,7024383	-75,1279238	C-Node	Bottom		359	4	-3,3	-1,22	31,64	1022,56	99	
5	DE210	Open water	2021-10-15	17:56	76,690072	-75,1685962	AUV	Deployment		7	5,5	-3,4	-0,99	31,63	1023,05	99	
5	DE310	Open water	2021-10-16	12:51	78,2402227	-74,051472	Hydrobios	Deployment	620	4	17,5	-10	-0,28	31,86	1028,45	88	
5	DE310	Open water	2021-10-16	13:07	78,2387168	-74,0666993	Hydrobios	Bottom	622	11	15,2	-4,9	-0,27	31,89	1028,54	81	
5	DE310	Open water	2021-10-16	13:29	78,2365688	-74,0848557	Hydrobios	Recovery	623	338	8,6	-5	-0,22	31,93	1028,58	79	
5	DE310	Open water	2021-10-16	13:59	78,2107005	-74,153078	CTD Rosette	Deployment	638	29	11,8	-4,2	-0,25	31,93	1028,66	79	
5	DE310	Open water	2021-10-16	14:18	78,2085025	-74,1585522	CTD Rosette	Bottom	643	37	12,2	-5,7	-0,29	31,92	1028,54	81	
5	DE310	Open water	2021-10-16	15:03	78,2016522	-74,1703817	CTD Rosette	Recovery	664	358	18,5	-6,1	-0,14	31,92	1028,49	80	
5	DE310		2021-10-16	15:17	78,1917358	-74,2086087	Phytoplankton Net	Deployment	655	4	19,8	-9,6	-0,29	31,92	1028,42	89	
5	DE310		2021-10-16	15:19	78,1916138	-74,2111482	Phytoplankton Net	Bottom	652	4	20,6	-9,7	-0,06	31,92	1028,36	89	
5	DE310		2021-10-16	15:24	78,1916827	-74,218771	Phytoplankton Net	Recovery	656	14	22,8	-9,9	-0,27	31,92	1028,48	89	
5	DE310		2021-10-16	15:28	78,1911843	-74,2232595	Phytoplankton Net	Deployment	657	16	12,6	-4,8	-0,29	31,92	1028,58	83	
5	DE310		2021-10-16	15:32	78,1909685	-74,226354	Phytoplankton Net	Bottom	660	5	21,5	-7,6	-0,29	31,92	1028,54	89	

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						
5	DE310		2021-10-16	15:35	78,190684	-74,2290753	Phytoplankton Net	Recovery	663	354	11,8	-6,9	-0,27	31,92	1028,54	82	
5	DE310	Open water	2021-10-16	16:41	78,170456	-74,3623798	IKMT	Deployment	689	2	16,9	-8,6	-0,33	31,88	1028,72	91	
5	DE310	Open water	2021-10-16	16:51	78,1641585	-74,3709817	IKMT	Bottom	652	16	20,2	-9,2	-0,29	31,84	1028,33	92	
5	DE310	Open water	2021-10-16	17:46	78,1274957	-74,3158572	IKMT	Recovery	698	10	20,6	-9,4	-0,25	31,85	1027,94	93	
5	DE310	Open water	2021-10-16	18:05	78,1283935	-74,366224	CTD Rosette	Deployment	680	13	24,4	-9,3	-0,34	31,86	1028,17	92	
5	DE310	Open water	2021-10-16	18:22	78,1274877	-74,3717608	CTD Rosette	Bottom	682	11	23	-9,2	-0,31	31,86	1028,43	93	
5	DE310	Open water	2021-10-16	18:46	78,1269395	-74,380625	CTD Rosette	Recovery	676	17	22,1	-9,1	-0,33	31,86	1028,51	94	
5	DE310	Open water	2021-10-16	19:28	78,1547218	-74,4269553	Catamaran	Deployment	652	9	22,8	-9,3	-0,18	31,83	1028,47	93	
5	DE310	Open water	2021-10-16	19:37	78,1517408	-74,4380958	C-OPS	Deployment	657	22	21,7	-9,4	-0,21	31,83	1028,36	93	
5	DE310	Open water	2021-10-16	19:43	78,1498083	-74,446393	C-OPS	Bottom	652	16	25,3	-9,3	-0,22	31,83	1028,34	93	
5	DE310	Open water	2021-10-17	0:14	78,1645748	-74,3388388	Hydrobios	Deployment	672	4	23	-7	-0,12	31,74	1027,54	89	
5	DE310	Open water	2021-10-17	0:32	78,1657797	-74,3465128	Hydrobios	Bottom	677	9	22,1	-4,7	-0,16	31,73	1027,79	85	
5	DE310	Open water	2021-10-17	0:54	78,1663747	-74,3576245	Hydrobios	Recovery	657	15	11,2	-3,6	-0,15	31,74	1027,56	86	
5	DE310	Open water	2021-10-17	1:13	78,161725	-74,3715378	Tucker Net	Deployment	659	14	16,4	-7,2	-0,19	31,73	1027,35	89	
5	DE310	Open water	2021-10-17	1:23	78,1574112	-74,3818963	Tucker Net	Bottom	664	7	18,3	-8,9	-0,21	31,73	1027,19	95	
5	DE310	Open water	2021-10-17	1:33	78,1521433	-74,375127	Tucker Net	Recovery	685	1	19,6	-9,3	-0,24	31,74	1027,05	94	
5	DE310	Open water	2021-10-17	1:58	78,160864	-74,3833558	IKMT	Deployment	656	3	19	-8,9	-0,20	31,73	1027,04	94	
5	DE310	Open water	2021-10-17	2:12	78,1523325	-74,3795322	IKMT	Bottom	685	7	14,9	-9,1	-0,27	31,74	1027,01	95	
5	DE310	Open water	2021-10-17	2:55	78,1222987	-74,3247348	IKMT	Recovery	703	356	17,7	-8,8	-0,58	31,89	1026,69	95	
5	DE310		2021-10-17	3:16	78,1219603	-74,3331242	Monster Net	Deployment	697	13	14,9	-3,9	-0,44	31,91	1026,94	91	
5	DE310		2021-10-17	3:21	78,1214995	-74,3350675	Monster Net	Bottom	697	18	17,9	-4,8	-0,56	31,91	1026,95	83	
5	DE310		2021-10-17	3:24	78,1213325	-74,3366913	Monster Net	Recovery	698	29	14,3	-5,3	-0,57	31,89	1027,00	98	
5	DE310	Open water	2021-10-17	4:26	78,1725823	-74,372212	CTD Rosette	Deployment	700	6	18,5	-8,9	-0,17	31,74	1026,79	95	
5	DE310	Open water	2021-10-17	4:45	78,1723355	-74,3828298	CTD Rosette	Bottom	696	13	21,3	-9	-0,17	31,74	1026,71	94	
5	DE310	Open water	2021-10-17	5:11	78,1697367	-74,4030672	CTD Rosette	Recovery	690	12	17,5	-9,1	-0,15	31,74	1026,79	94	
5	DE320	Sea Ice	2021-10-17	12:10	78,2048982	-74,551687	Phytoplankton Net	Deployment	575	19	14,3	-8,8	-0,68	31,77	1025,45	96	
5	DE320	Sea Ice	2021-10-17	12:13	78,2047695	-74,5539962	Phytoplankton Net	Bottom	576	16	12,9	-8,8	-0,68	31,77	1025,46	95	
5	DE320	Sea Ice	2021-10-17	12:18	78,2044323	-74,5578323	Phytoplankton Net	Recovery	577	22	11,8	-8,8	-0,65	31,78	1025,34	95	
5	DE320		2021-10-17	12:22	78,2040197	-74,5601422	Phytoplankton Net	Deployment	579	22	13,5	-8,8	-0,63	31,77	1025,27	96	
5	DE320		2021-10-17	12:25	78,203707	-74,561337	Phytoplankton Net	Bottom	579	19	11,2	-8,7	-0,61	31,78	1025,21	96	
5	DE320		2021-10-17	12:33	78,2030418	-74,5628595	Phytoplankton Net	Deployment	579				-0,56	31,79			
5	DE320		2021-10-17	12:36	78,202879	-74,5634182	Phytoplankton Net	Bottom	579	25	9,5	-8,8	-0,55	31,78	1025,26	95	
5	DE320		2021-10-17	12:41	78,2024803	-74,5640285	Phytoplankton Net	Recovery	580	21	11,6	-8,9	-0,58	31,79	1025,07	95	
5	DE310		2021-10-17	12:44	78,2023803	-74,5639078	Phytoplankton Net	Deployment	579	21	10,7	-8,9	-0,59	31,79	1025,04	96	
5	DE310		2021-10-17	12:46	78,2023375	-74,563883	Phytoplankton Net	Bottom	580	25	10,1	-8,9	-0,62	31,79	1025,05	96	
5	DE310		2021-10-17	12:51	78,2020393	-74,5660452	Phytoplankton Net	Recovery	582	32	10,7	-8,8	-0,59	31,79	1024,99	96	
5	DE320	Sea Ice	2021-10-17	13:05	78,2015968	-74,5859802	CTD Rosette	Deployment	601	340	0,6	-7,8	-0,61	31,78	1024,79	93	
5	DE320	Sea Ice	2021-10-17	13:22	78,1996082	-74,5908923	CTD Rosette	Bottom	604	23	9,5	-8	-0,60	31,78	1024,86	92	
5	DE320	Sea Ice	2021-10-17	14:00	78,1967402	-74,609561	CTD Rosette	Recovery	614	15	10,5	-9,1	-0,61	31,78	1024,50	95	
5	DE320	Sea Ice	2021-10-17	16:13	78,1683267	-74,82013	CTD Rosette	Deployment	537	332	1,1	-7,7	-1,22	31,58	1024,06	97	
5	DE320	Sea Ice	2021-10-17	16:33	78,1630517	-74,8424758	CTD Rosette	Bottom	599	68	4,2	-7,4	-1,30	31,57	1023,97	98	
5	DE320	Sea Ice	2021-10-17	16:58	78,1555075	-74,8722108	CTD Rosette	Recovery	622	13	5,7	-8,1	-1,23	31,62	1023,89	97	
5	DE320		2021-10-17	17:38	78,1463785	-74,9258555	ROV	Deployment	619	32	7,4	-7,8	-1,51	31,45	1023,68	98	
5	DE320		2021-10-17	18:14	78,1347553	-74,9680395	ROV	Recovery	625	15	7,4	-7,9	-1,42	31,52	1023,69	98	
5	DE320		2021-10-18	1:12	78,0464388	-75,2163073	C-OPS	Deployment	591	198	6,5	-2,4	-1,42	31,53	1022,26	84	
5	DE320		2021-10-18	1:17	78,0457115	-75,2181488	C-OPS	Recovery	592	227	4,8	-2,2	-1,36	31,53	1022,30	85	
5	DE320	Sea Ice	2021-10-18	2:02	78,0258855	-75,1421957	CTD Rosette	Deployment	617	182	11,2	2,4	-0,59	31,65	1022,25	72	
5	DE320	Sea Ice	2021-10-18	2:18	78,026275	-75,1490658	CTD Rosette	Bottom	627	181	14,5	-0,7	-0,74	31,61	1022,09	79	
5	DE320	Sea Ice	2021-10-18	2:38	78,0266692	-75,1496568	CTD Rosette	Recovery	629				-1,13	31,57			
5	DE320		2021-10-18	3:31	78,0290552	-75,0886672	CTD Rosette	Deployment	634				-0,44	31,74			
5	DE320		2021-10-18	3:47	78,0293982	-75,0892598	CTD Rosette	Bottom	633	168	24	-1,6	-0,46	31,74	1021,46	79	
5	DE320		2021-10-18	4:26	78,0289718	-75,0847858	CTD Rosette	Recovery	639	175	16	-1,5	-0,45	31,74	1021,55	85	
5	DE320		2021-10-18	4:48	78,0284983	-75,0858	CTD Rosette	Deployment	639	160	16,2	-1,5	-0,42	31,74	1021,39	85	
5	DE320		2021-10-18	5:33	78,028287	-75,0867292	CTD Rosette	Bottom	637	155	18,1	-1,2	-0,30	31,74	1021,02	87	
5	DE320		2021-10-18	5:42	78,028301	-75,0869772	CTD Rosette	Recovery	638	156	18,8	-1,1	-0,30	31,72	1020,89	88	
5	DE400		2021-10-20	0:01	76,001293	-81,7827572	CTD Rosette	Deployment	707	261	16,9	1,2	-0,90	31,64	1003,87	89	
5	DE400		2021-10-20	0:18	76,000919	-81,7896108	CTD Rosette	Bottom	702	275	8,9	-0,6	-0,91	31,66	1004,08	99	
5	DE400		2021-10-20	0:32	76,0007017	-81,788854	CTD Rosette	Recovery	702	288	11,4	-0,8	-0,94	31,64	1003,90	99	
5	DE410		2021-10-20	10:19	75,9618067	-85,5946955	CTD Rosette	Deployment	616	257	14,9	-4,5	-0,92	31,55	1018,86	83	
5	DE410		2021-10-20	11:01	75,9679128	-85,6035655	CTD Rosette	Recovery	606	236	16,4	-2,8	-0,90	31,57	1019,31	73	
5	DE410		2021-10-20	12:55	75,9635977	-85,596517	CTD Rosette	Deployment	615	267	14,3	-6,9	-0,98	31,56	1020,40	82	
5	DE410		2021-10-20	13:12	75,966446	-85,5980893	CTD Rosette	Bottom	609	268	10,7	-2,9	-1,01	31,51	1020,35	79	
5	DE410		2021-10-20	13:42	75,9707102	-85,604234	CTD Rosette	Recovery	608	255	18,1	-5,2	-1,00	31,48	1020,42	81	
5	DE410		2021-10-20	15:04	75,9689857	-85,5897117	Bongo Net	Deployment	611	274	16,8	-6,2	-1,07	31,46	1021,12	86	
5	DE410		2021-10-20	15:07	75,9690597	-85,5922093	Bongo Net	Bottom	611	258	12,4	-5,3	-1,03	31,46	1021,21	88	
5	DE410		2021-10-20	15:11	75,969603	-85,5929397	Bongo Net	Recovery	611	280	20,4	-4,7	-1,01	31,48	1021,11	83	
5	DE410		2021-10-20	15:16	75,9701075	-85,5908538	Bongo Net	Deployment	610	285	19,6	-6,2	-1,07	31,46	1021,28	83	
5	DE410		2021-10-20	15:19	75,9704592	-85,5918992	Bongo Net	Bottom	611	287	16,6	-6,4	-1,05	31,46	1021,30	85	
5	DE410		2021-10-20	15:23	75,9709552	-85,5928328	Bongo Net	Recovery	610	288	18,1	-4,1	-1,05	31,47	1021,33	75	
5	DE410		2021-10-20	16:07	75,9606412	-85,5871595	CTD Rosette	Deployment	623	309	10,1	-2,1	-1,05	31,53	1021,78	80	
5	DE410		2021-10-20	16:23	75,9621898	-85,5873508	CTD Rosette	Bottom	621	293	13,3	-4,4	-1,08	31,50	1021,89	82	
5	DE410		2021-10-20	16:44	75,9638593	-85,5872428	CTD Rosette	Recovery	618	317	16,6	-5,7	-1,09	31,49	1021,98	79	
5	DE410		2021-10-20	16:50	75,964322	-85,5862953	C-OPS	Deployment	618	266	13,5	-5,8	-1,08	31,47	1022,03	84	
5	DE410		2021-10-20	17:34	75,9730008	-85,5967962	C-OPS	Recovery	606	301	18,7	-7,5	-1,10	31,45	1022,31	85	
5	DE410		2021-10-20	17:50	75,9680608	-85,5950675	Hydrobios	Deployment	610	299	16,9	-6,6	-1,09	31,45	1022,42	88	
5	DE410		2021-10-20	18:07	75,9684103	-85,5956695	Hydrobios	Bottom	610	283	20,6	-8	-1,10	31,45	1022,41	82	
5	DE410		2021-10-20	18:26	75,9681488	-85,602986	Hydrobios	Recovery	608	319	22,8	-8,4	-1,06	31,45	1023,07	86	
5	DE410		2021-10-20	18:58	75,9590477	-85,5935823	CTD Rosette	Deployment	627	316	12,4	-5,6	-1,09	31,46	1023,64	78	
5	DE410		2021-10-20	19:13	75,9598637	-85,5921378	CTD Rosette	Bottom	623	296	1,7	-7,2	-1,10	31,46	1024,00	81	
5	DE410		2021-10-20	19:30	75,9598238	-85,5853352	CTD Rosette	Recovery	624	312	21,5	-7,4	-1,05	31,47	1024,27	81	
5	DE410		2021-10-20	19:36	75,9594483	-85,582769	C-OPS	Deployment	626	288	13,3	-6,8	-1,03	31,48	1024,18	78	
5	DE410		2021-10-20	19:47	75,9632645	-85,5898208	C-OPS	Bottom	618	309	12,6	-3,8	-0,99	31,48	1024,61	71	
5	DE410		2021-10-20	21:59	75,96187167	-85,5934533	CTD Rosette	Deployment					-0,99	31,46			
5	DE410		2021-10-20	22:15	75,9639818	-85,5915963	CTD Rosette	Bottom	614	291	14,7	-6,9	-0,97	31,47	1026,41	72	
5	DE410		2021-10-20	22:32	75,9660135	-85,589474	CTD Rosette	Recovery	611	277	17,7	-5,5	-0,94	31,47	1026,44	71	
5	DE410		2021-10-20	23:48	75,962701	-85,593561	Hydrobios	Deployment	616	294	10,5	-4,9	-1,02	31,44	1026,56	76	

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						
5	DE410		2021-10-21	0:04	75,9645933	-85,5943917	Hydrobios	Bottom	612	285	13,9	-7,9	-1,00	31,44	1026,96	69	
5	DE410		2021-10-21	0:25	75,9649693	-85,5981445	Hydrobios	Recovery	611	269	10,1	-5,7	-0,99	31,45	1026,75	71	
5	DE410		2021-10-21	1:05	75,9602248	-85,5826183	CTD Rosette	Deployment	624	296	15,6	-8	-1,00	31,45	1026,70	68	
5	DE410		2021-10-21	1:22	75,9600632	-85,5823515	CTD Rosette	Bottom	624	275	9,9	-8	-1,00	31,45	1026,81	71	
5	DE410		2021-10-21	1:43	75,959593	-85,581593	CTD Rosette	Recovery	625	288	16,4	-7,9	-1,01	31,46	1026,35	71	
5	DE410		2021-10-21	1:58	75,9601352	-85,5737478	IKMT	Deployment	627	284	10,9	-7,9	-0,98	31,46	1026,96	73	
5	DE410		2021-10-21	2:16	75,9672088	-85,5396055	IKMT	Bottom	628	293	15,2	-7,6	-0,91	31,50	1026,83	75	
5	DE410		2021-10-21	2:57	75,9952372	-85,5028997	IKMT	Recovery	606	274	11	-7,9	-0,90	31,50	1026,98	72	
5	DE410		2021-10-21	4:03	75,9619892	-85,5906983	CTD Rosette	Deployment	619	260	17,3	-7,9	-1,08	31,45	1026,53	73	
5	DE410		2021-10-21	4:23	75,9619278	-85,5881408	CTD Rosette	Bottom	620	277	13,3	-8	-1,17	31,40	1026,73	73	
5	DE410		2021-10-21	4:39	75,9617948	-85,5864198	CTD Rosette	Recovery	621	273	14,3	-8	-1,21	31,37	1026,62	78	
5	DE420		2021-10-21	10:15	75,962682	-85,5944275	CTD Rosette	Deployment	615	163	1,9	-6,8	-1,34	31,27	1025,03	72	
5	DE420		2021-10-21	10:30	75,9647753	-85,5994323	CTD Rosette	Bottom	611	163	2,5	-6,4	-1,27	31,28	1024,93	72	
5	DE420		2021-10-21	10:49	75,966446	-85,6078752	CTD Rosette	Recovery	605	210	3,6	-6,9	-1,32	31,28	1024,77	73	
5	DE420		2021-10-21	11:10	75,9622802	-85,5969725	Bongo Net	Deployment	615	202	0	-7,1	-1,35	31,26	1024,66	72	
5	DE420		2021-10-21	11:30	75,9644515	-85,6060052	Bongo Net	Recovery	608	37	0	-6,9	-1,32	31,27	1024,37	71	
5	DE420		2021-10-21	12:38	75,9609903	-85,6026503	Catamaran	Deployment	615	126	5	-7,3	-1,39	31,23	1023,69	72	
5	DE420		2021-10-21	13:02	75,9613137	-85,6028498	CTD Rosette	Deployment	616	114	3,2	-7,3	-1,40	31,24	1023,44	76	
5	DE420		2021-10-21	13:20	75,9624533	-85,6086172	CTD Rosette	Bottom	612	121	6,9	-7,3	-1,42	31,24	1023,10	76	
5	DE420		2021-10-21	13:58	75,9637213	-85,6156455	CTD Rosette	Recovery	607	115	6,7	-7,4	-1,40	31,24	1022,39	83	
5	DE420		2021-10-21	14:51	75,9690142	-85,6686807	C-OPS	Deployment	576	90	9,3	-7,5	-1,41	31,23	1021,55	90	
5	DE420		2021-10-21	15:35	75,9806917	-85,7351483	C-OPS	Recovery	560	88	12	-7,3	-1,36	31,24	1020,79	89	
5	DE420		2021-10-21	15:58	75,9715645	-85,6789123	CTD Rosette	Deployment	564	101	13,9	-7	-1,47	31,23	1020,32	86	
5	DE420		2021-10-21	16:14	75,972228	-85,6902625	CTD Rosette	Bottom	561	94	12	-7,1	-1,48	31,22	1020,11	84	
5	DE420		2021-10-21	16:38	75,9733777	-85,7013775	CTD Rosette	Recovery	559	93	14,3	-7	-1,47	31,21	1019,74	90	
5	DE420		2021-10-21	16:49	75,9786762	-85,728525	IKMT	Deployment	562	160	11,4	-6,9	-1,46	31,22	1019,91	87	
5	DE420		2021-10-21	16:59	75,9814825	-85,752658	IKMT	Bottom	562	90	10,5	-6,5	-1,47	31,22	1019,85	85	
5	DE420		2021-10-21	17:21	75,9850253	-85,8070607	IKMT	Recovery	558	82	13,1	-7,1	-1,46	31,22	1019,49	88	
5	DE420		2021-10-21	17:41	76,0014183	-85,8722947	C-OPS	Deployment	534	88	15,4	-6,6	-1,36	31,26	1018,95	85	
5	DE420		2021-10-21	17:50	76,0036997	-85,8928588	C-OPS	Bottom	518	99	15,8	-6,6	-1,42	31,25	1018,57	84	
5	DE420		2021-10-21	18:23	76,0133397	-85,9433077	C-OPS	Recovery	526	91	13,5	-6,4	-1,43	31,26	1018,47	85	
5	DE420		2021-10-21	19:05	75,9619597	-85,589189	CTD Rosette	Deployment	620	92	16,6	-6	-1,48	31,22	1018,15	85	
5	DE420		2021-10-21	19:22	75,9638228	-85,5931157	CTD Rosette	Bottom	616	88	17,5	-6,1	-1,48	31,21	1018,12	85	
5	DE420		2021-10-21	19:39	75,9652478	-85,5983702	CTD Rosette	Recovery	612	94	15,6	-6,2	-1,47	31,20	1017,93	85	
5	DE420		2021-10-21	22:24	75,962274	-85,5938197	CTD Rosette	Deployment		86	11,8	-1	-1,42	31,21	1016,55	70	
5	DE420		2021-10-21	22:24	75,9622755	-85,5938312	CTD Rosette	Deployment		95	9,5	-1	-1,42	31,21	1016,59	70	
5	DE420		2021-10-21	22:42	75,9629153	-85,599235	CTD Rosette	Bottom		81	11,6	-1,4	-1,44	31,22	1016,41	75	
5	DE420		2021-10-21	22:57	75,962822	-85,6029503	CTD Rosette	Recovery		95	8,8	-1,5	-1,47	31,22	1016,40	80	
5	DE430		2021-10-22	12:03	76,2251848	-81,736267	CTD Rosette	Deployment		20	9,5	-6,1	-1,56	31,13	1013,76	76	
5	DE430		2021-10-22	12:16	76,2250608	-81,7329758	CTD Rosette	Bottom		339	7,6	-4,1	-1,58	31,13	1013,70	71	
5	DE430		2021-10-22	12:20	76,2251158	-81,731447	CTD Rosette	Recovery		14	11,6	-3,7	-1,57	31,13	1013,60	71	
5	DE430		2021-10-22	12:51	76,223293	-81,6920215	C-node	Deployment		12	13,9	-7,1	-1,47	31,14	1013,11	79	
5	DE430		2021-10-22	14:33	76,222739	-81,6792622	AUV	Deployment		22	8,4	-6,5	-1,52	31,15	1012,19	79	
5	DE430		2021-10-22	15:26	76,2251118	-81,6637228	AUV	Recovery		111	2,1	-6,9	-1,52	31,15	1011,93	77	
5	DE430		2021-10-22	16:36	76,2273813	-81,6797442	CTD Rosette	Deployment	203				-1,55	31,19			
5	DE430		2021-10-22	16:44	76,2279558	-81,6779693	CTD Rosette	Bottom	205	59	0	-6,3	-1,50	31,20	1011,24	76	
5	DE430		2021-10-22	17:08	76,2302352	-81,6727195	CTD Rosette	Recovery	207	52	0,6	-6,5	-1,46	31,23	1011,12	76	
5	DE430		2021-10-22	17:47	76,2341092	-81,6678293	Barge	Deployment	213	99	5,5	-7,3	-1,42	31,23	1010,98	77	
5	DE430		2021-10-22	18:19	76,2442277	-81,652597	Flame-lite	Deployment	194	78	2,7	-6,6	-1,51	31,16	1010,83	76	
5	DE440		2021-10-23	0:36	76,2262515	-81,731481	CTD Rosette	Deployment	274	321	7	-7,8	-1,50	31,24	1009,38	73	
5	DE440		2021-10-23	0:45	76,2267652	-81,728797	CTD Rosette	Bottom	274	348	10,5	-8,6	-1,50	31,26	1009,42	72	
5	DE440		2021-10-23	0:56	76,2270122	-81,7275238	CTD Rosette	Recovery	273	349	7,2	-7,2	-1,49	31,28	1009,53	74	
5	DE440		2021-10-23	1:44	76,2253877	-81,7313937	WBAT	Deployment	279	26	2,5	-7,8	-1,53	31,32	1008,96	73	
5	DE440		2021-10-23	1:56	76,224416	-81,7300567	WBAT	Bottom	272	134	14,3	-8,6	-1,55	31,27	1009,09	74	
5	DE440		2021-10-23	2:49	76,2235587	-81,7001393	WBAT	Recovery	227	4	10,9	-8,8	-1,52	31,27	1008,84	67	
5	DE440		2021-10-23	3:24	76,2273672	-81,7371598	CTD Rosette	Deployment	297	14	16,2	-8,7	-1,54	31,27	1008,62	62	
5	DE440		2021-10-23	4:31	76,2296947	-81,7283063	CTD Rosette	Recovery	294	340	9,7	-7,5	-1,54	31,31	1008,71	69	
5	DE440		2021-10-23	12:27	76,2262378	-81,7347418	Bongo Net	Deployment	277	345	13,7	-9,5	-1,55	31,31	1008,88	70	
5	DE440		2021-10-23	12:34	76,2265457	-81,7343733	Bongo Net	Recovery	278	208	16,9	-9	-1,57	31,30	1009,11	70	
5	DE440		2021-10-23	12:37	76,2267385	-81,7341273	Bongo Net	Deployment	283	352	10,5	-7,7	-1,56	31,29	1009,17	73	
5	DE440		2021-10-23	12:41	76,2269698	-81,7331378	Bongo Net	Bottom	286	350	9,9	-6	-1,56	31,29	1009,12	65	
5	DE440		2021-10-23	12:45	76,2273138	-81,73107	Bongo Net	Recovery	290	2	10,9	-5,8	-1,55	31,28	1009,23	67	
5	DE440		2021-10-23	12:48	76,227618	-81,7295347	Bongo Net	Deployment	287	331	7,2	-5,5	-1,56	31,28	1009,14	68	
5	DE440		2021-10-23	13:13	76,2248445	-81,7322343	CTD Rosette	Deployment	272	354	13,3	-6	-1,49	31,27	1009,39	64	
5	DE440		2021-10-23	13:25	76,2255538	-81,7276915	CTD Rosette	Bottom	278	311	5	-8,5	-1,45	31,28	1009,47	69	
5	DE440		2021-10-23	13:46	76,226059	-81,7200893	CTD Rosette	Recovery	260	2	5,1	-9,2	-1,46	31,27	1009,48	69	
5	DE440	Sea Ice	2021-10-24	0:59	76,1837417	-81,8370118	Hydrobios	Deployment	233	19	11,6	-9,2	-1,60	31,36	1011,53	61	
5	DE440	Sea Ice	2021-10-24	1:07	76,1830167	-81,8329938	Hydrobios	Bottom	231	24	9,3	-9,1	-1,47	31,33	1011,50	62	
5	DE440	Sea Ice	2021-10-24	1:15	76,1825372	-81,8291047	Hydrobios	Recovery	230	17	11,2	-8,9	-1,57	31,33	1011,47	67	
5	DE440	Sea Ice	2021-10-24	1:47	76,1816945	-81,8174823	UVP	Deployment	227	14	9,3	-8,7	-1,60	31,35	1011,44	68	
5	DE440	Sea Ice	2021-10-24	4:07	76,1953008	-81,773279	UVP	Recovery	212	30	0,8	-8,4	-1,54	31,38	1011,33	74	
5	DE440	Sea Ice	2021-10-24	5:04	76,1808905	-81,830436	CTD Rosette	Deployment	230	129	2,1	-8,3	-1,62	31,29	1011,40	78	
5	DE440	Sea Ice	2021-10-24	5:15	76,181662	-81,8311908	CTD Rosette	Bottom	231	96	1,1	-8	-1,62	31,29	1011,29	77	
5	DE440	Sea Ice	2021-10-24	5:47	76,1838863	-81,8242542	CTD Rosette	Recovery	233	34	8,9	-8,3	-1,52	31,29	1011,14	68	
5	DE440	Sea Ice	2021-10-24	13:50	76,2539788	-81,8358017	Canoe	Deployment	586	8	3,8	-7	-1,62	31,42	1010,14	64	
5	BB2		2021-10-25	18:03	72,7493115	-67,0016382	CTD Rosette	Deployment	2370	277	12	-3,1	-0,56	31,61	1005,92	80	
5	BB2		2021-10-25	18:35	72,7476485	-66,9948613	CTD Rosette	Bottom	2370	234	3	-3,4	-0,56	31,62	1006,29	80	
5	BB2		2021-10-25	19:49	72,7446857	-66,968465	CTD Rosette	Recovery	2369	208	0,8	-2,7	-0,55	31,62	1006,74	78	
5			2021-10-27	10:37	68,0804413	-58,7854297	CTD Rosette	Deployment	270			3,1	1,16	31,89	1007,24	87	
5			2021-10-27	10:45	68,080992	-58,7821047	CTD Rosette	Bottom	269			1,6	1,15	31,89	1007,39	96	
5			2021-10-27	10:56	68,0816798	-58,7789053	CTD Rosette	Recovery	270			2,8	1,16	31,88	1007,22	90	
5			2021-10-27	11:14	68,081712	-58,7713472	Hydrobios	Deployment	270			0,9	1,17	31,88	1007,24	99	
5			2021-10-27	11:26	68,0816325	-58,768365	Hydrobios	Bottom	269			0,7	1,18	31,88	1007,23	99	
5			2021-10-27	11:37	68,0809683	-58,761278	Hydrobios	Recovery	270			0,6	1,15	31,88	1007,11	99	
5			2021-10-27	11:55	68,0801997	-58,7578038			270			0,6	1,19	31,87	1007,13	99	
5			2021-10-27	12:02	68,0801093	-58,7572367	Hydrobios	Deployment	271			2,6	1,15	31,88	1007,14	93	

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						
5			2021-10-27	12:10	68,0802258	-58,7551322	Hydrobios	Bottom	269			0,9	1,15	31,88	1007,23	98	
5			2021-10-27	12:25	68,0814327	-58,7504608	Hydrobios	Recovery	270			2,6	1,13	31,87	1007,11	88	
5			2021-10-27	12:48	68,050815	-58,7473725	IKMT	Deployment	268			0,7	1,20	31,86	1007,21	99	
5			2021-10-27	12:59	68,0522203	-58,7277873	IKMT	Recovery	269			0,5	1,18	31,89	1006,97	99	

Appendix 5 - ROV Dives Reports for the 2021 Amundsen Expedition

Refers to the project on Deep-water coral and seep habitats of the Northern Labrador Sea and Baffin Bay: biodiversity, microbiology, paleoceanography, and conservation; Leg 2.

Site 1: Makkovik, dives C13-C15, 19-21 July 2021.

The environment being sampled at Makkovik is near the landward end of one of the largest glacially excavated shelf-crossing troughs of the Labrador Shelf (figure). Bycatch of large gorgonian corals had been reported from the Makkovik Trough and Okak Trough further north, both by Inuit fishermen, Newfoundland fishermen, and from the Fisheries Observer Program. Nonetheless, it was not known what sort of habitat hosted these species, which normally occur in NL waters only on the upper continental slope. . Similarly, large sponges are recognized as Vulnerable Marine Ecosystem (VME) taxa, but normally occur only on the continental slope. Other bycatch records and DFO box core or drop camera records from 2020 near Makkovik included sea pens and soft corals, indicating a complex mosaic of bottom types in a relatively small area. Inuit fishermen have noted very steep slopes and a high risk of fishing gear in this area, although fishing effort maps still show intensive fishing in the Makkovik trough, mostly fixed-gear fisheries for crab and groundfish. *Amundsen* multibeam sonar data from 2020 and this voyage showed a highly dissected glacially carved seascape of steeply sloping bedrock edifices gradually deepening from South to North, leading to mega-scale glacial lineations (MSGL) that eventually connect to the rest of the Makkovik trough leading out to the shelf break (figure 3).

The Makkovik site lies just at the edge of the 12 nautical mile boundary of the Imappivut area, or Nunatsiavut marine zone. The site of potential interest to the Nunatsiavut Government Imappivut marine conservation program, as well as to DFO in aiming to conserve the full range of marine habitats in Newfoundland and Labrador waters.

CTD casts before the ROV dives and at the site of the Makkovik mooring deployed in 2020 (which was recovered on this mission) showed a strong water-mass boundary about 300-350 m depth, separating cold, relatively low salinity water of the cold intermediate layer waters from warmer saltier water, probably Labrador Slope Water (figure 4). LADCP measurements of currents from the CTD casts showed modest bottom currents, generally less than 20 cm/s, but variable surface currents up to 50 cm/s (Figure 5).

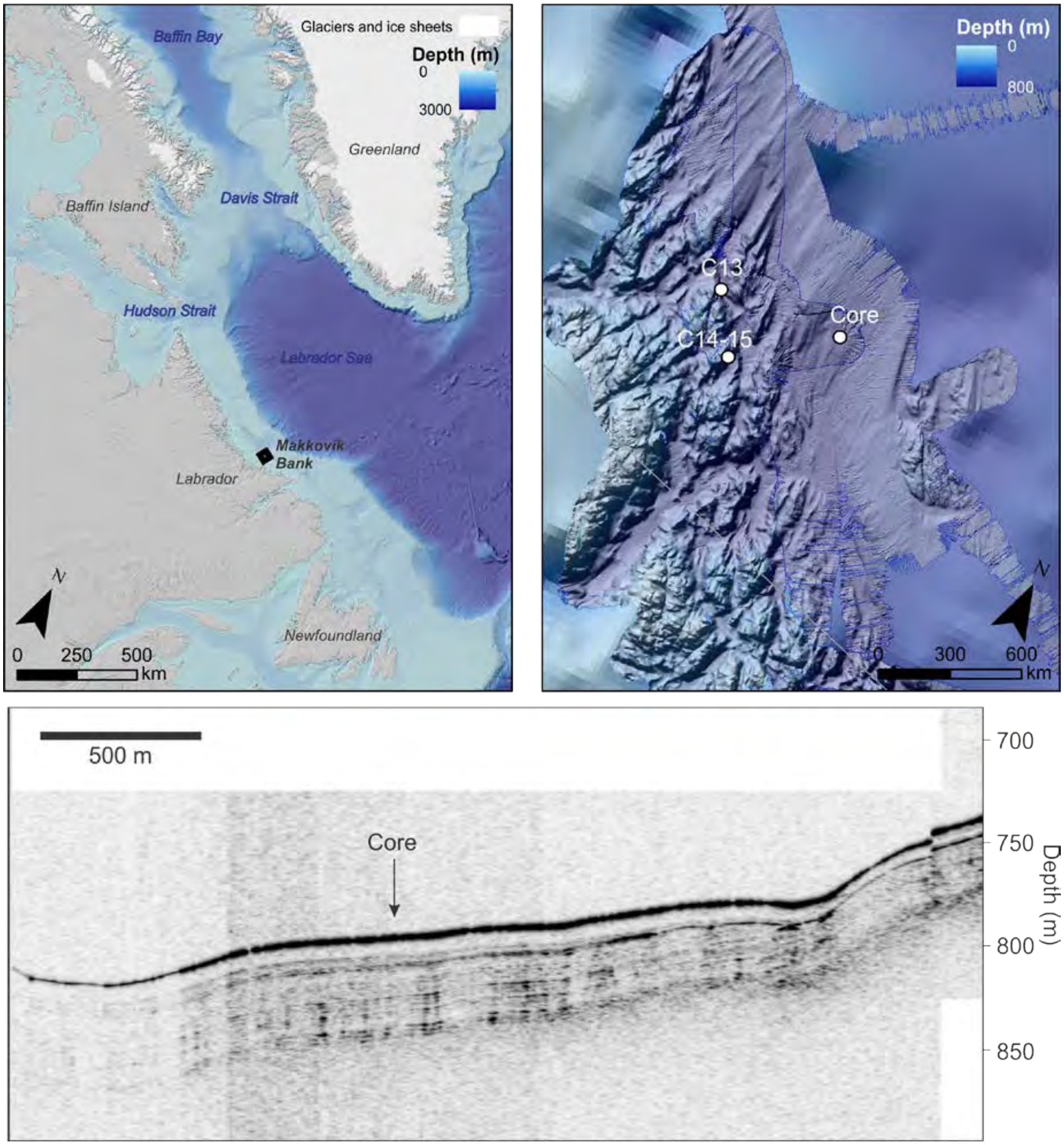


Figure 3. Mapping, ROV dives, and coring at the Makkovik site. A: site location. B. Combined 2020 and 2021 multibeam bathymetry of the Makkovik site, showing the lcoations of the ROV dives and the long gravity core. The southern end of this area shows the highly dissected glaciated landscape, while the northern end, shows depositional features like mega-scale glacial lineations (MGSL). Grey diagonal line is the boundary of the Imappivut zone (Nunatsiavut marine zone). C. sub-bottom profile at location of long gravity core. Image courtesy of Alexandre Normandeau, GSC.

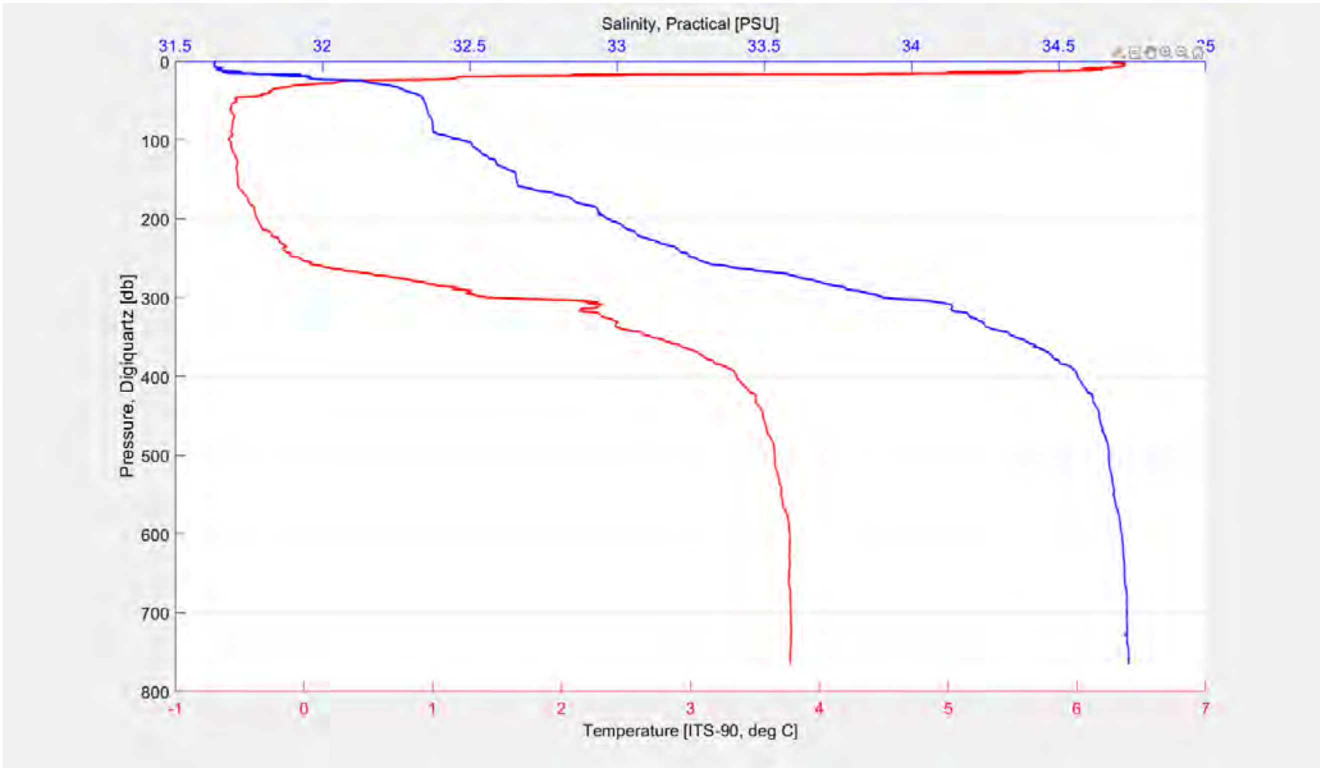


Figure 4. Temperature and salinity plots for Makkovik Trough (CTD cast 2021006, ROV dives C13-C15).

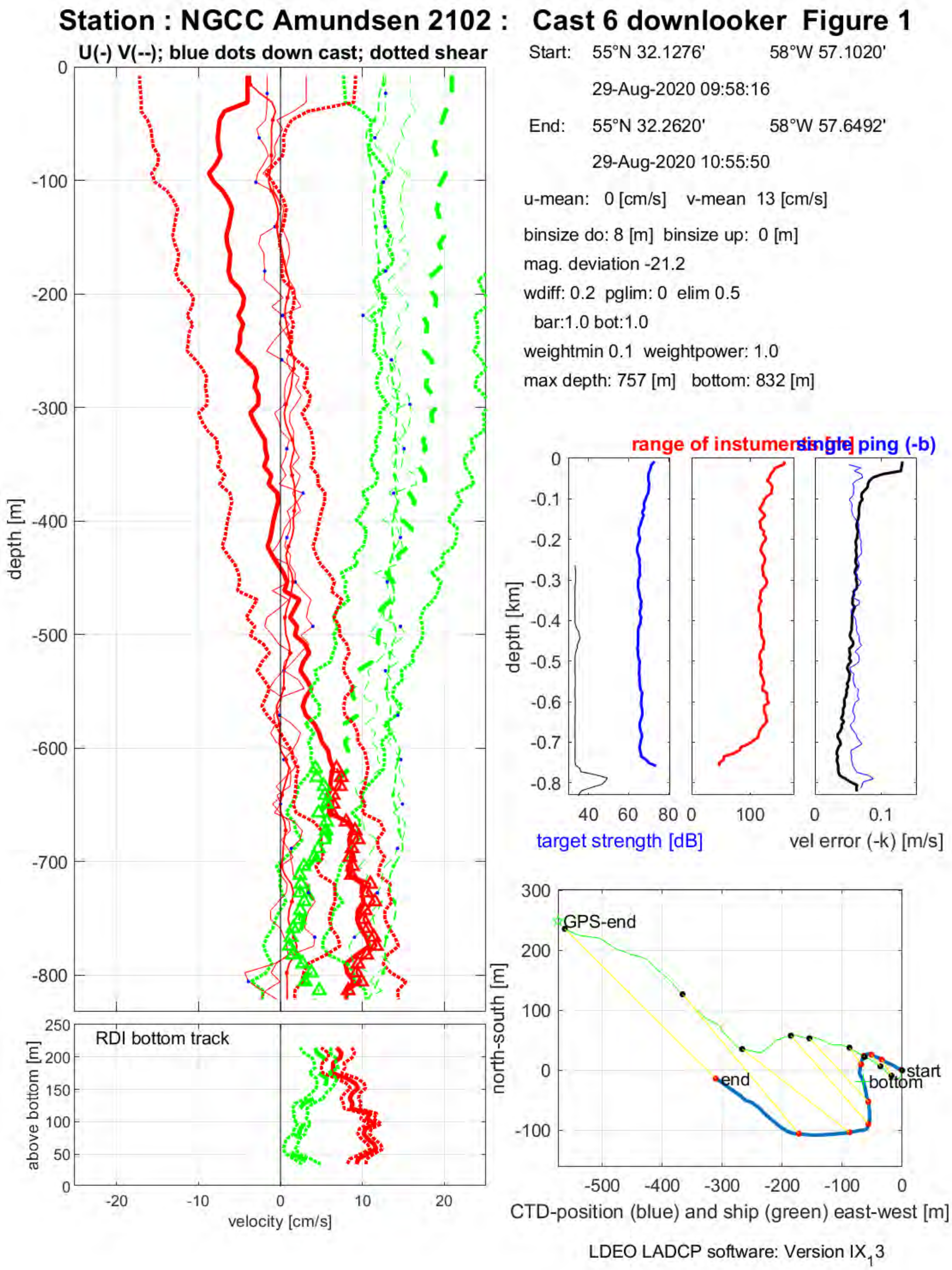


Figure 5. Bottom current measurements at Makkovik from the LADCP unit on the CTD/Rosette.

Dive C13: Makkovik 1 (55.53179N, -58.9591W), 700-515 m. 19 July 2021.

This was the first scientific dive of the mission, and also the first scientific dive executed with this ROV. Given that the ROV did not dive during Amundsen Sea Trials in June, and that the ROV test dive in Conception Bay had to be aborted due to electrical problems, it was not surprising that there would be a learning curve for operating a new ROV on the ship. Furthermore, because the Comanche 38 is operated from the foredeck of the ship, without a tether management system (TMS, or "cage"), coordination of ship movement and ROV movement, and cable management near the surface, required a different approach to ship-handling. Even had the ROV been successful tested during sea trials, this would have been the first dive below 250 m (the depth of the Saguenay Fjord sea trials location). Therefore, we expected, correctly, that some of the time allocated to this dive would be consumed with learning how to use this ROV effectively from the Amundsen. More than 1.5 hours of the dive was spent with the ROV off bottom while the ship was adjusting its position relatively to the ROV and the planned transect line (see map, figure 6). Furthermore, a software error in the second camera (alpha-cam) meant that no digital still camera (DSC) images were recorded during this dive.

This dive began on flat to gently inclined soft bottom with abundant anemones of at least 3 species, plus cerianthids, where we collected push cores for Algar lab. We quickly encountered the first rock wall, which was steeply inclined, but not vertical, with slopes between 50 and 70 degrees, according to the 2020 multibeam sonar. Many parts of this rock wall had a veneer of sediment on them, visible, but thin enough that the rock could be seen beneath it (figure ---). We were unable to see enough fresh, unweathered and unencrusted, views of the rock face to assess rock type, but it appeared to be well-indurated igneous or metamorphic rock, based upon the fracture and erosional patterns. Wherever the slope lessened, on ledges within the rock face, fine-grained sediment was observed accumulating. The origin of this sediment is unknown, but is likely resuspended from the shallow sandy Makkovik Bank nearby, rather than hemipelagic sediment of biogenic origin (A. Normandeau, GSC, pers. comm.).

The fauna on these steeply inclined rock walls was dominated by a variety of sponges, mostly demosponges and some glass sponges (figure 7). We saw one unidentified carnivorous sponge (possibly *Asbestopluma*). Where the rock wall became steeper, we saw a few *Primnoa* corals, and 1 *Paragorgia* coral. Unfortunately, the time lost to working out the joint navigation of the ship and the ROV meant that we were unable to complete the planned transect, and in particular, we did not as far as the second, steeper rock face, with slopes exceeding 70 degrees. Seeing very few corals, we did not collect corals along the cliffs, but we did collect one sponge as a voucher specimen for sponge ID (table ---, appendix), and one sea pen.

Where the slope lessened, at the top of the first underwater cliffs, the bottom returned to a sandy mud bottom with abundant anemones, much like the bottom at the beginning of the dive.

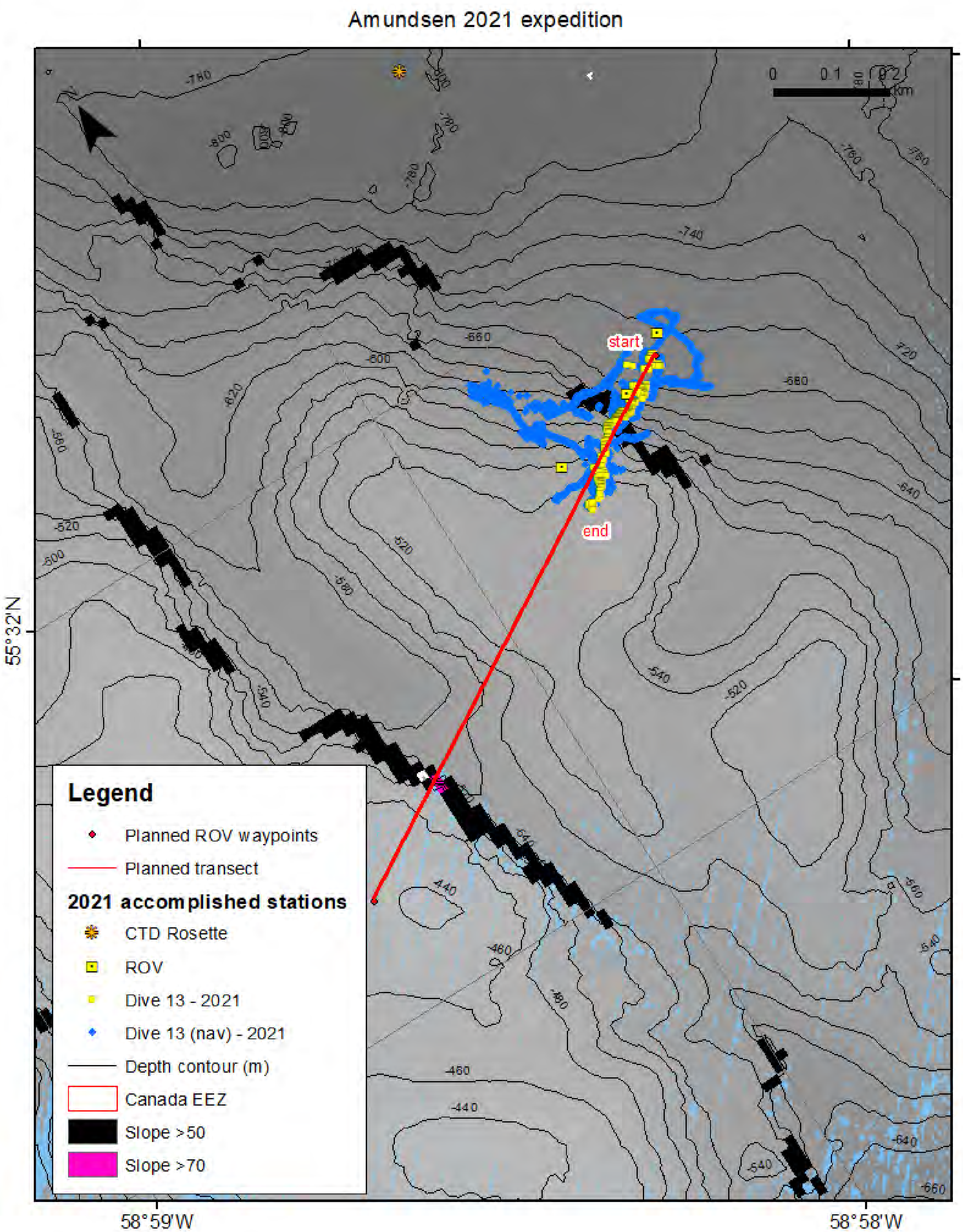


Figure 6. Map of Makkovik dive 1, showing planned and accomplished ROV and drop-video transects during the 2021 CCGS *Amundsen*.

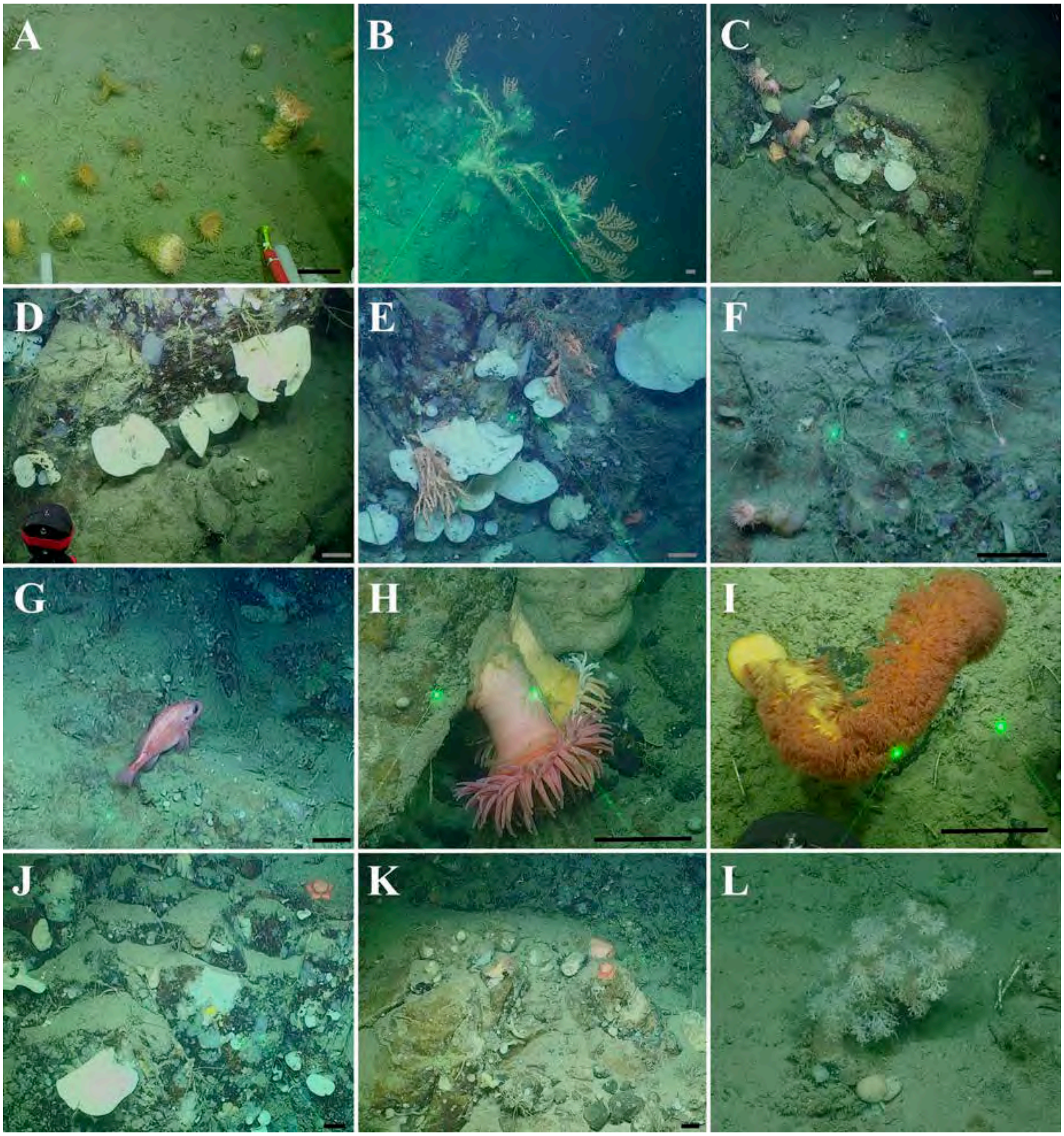


Figure 7. Photo-plate of sediment-draped bedrock observed during the ROV investigation at Makkovik dive C13. Lasers are 10 cm apart. Images are frame-grabs from the mini-Zeus HD camera, and are not full resolution. A) Soft bottom area at beginning of dive, with a field of sea anemones. B)Partially dead colony of *Paragorgia arborea*, C) rocky substrate colonized by an unidentified sponge, D) close-up of sponges, E) close-up of sponges and small colonies of *Primnoa resedaeformis*, F) close-up of dead branch colonized with hydroids, G) Redfish (*Sebastes* sp.), H) Close-up of sea anemone, I) close-up of sea pen *Anthoptilum* sp., J-K) diversity on rocky substrate, L) Nephtheidae soft coral.

Dive C14: Makkovik Dive 2, 55.51692N/-58.9425W, 685-550 m, 20 July 2021

The second dive planned for the Makkovik site also targeted steep rock walls, with the maximum slope in the 2020 multibeam sonar data exceeding 70 degrees in this location (figure 8). The wall orientation was similar to that in the first dive, facing approximately northeast. Similar to the first dive, the bottom on landing was flat to gently sloping soft sediment, which proved to be cohesive mud when sampled with the ROV-push cores. As observed at the first site, the steep rock wall here appears to be igneous or high-grade metamorphic rock, without obvious bedding, but with apparent jointing at 60-90 degree angles in some places. Also similar to the first site, where the slope was less steep, sediment veneer was observed on the rock, and the fauna was dominated by a variety of sponges (figure 9). Where the slope became more nearly vertical, we observed abundant *Primnoa resedaeformis* corals, all hanging vertically downward, with the holdfast at the highest point. The sediment surface in these higher slope areas was free of sediment. Nearly all the coral observed on the vertical rock walls were *Primnoa*. The *Primnoa* colonies at this site appeared to be longer and narrower, and perhaps with thinner stems, than the *Primnoa* colonies found at cobble-boulder bottom elsewhere.

Unfortunately, this dive was aborted, due to damage to the ROV umbilical cable incurred while the ROV was ascending the near-vertical cliff and the ship overtook the ROV. Caution demanded inspection of the cable, which showed a ~1 m section of the cable where the outer cable jacket had been torn by the rock face. Fortunately, no water had entered any of the electronics, and the cable was re-terminated quickly by the ROV team. The retermination of the cable proceeded quickly enough that we were able to carry out a repeat survey of the second dive location in Makkovik the following day. The cruise PIs determined that the Makkovik site was a high priority site for the DFO team in particular, and warranted adjusting the mission schedule to allow an extra day in Makkovik to complete the ROV-based sampling and surveying objectives.

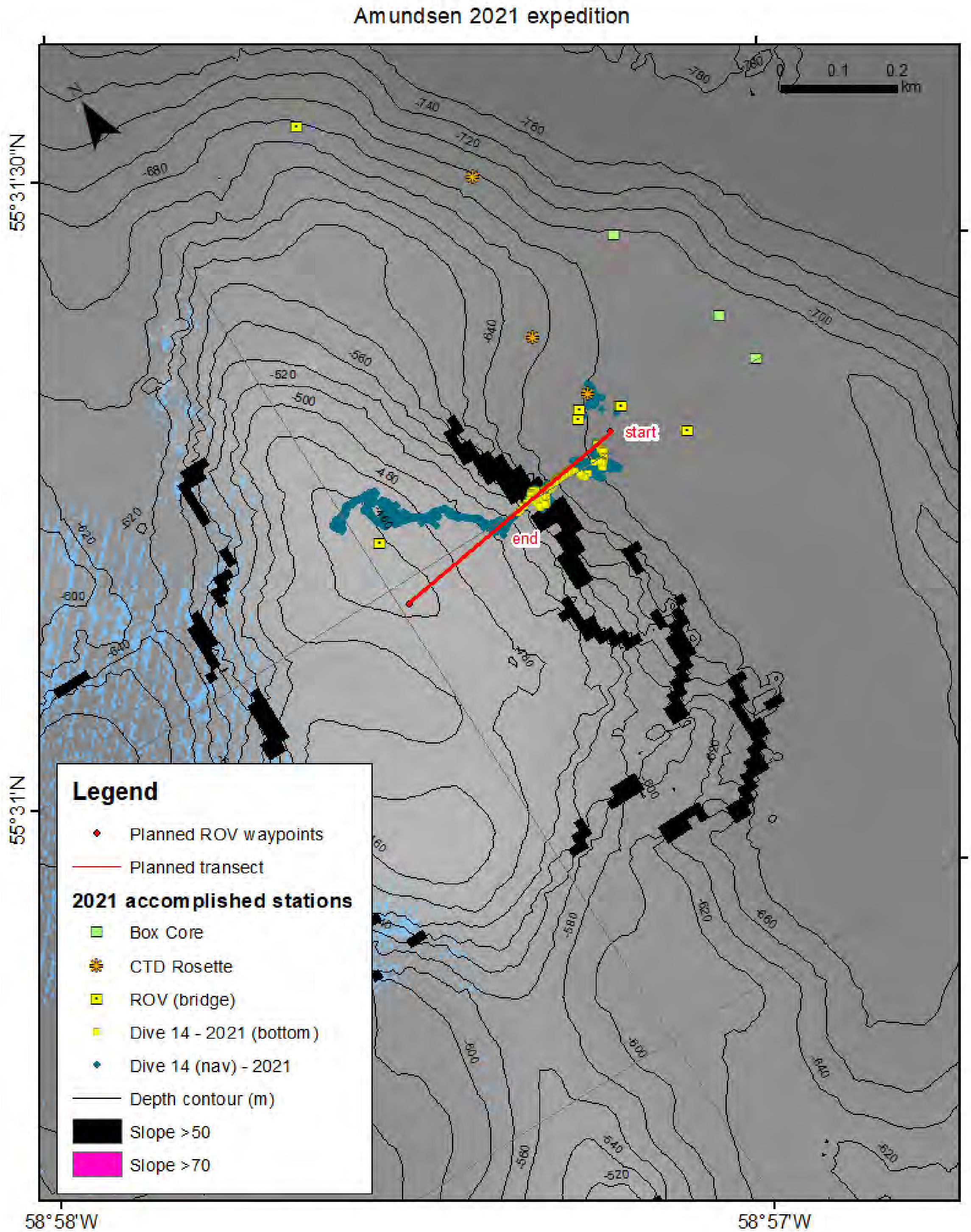


Figure 8. Map of Makkovik dive site 2, showing the tracks of dive C14, on 20 July.

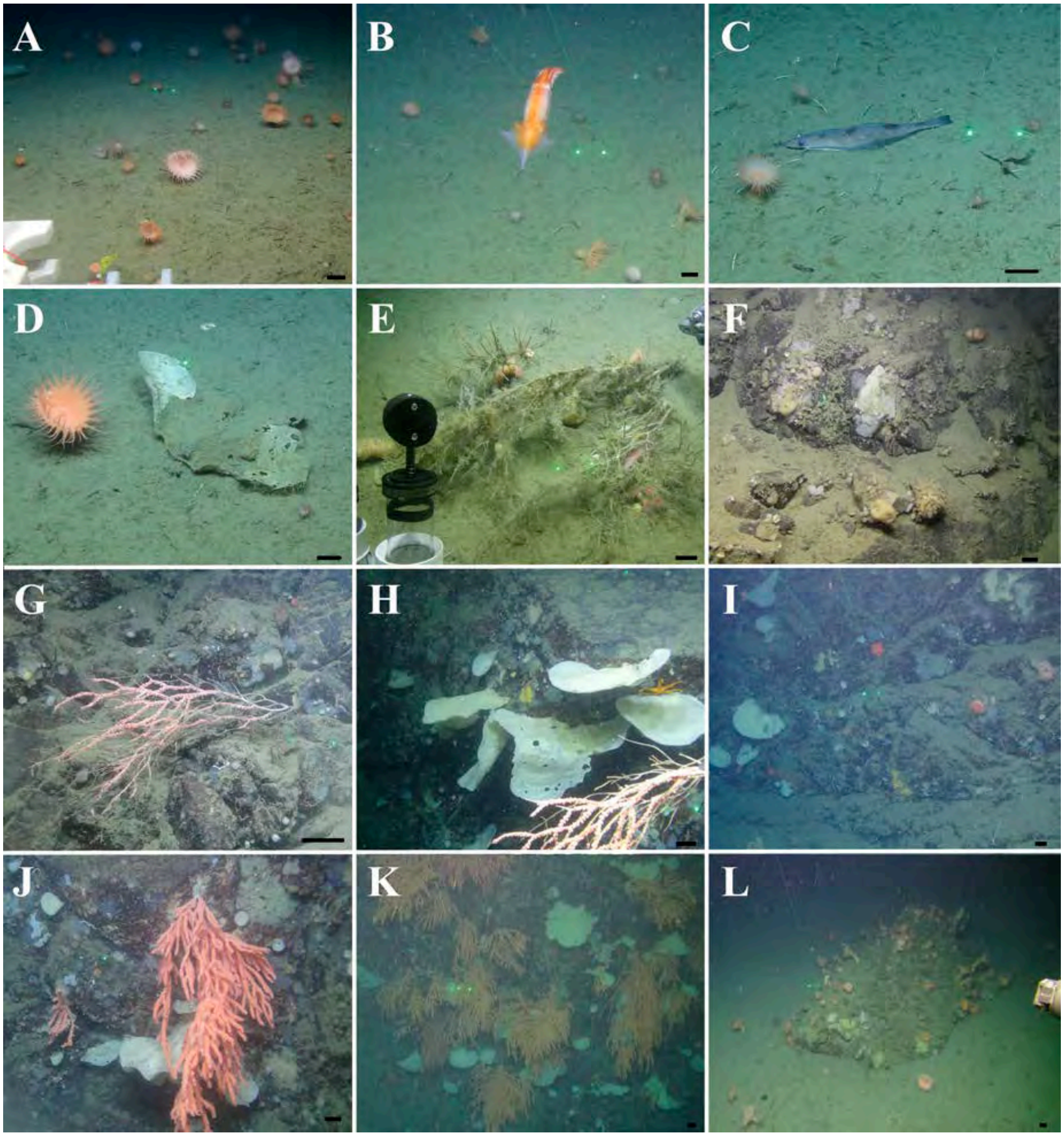


Figure 9. Photo-plate of bottom substrates observed during dive C14. Lasers are 6.25 cm apart (digital still images from Alpha-Cam). A) Soft bottom area at beginning of dive, with a field of sea anemones, B) close-up of squid, C) Halibut, D) close-up of sea anemone and sponge on soft sediment, E) large dead coral skeleton colonized with hydroids and carnivorous sponges (push-core handle seen), F) rocky substrate, G) partially dead *Primnoa resedeaformis* on rocky wall, H) close-up of *P. resedaeformis* and unidentified sponge, I) rock wall covered with sediment, J-k) *Primnoa resedaeformis* on vertical wall, L) boulder colonized with sea anemones on soft bottom area.

Dive C15, (launch coordinates, depth, July 21, 2021.

This ROV dive revisited the location of Dive C14, which was truncated due to the damage to the umbilical cable on the bedrock cliff (figure 10). The first half of the dive completed a video transect up the steep cliff, in the habitat occupied by *Primnoa* corals on vertical rock wells (figure 11). Ship positioning problems required a lateral shift to north during this vertical transect, which then continued to the top of the near-vertical cliff. We then descended to the base of the cliff for a repeat transect about 100 m northward. Unfortunately, just before the start of the second vertical transect, the ROV positioning beacon ceased to function, such that the position and depth of the ROV no longer change in the IRLS log after that point. We ascended the cliff for another vertical video transect, then spend the remainder of the dive collecting samples near the top of the cliff, in about 555 m water depth (actual depth, from the pressure-transducer depth gauge on the ROV, not from the USBL beacon). Sampling focused on sponges for voucher specimens, and *Primnoa* corals for genetics, carbonate production estimates, sclerochronology, and paleoceanography. The last *Primnoa* coral collected had a number of shrimp and one fish in it, which did not swim away when the coral was collected. The fish was identified as a thread-fin rockling, *Gaidropsarus ensis* (figure 11).

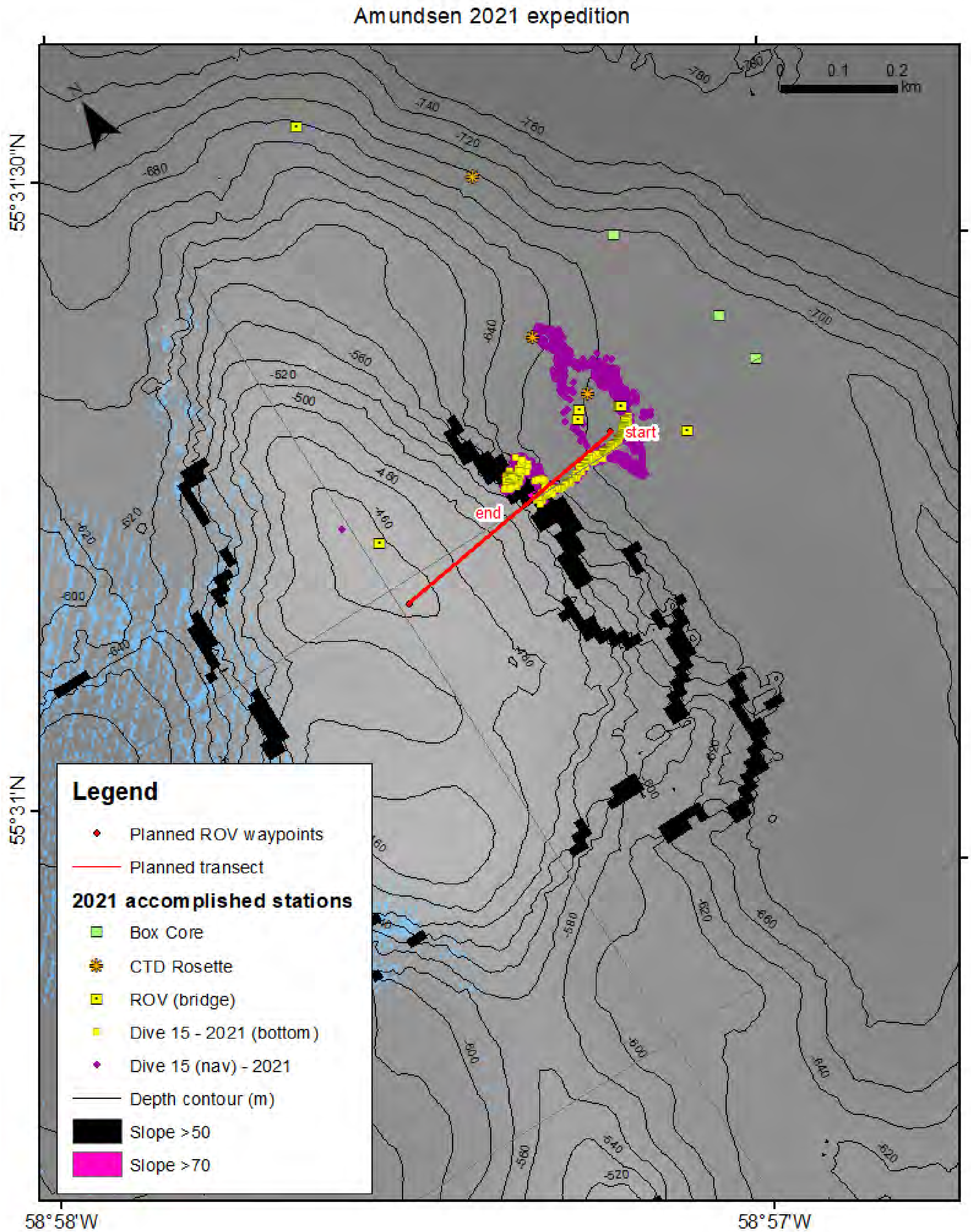


Figure 10. Map of ROV dive C15, Makkovik.

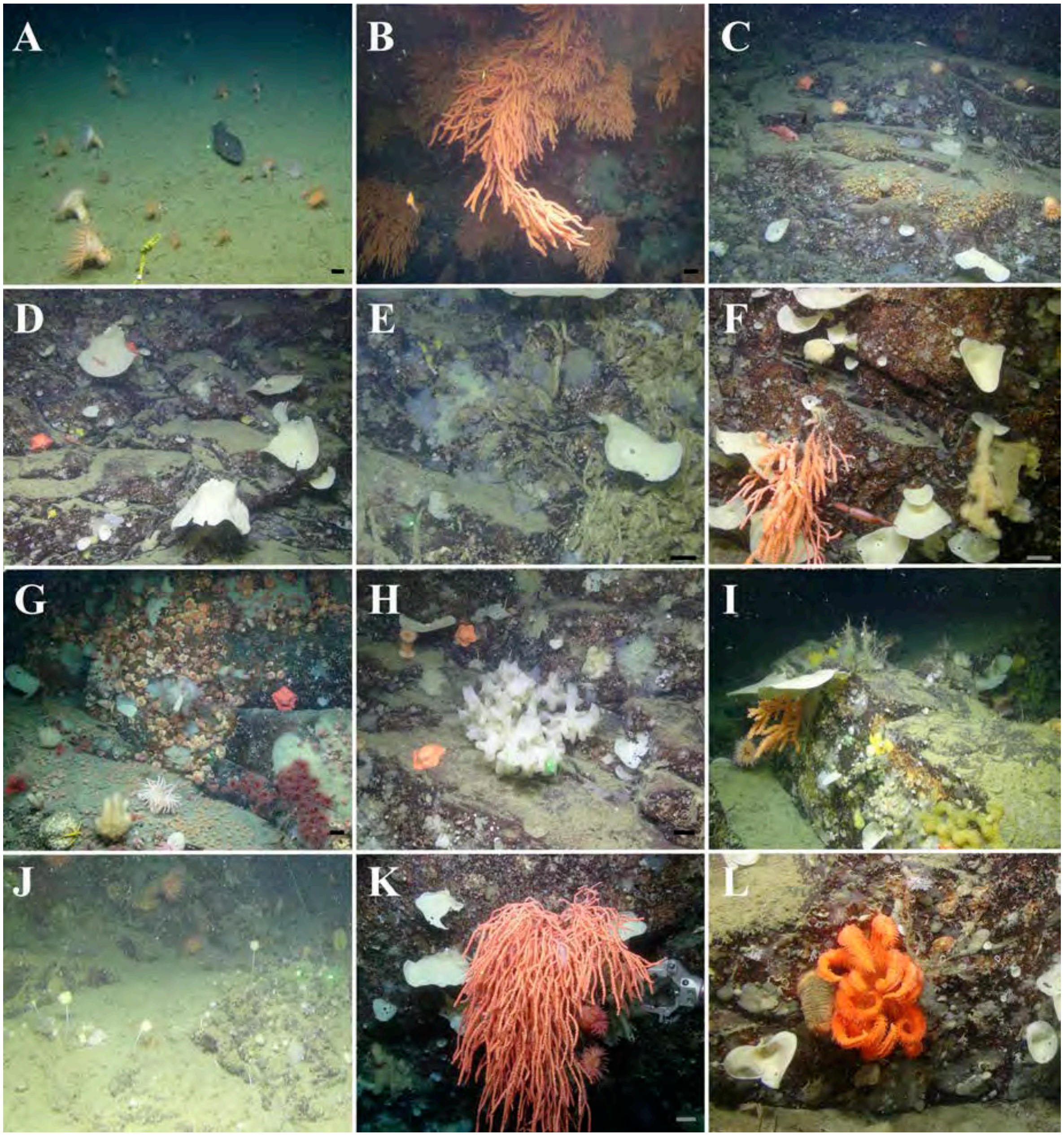


Figure11. Photo-plate of megafauna observed during the Dive C15 at Makkovik Trough. A) Halibut and sea anemones on flat portion of dive, B) large *Primnoa resedaeformis* colonies on vertical wall, C) diversity of other fauna on wall, including several small sea anemones, sponges, and Redfish (*Sebastes* sp.), D-F) sponges and *P. resedaeformis* on wall (note sediment accumulated on D and E, but not in F (high slope), G) diversity of other fauna on wall, including several small sea anemones, sea stars and sponges, H) glass sponge (*Asconema* sp.) and sea stars, I) sponges and *P. resedaeformis*, J) rocky substrate covered with sediment, some lollipop sponges, K) P. *resedaeformis* (being sampled), sponges, and sea anemones, L) brisingiid sea star, sponges, sea anemones, and bryozoans.

Dives C16-C19: NE Saglek Bank (24-25 July 2021).

The NE Saglek Bank area is one of the most important sites for cold-water corals in Newfoundland and Labrador waters, and has been visited with Amundsen ROVs in 2016 and 2018. The primary purpose of the ROV dives here in this mission were to collect Primnoa resedaeformis coral skeletons for carbonate production and sclerochronology, and to survey previously unknown locations and features within the NE Saglek coral hotspot. Other activities at the site included two mooring recoveries, plus one mooring redeployment, bottom mapping, and pelagic sampling for plankton and midwater fish. Of the two locations chosen for ROV dives in the 2021 mission, one was already known to host abundant Primnoa corals based upon drop-video surveys in 2020 (figure 12). The other dive targeted a large geomorphic feature identified from multibeam sonar on the NE Saglek Bank slope that resembles a retrogressive slope failure. Bottom current modeling by MUN physical oceanography student and cruise participant Josiane Ostiguy based on 2018 current mooring data and the tide tables for the nearest coastal stations predicted the times and strengths of bottom currents at NE Saglek Bank, where the currents are linked to the Frobisher Bay macrotidal oscillation. The strong bottom currents at this site required us to divide the ROV dives for each day into two short dives, each timed to the slack tide time of lowest predicted bottom currents. The CTD-based temperature and salinity profile for this site is presented in figure 13, and the bottom urrent measurements immediately before the first dive are presented in figure 14.

Dive 16. NE Saglek Bank Dive 1, (lat/long; depth) 24 July, 2021, morning.

Launch was about 1.5 hours later than intended based upon the predicted tidal currents table. Video transect found this location to be dominantly sandy gravel, with abundant soft corals on the cobbles, and occasional sea pens in the gravelly sand between the larger stones (figure 15). Where boulders occurred, they were colonized by *Primnoa resedaeformis* corals, and more rarely, but *Paragorgia arborea*. Abundant and diverse sponges were found, again mostly on boulders. The first sampling objective was colour calibration card photos with corals and echinoderms. Unfortunately, by the time this operation was completed, the tidal currents had increased in strength to the point that the ROV could no longer move up-current along the planned transect line, and could not hold position to collect samples. This dive was aborted early, with a plan to dive again in the early afternoon, and to be descending with the ROV while the tidal currents were predicted to be decreasing, to allow us the maximum slack-tide bottom time possible. We also changed the sequence of CTD casts to ensure that more instrumental casts with the laterally-facing ADCP would be collected, to compare against the tidal current model.

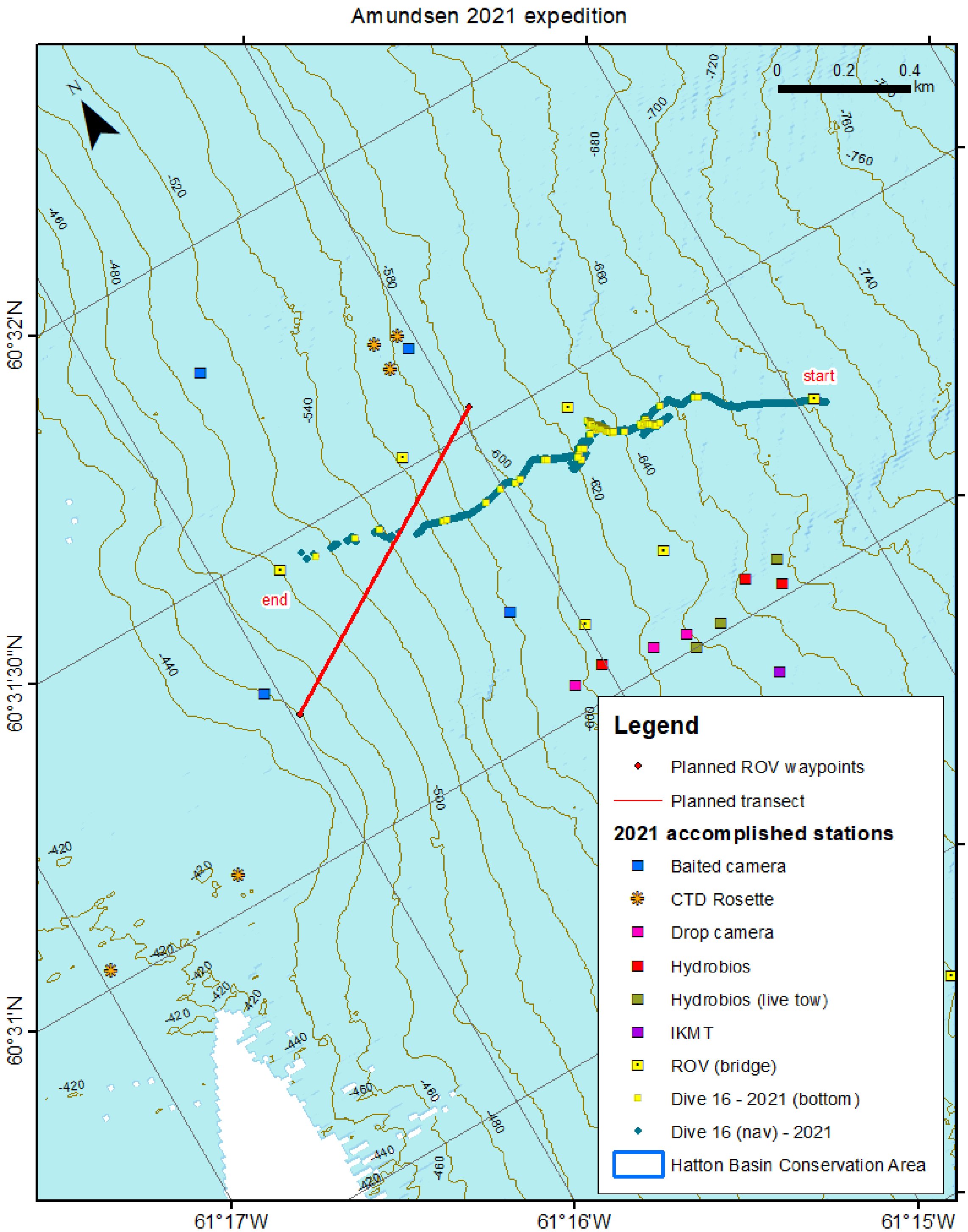


Figure 12. Map of dive C16, showing planned and accomplished transects. Contour interval 10 m.

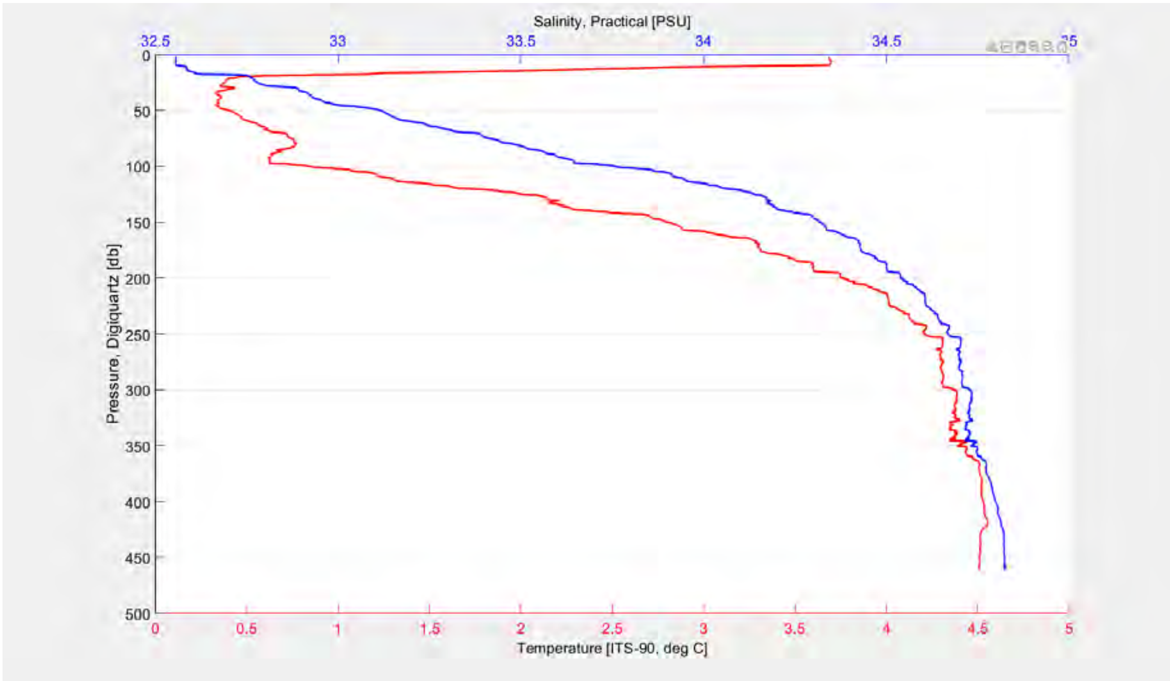


Figure 13. Temperature and salinity plot for NE Saglek Bank (position at start of dive, depth ~620 m).

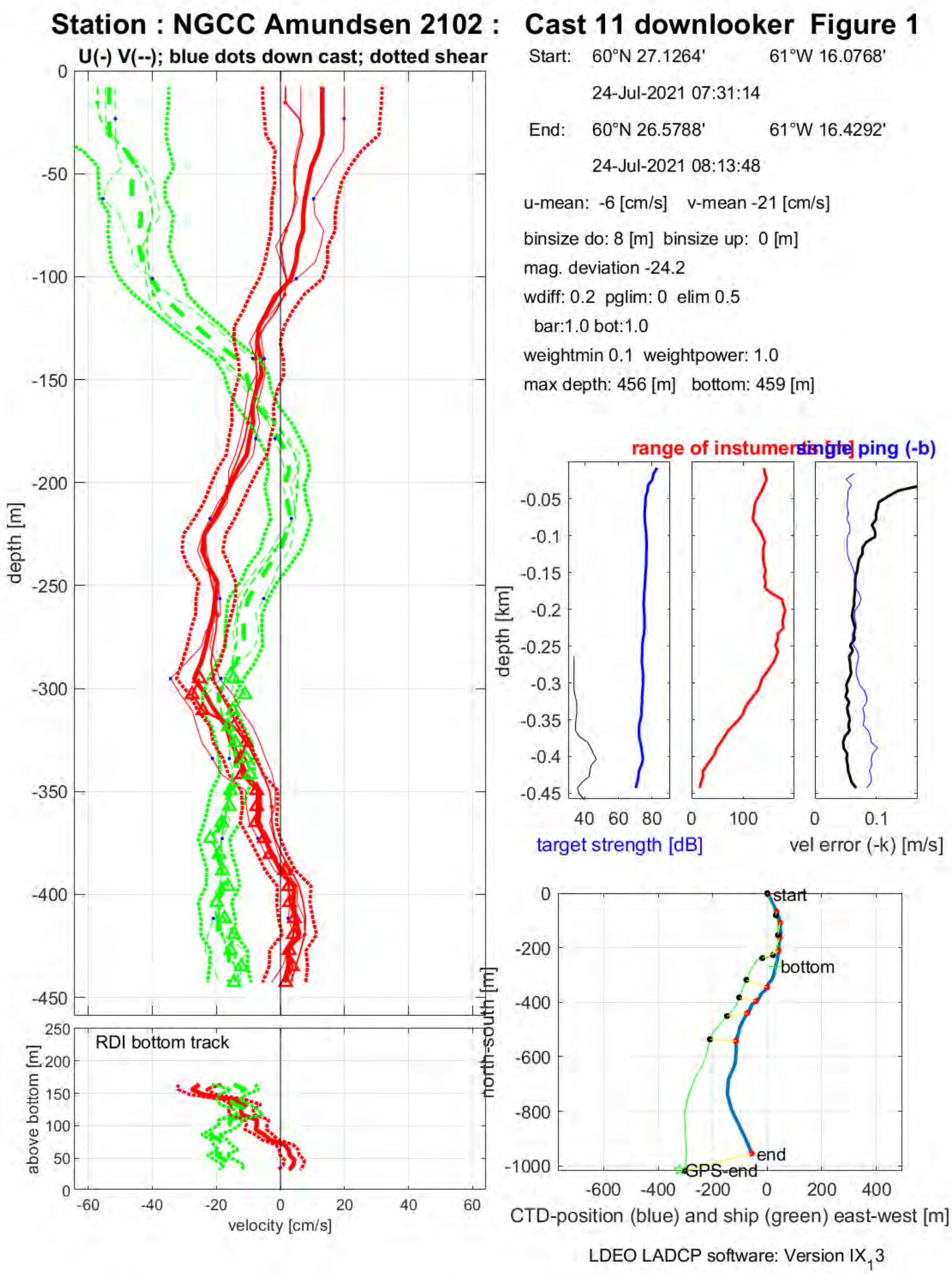


Figure 14. Bottom current observations at NE Saglek Bank, immediately before start of dive 16, from the LADCP unit on the CTD/Rosette.

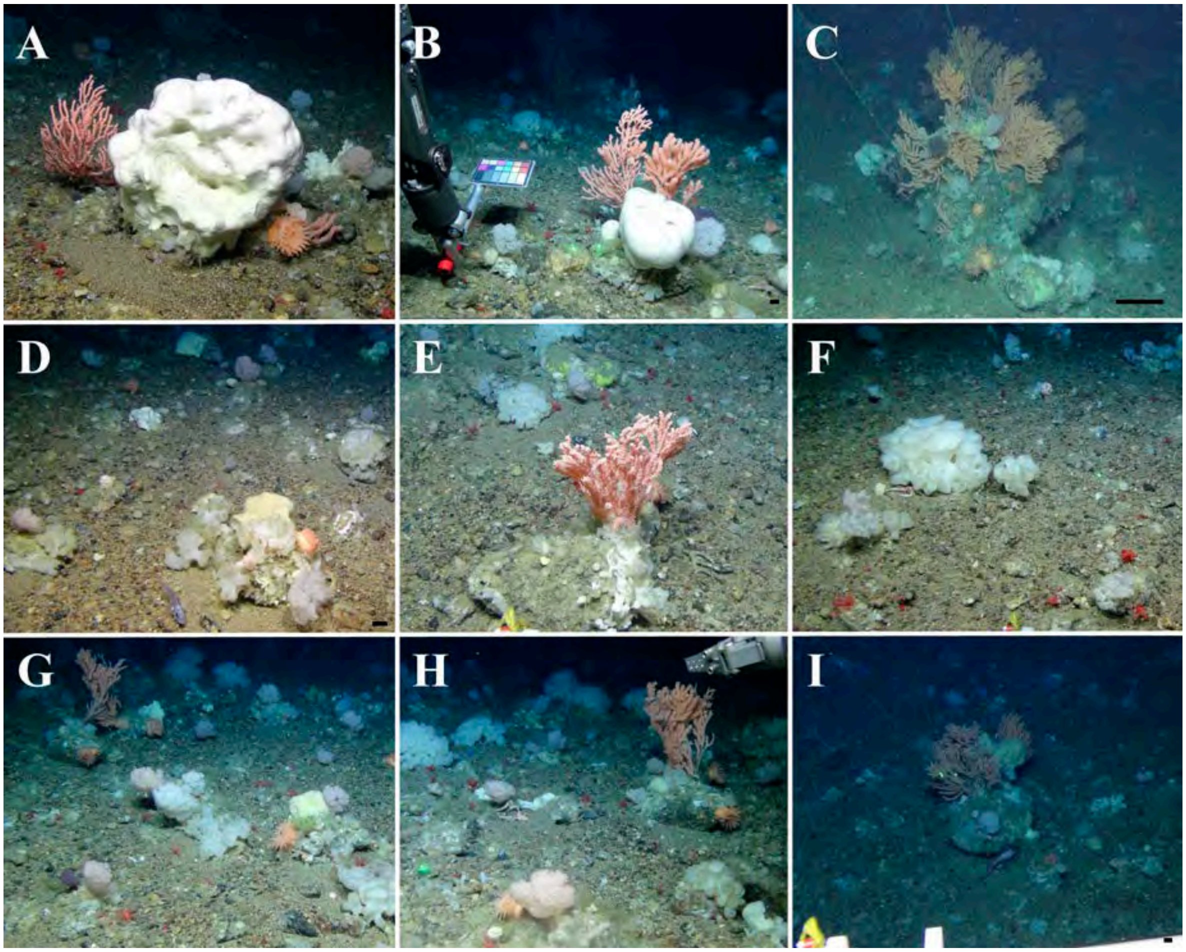


Figure 15. Photo-plate of observations on dive C16. A) large *Geodia* sp. sponge and *Primnoa resedaeformis*, B) same species seeing in A and use of color card, C) large boulder colonized with *P. resedaeformis* and sponges, D) gravelly bottom with Nephtheidae soft corals, glass sponges (*Asconema* sp.), and a grenadier, E) *P. resedaeformis* live on rock and dead branch on the seafloor, glass sponges, and several mushroom corals (*Anthomastus* sp.), F) large *Asconema* sp. with squat lobsters near it, soft corals, mushroom corals, G-I) bottom dominated by Nephtheidae soft corals, sponges, mushroom corals, and large *P. reseadaeformis*.

Dive C17, NE Saglek Bank site 1, Dive 2, 60.51945, -61.24395, 24 July 2021.

The focus of this dive was primarily specimen collection, particularly collection of live *Primnoa* corals and dead *Primnoa* skeletons for carbonate production analysis and paleoceanography. This was the 2nd, afternoon, dive for this site, and was timed to descend while bottom currents were predicted to be strong but declining, to allow maximum bottom time during slack tide. This strategy was effective. We used slightly more than 2 hours of bottom time in collecting, before the current strenght increased again to the point that we could no longer collect or move forward into the current. A dive focused on specimen collection necessarily covers very little ground (figure 16).

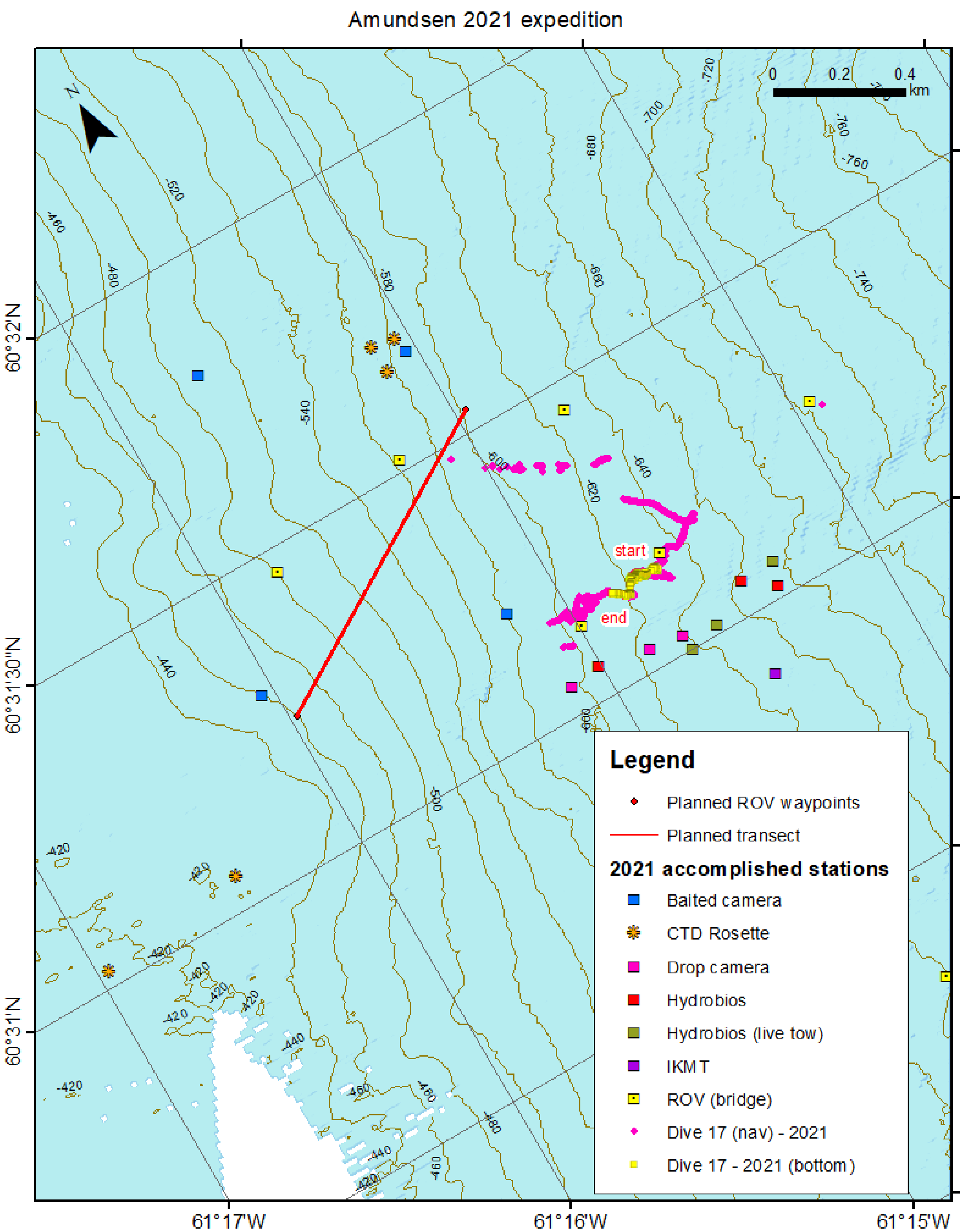


Figure 16. Map of ROV dive C17, NE Saglek Bank 1, Afternoon dive.

The bottom type here was sand and gravel, with occasional cobbles and boulders (figure 17). The boulders were mostly colonized by *Primnoa* corals of a variety of sizes, with rare *Geodia* sponges and *Paragorgia* corals. A variety of sponges were present at the site, with sponge collections for taxonomic voucher specimens. Several species of soft corals were presente on cobbles within the sand & gravel, and were the most common types of corals observed. Eleven live *Primnoa* samples were collected, along with 2 dead *Primnoa* skeletons. We also collected sediment with the scoop, which had some mud in it, to our surprise, despite its overall sand-gravel composition.

The presence of the mud in the sediment is consistent with an interpretation of the bottom type as glacial outwash plain, which would normally mix mud, sand, and gravel, up to cobbles. This implies that most of the large boulders present at the NE Saglek Bank site were deposited as glacial dropstones. A glacial outwash interpretation as the origin of the sediment is also consistent with some of the larger anastomosing channels visible in multibeam sonar imagery of the NE Saglek Bank shelf break; these channels appear to be larger and less chaotic than the iceberg scours that are visible in multibeam sonar on the Hatton Sill, and frequently on bank-top sediments of Saglek and Nain Banks.

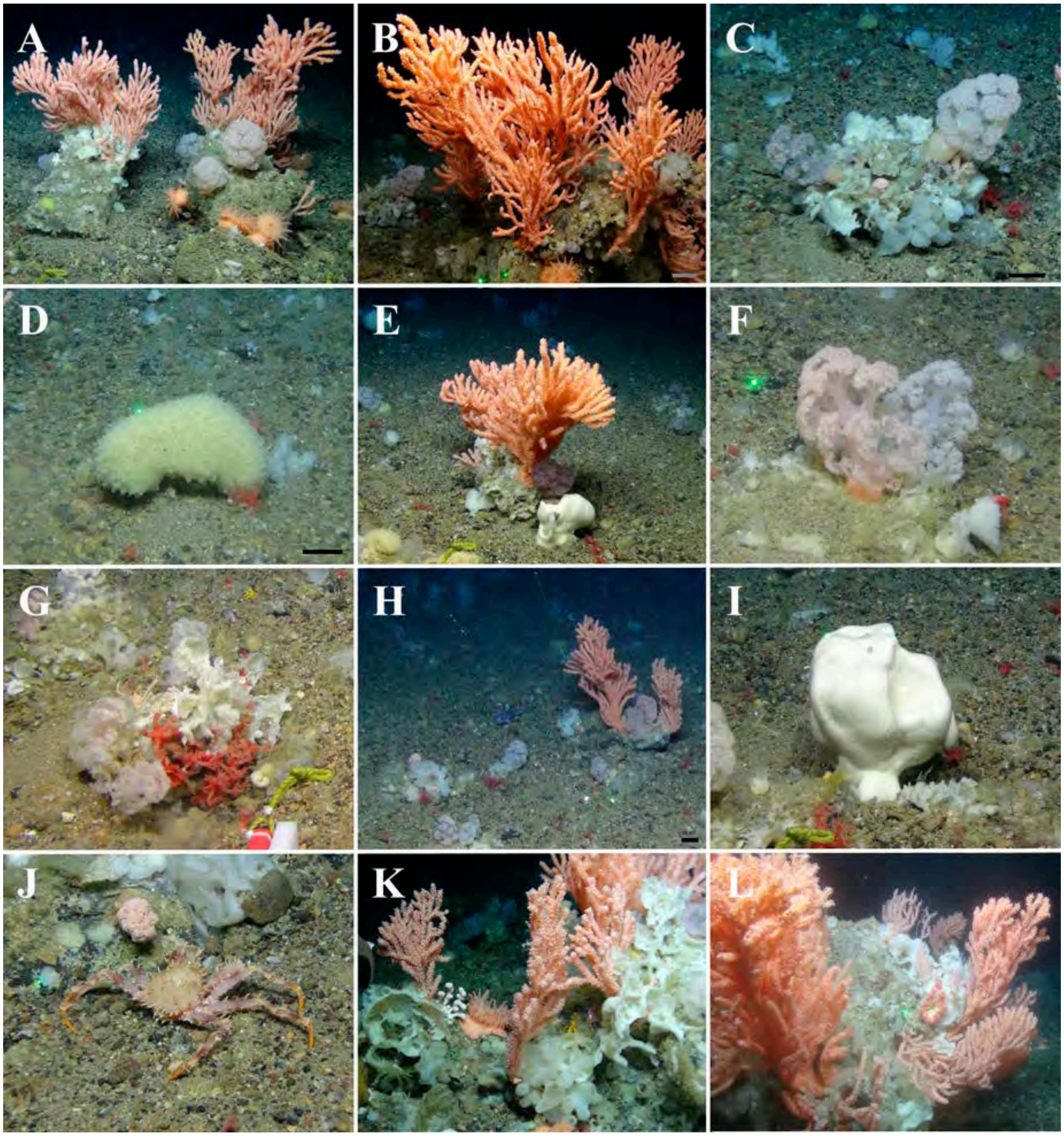


Figure 171. Photo-plate of bottom types and megafauna observed during the ROV dives C17, NE Saglek Bank site 1. A-B) large colonies of *Primnoa resedaeformis* on boulders, with Nephtheidae soft corals (A) and sea anemones, C) close-up on Nephtheidae soft corals, glass sponges and other sponges on cobble, D) close-up on unidentified sponge (which was sampled for id verification) and mushroom coral (*Anthomastus* sp.), E) *P. resedaeformis*, *Geodia* sp., and Nephtheidae soft corals, F) close-up of Nephtheidae soft coral, G-H) note gravelly bottom dominated by Nephtheidae soft corals, mushroom corals, *Asconema* sp. sponges (squat lobster also seen in G), I) *Geodia* sp. (this sponge was sampled), J) crab, probably spiny crab, *Lithodes maja*, K-L) close-up on *P. resedaeformis* with small branches of *Paragorgia arborea* between them.

Dives C18-19, NE Saglek Bank site 2, 60.4983, -61.2163, ~800 m, 25 July 2021.
This dive site was chosen as a second ROV dive target at NE Saglek Bank in order to investigate an unusual geomorphic feature on the NE Saglek Bank. This large, E-facing, horseshoe-shaped indentation, which is about 100 m deeper than the rest of the shelf break, which resembled a retrogressive slope failure in multibeam. The maximum slope of the walls of this depression is about 20 degrees maximum slope, although it looks steeper in the hillshade view of the multibeam map (figure 18). The dominantly WNW direction from which the currents were flowing necessitated a change in the planned transect through this feature: rather than ascending the SW slope of the depression, we attempted to ascent the WNW slope of the depression, so that the ROV would remain facing into the current throughout the dive. As with the NE Saglek site 1, the diving activities were planned for morning and afternoon, aiming for the slack tide interval of lowest bottom current speeds.

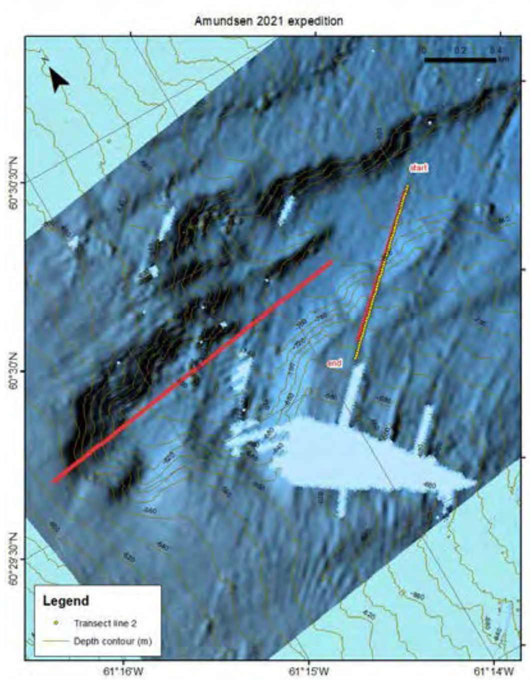


Figure 2. Geomorphic feature targeted by ROV dive site 2, Saglek Bank.

Dive C18, NE Saglek Bank II, July 25, 2021, morning.
Descent to this dive site while bottom current speeds were high, but predicted to be declining (figure 19, figure 20). The bottom type at this site was dominantly sand and gravel, with ocasional cobbles and boulders, much like that at NE Saglek site 1. Again like NE Saglek site 1, digging into the bottom revealed quite a lot of mud mixed into the sand and gravel, suggesting that the bottom here had started as a mixture of mud, sand and gravel, which had then been winnowed extensively. Movement up the transect line brought us to a ridge composed of boulders (figure 21), but with some rocky features resembling authigeic carbonate crusts, as opposed to cobbles and boulders that had been transported, or bedrock. More surprising yet were a series of white microbial mats seen on the bottom part of this horseshoe-shaped geomorphic feature (figure 22). These microbial mats appeared to be finer-grained than the surrounding sediments, but still had some angular pebbles in them, allowing us to collect microbial mats from the pebbles, as well as from sediment. While a petroleum seep had long been suspected in the NE Saglek Bank area based upon satelllite observations of dampened wave heights (Jauer et al. 2010, MPG), its location had never before been determined. The presence of numerous microbial mats and carbonate crusts within this depression raises the possibility that the depression observed in multibeam is an erosional feature in some way linked to the presence of hydrocarbon seeps. The observation of the microbial mats in Dive 18 changed our focus for Dive 19, as we dedicated more time to samplng the microbial mats and carbonate crusts, and the corals living near oro n these, meaning that we did not have enough time to reach the planned end of the transect at the apparent head-scarp of the feature.

Observations of the bottom type again suggested a winnowed muddy-sandy-gravel with cobbles as the dominant bottom type, implying a possible glacial outwash plain origin, which would be somewhat surprising given the depth of this site, although ice-contact sediments have been described at the 500-600 m depth range of the Hatton Sill (Rashid & Piper, 2007). The boulders on the site were dominantly angular, and did not show extensive rounding.

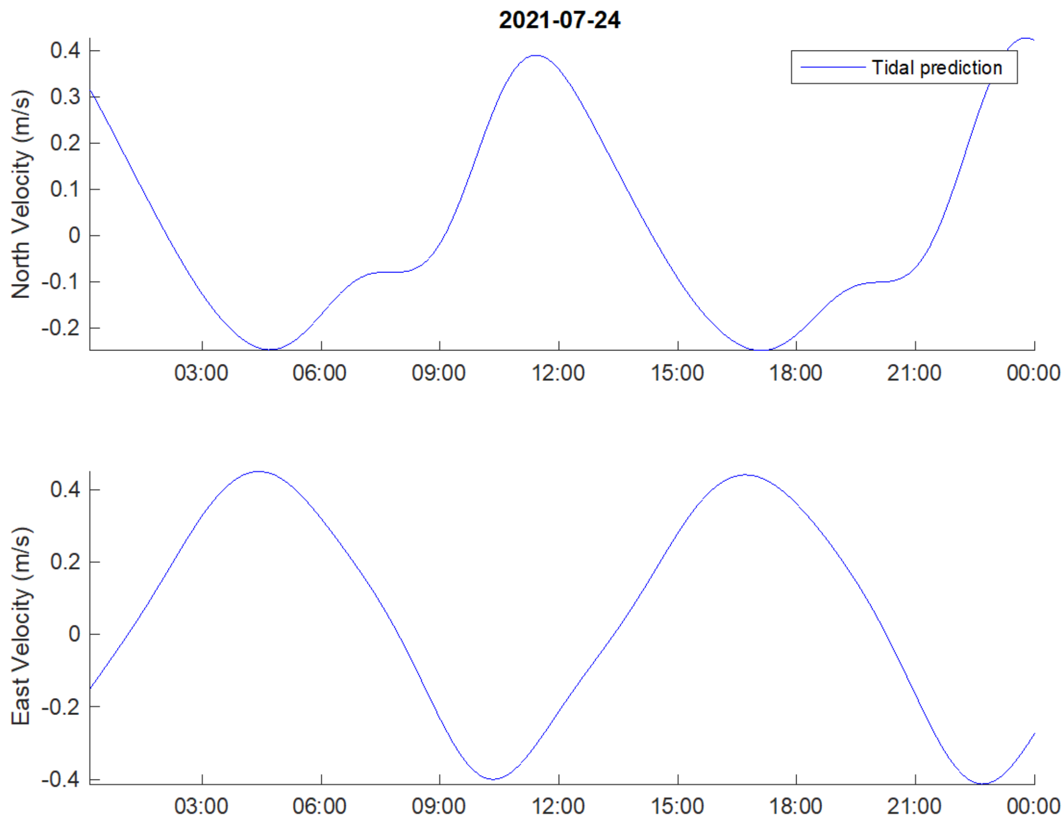


Figure 19. Predicted Bottom current plots for NE Saglek Bank dives on July 24.

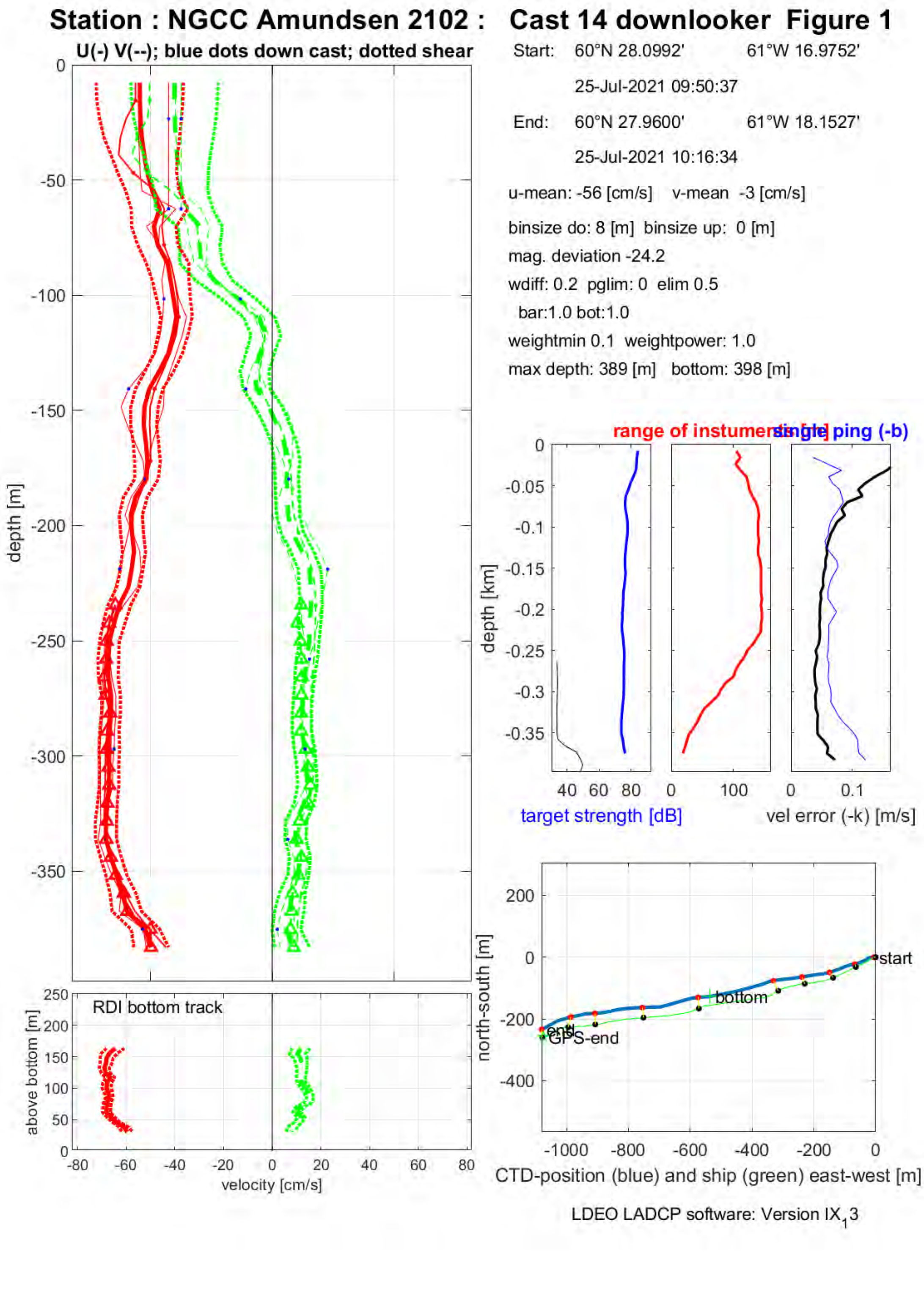


Figure 20. Observed LADCP bottom currents for NE Saglek Bank immediately before start of Dive 18.

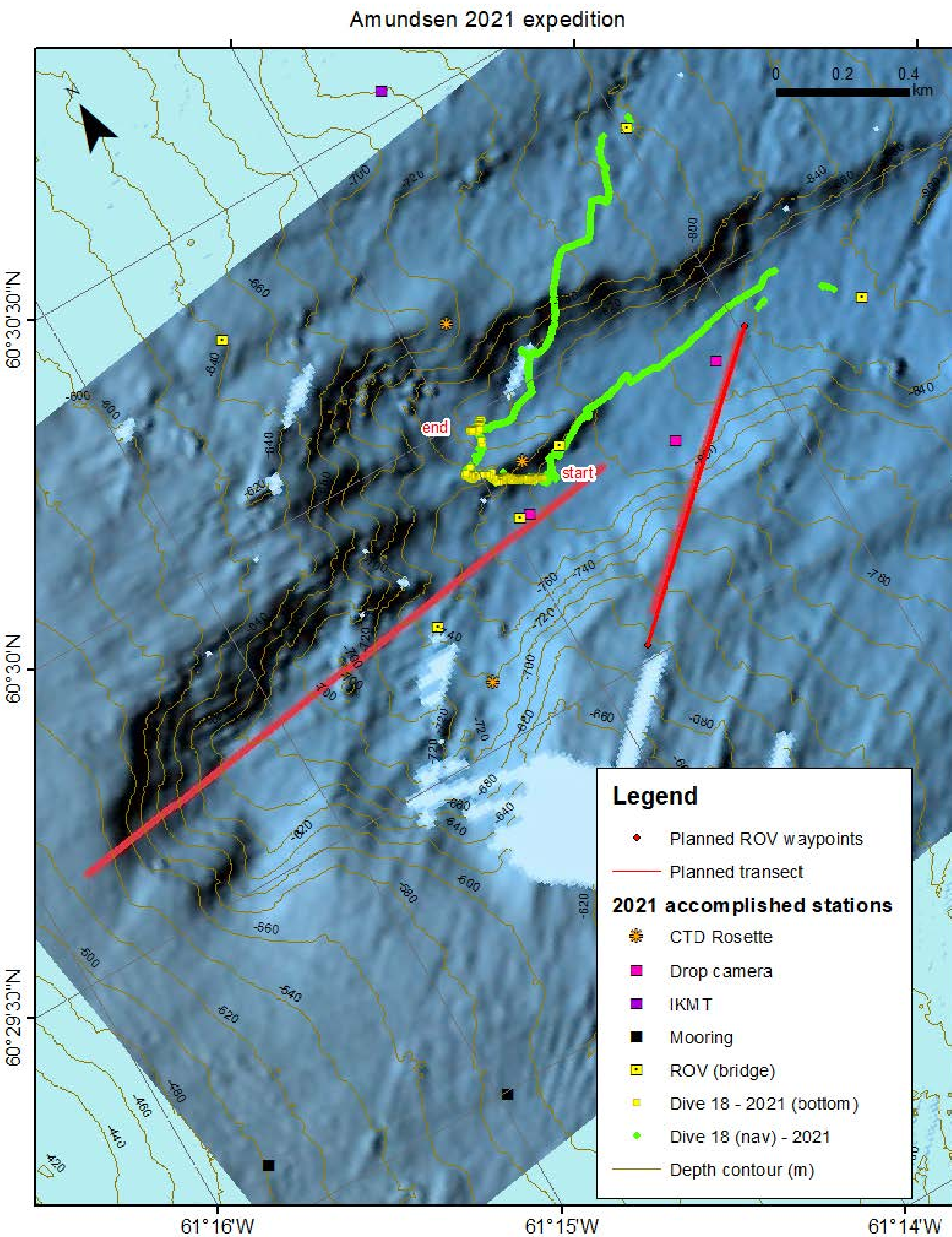


Figure 21. Map of dive C18, NE Saglek Site 2.

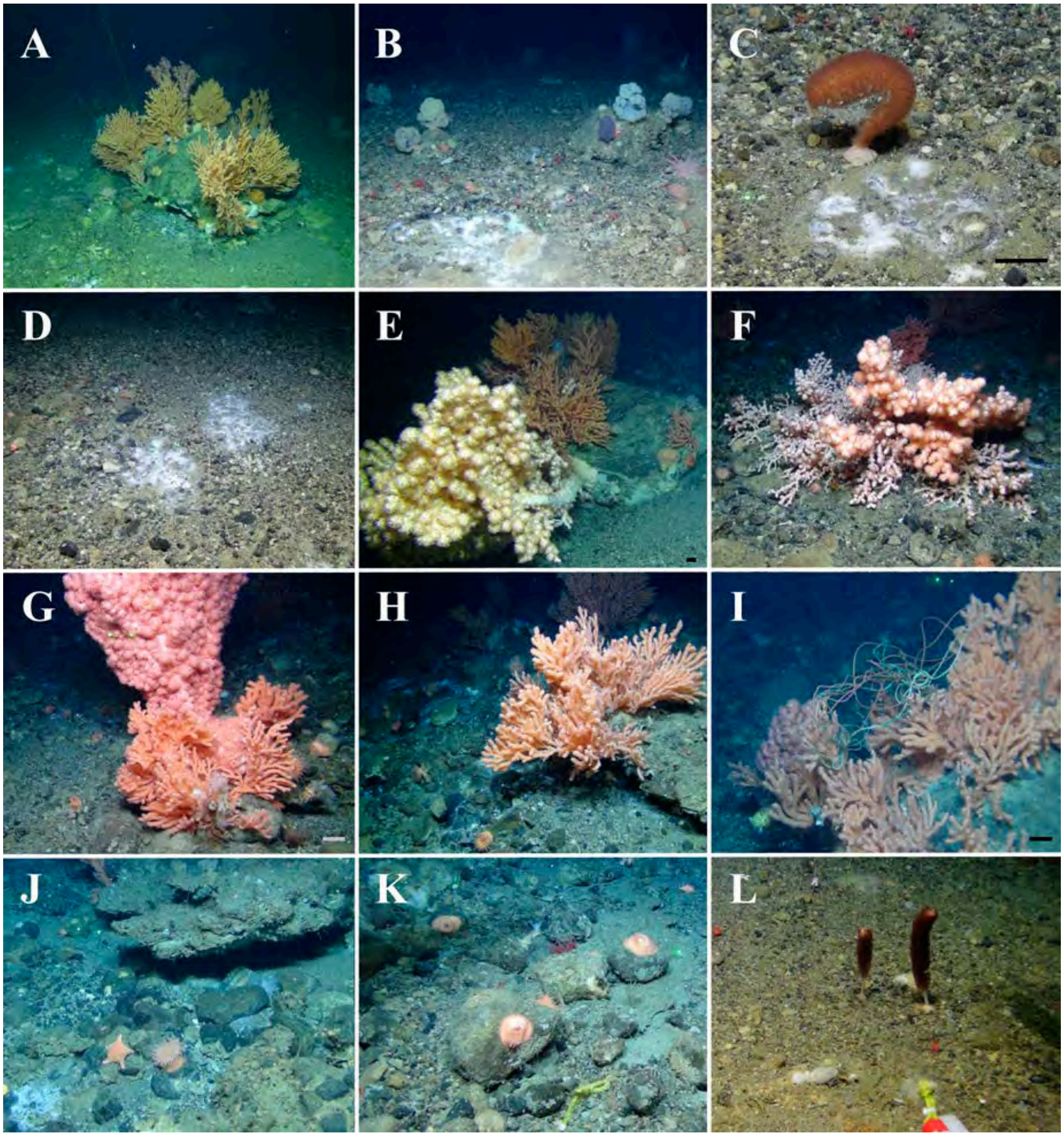


Figure 22. Photo-plate of dive C18, NE Saglek Bank site 2. A) large boulder colonized with *P. resedaeformis* colonies, B-C) bacterial mats on gravelly bottom and nearby fauna including Nephtheidae soft corals, mushroom corals, and sea anemones (B), *Anthoptilum* sp. sea pen (C), E-I) colonies of both *P. resedaeformis* and *Paragorgia arborea* (note fishing line on *P. resedaeformis* on I), J-K) authigenic carbonate crusts, bacterial mat (K), sea anemones, sea stars, and mushroom corals, L) sea pen *Balticina finmarchica* (better known as *Halipteris finmarchica*).

Dive 19, NE Saglek Bank Site 2, 25 July 2021, afternoon.

This dive returned to the site of microbial mats seen in dive 18 (figure 23). Biological observations found abundant and large *Primnoa* corals on the boulders, with *Paragorgia* corals apparently more frequent than at NE Saglek Bank site 1. *Primnoa* also occurred on some of the larger cobbles, but these were generally smaller colonies of Primnoa. There was an apparent association between size of cobble or boulder and the maximum size of coral observed. On the winnowed muddy-sandy-gravel bottom, a variety of soft corals and sponges were seen (figure 24), as well as several species of sea pens and anemones.Vagile invertebrates included shrimp, crab, and squid. Fish were somewhat abundant and diverse, with redfish the most commonly seen fish species, often seen close to corals, possibly sheltering from currents.

At several points in the flatter bottom part of this feature, we observed scrape marks on the bottom that appeared to be trawl door scars. Similarly, we saw fishing line entangled on corals at several locations on the bottom.

Collections included the microbial mats, collected both on cobbles and as sediment recovered with the sediment scoop. Coral collections included a number of Primnoa colonies for demographic, carbonate production and paleoceanographic analysis, as well as one Primnoa colony collected from a carbonate crust adjacente to a microbial mat. This coral was collected with the goal of analysing the tissue and protein layers of the skeleton for lipids and carbon isotopes indicative of a microbial or methanogenic contribution to the coral's nutrition.

Comments on dive operations: Dives 18 and 19 were both limited in duration by the strong bottom currents at this site, which became too strong for the ROV at the end of both dives. More effective dives at this location in the future will likely require a larger and more powerful ROV, and possibly a ship equipped with dynamic positioning (DP).

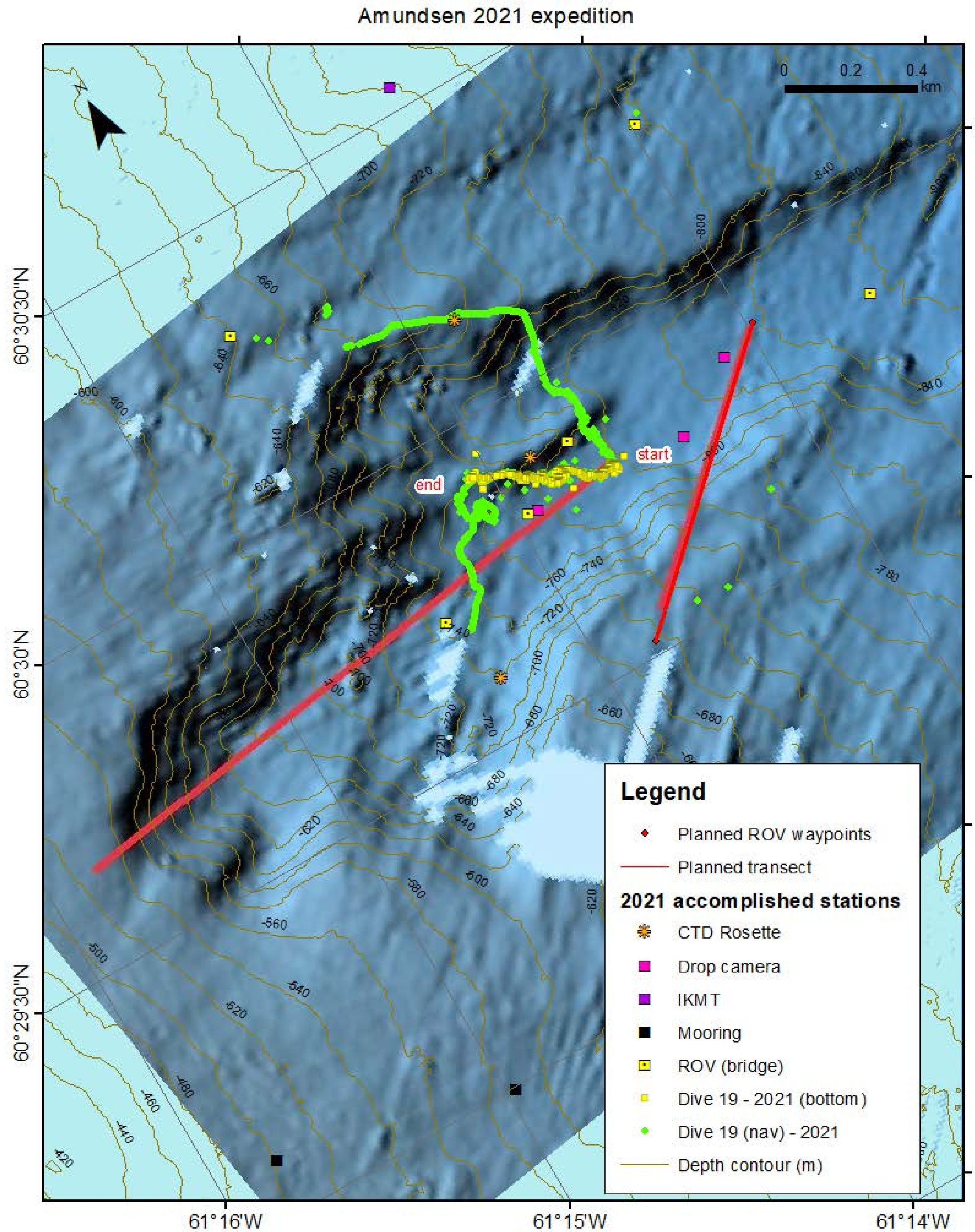


Figure 23. Map of dive C19, NE Saglek Site 2.

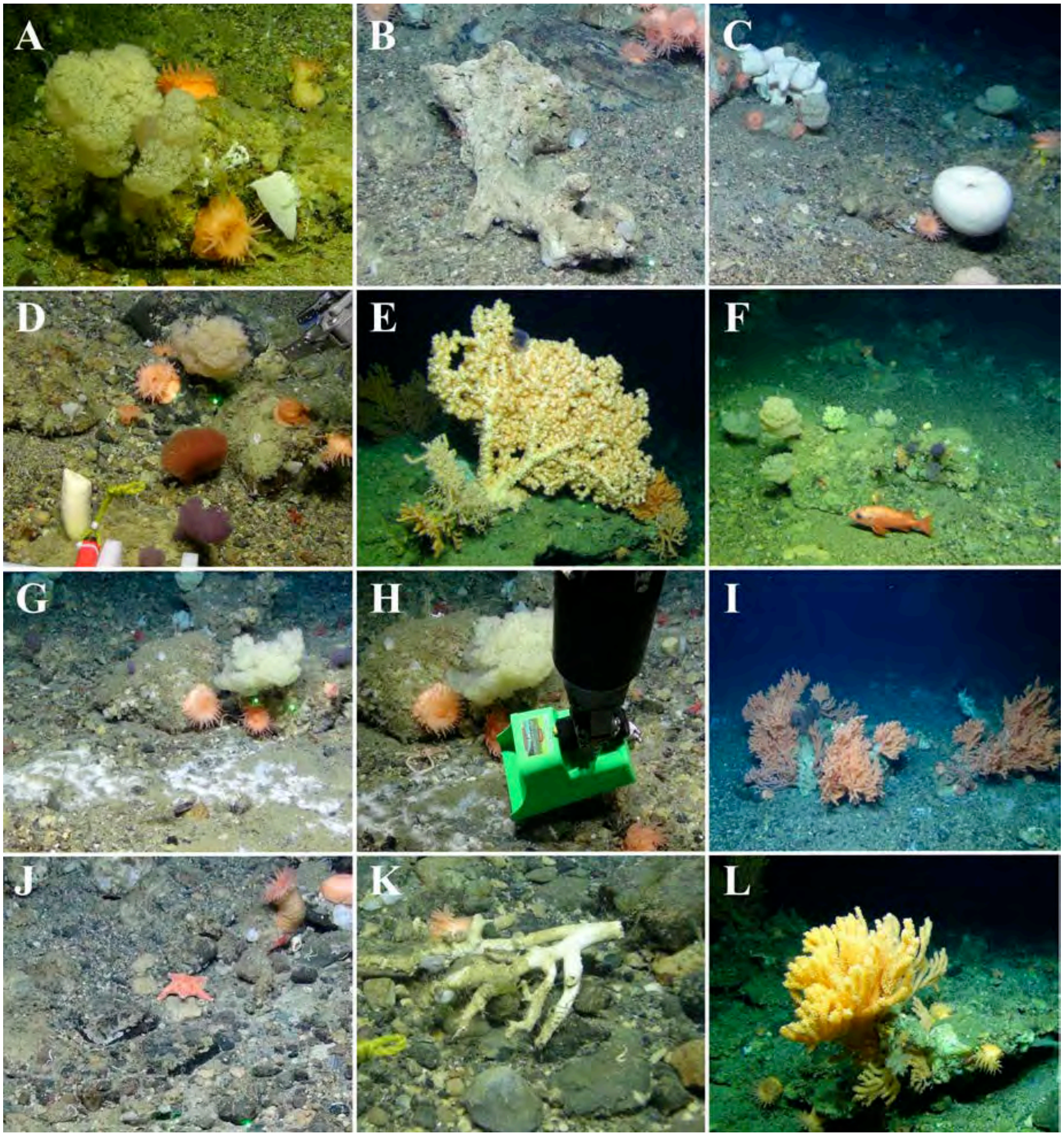


Figure 24. Photo-plate of megafauna observed during the ROV video transect at NE Saglek site 2, dive C19. A) close-up of soft corals and sea anemones, B) large piece of dead *Paragorgia arborea*, C) *Geodia* sponges in a gravelly bottom, D) diversity of fauna including sea anemones, Nephtheidae soft corals, and sea pen *Anthoptilum* sp, E) large colony of *Paragorgia arborea* and some smaller *Primnoa resedaeformis* on a boulder, F) Neptheidae soft corals and Redfish (*Sebastes* sp.), G-H) bacterial mats being sampled using sampling scoop, I) colonies of *Primnoa resedaeformis*, J) gravelly bottom and seastar, K) large piece of broken *P. resedaeformis*, L) *P. resedaeformis* growing on authigenic carbonate crust. Both coral and crust were sampled.

Dive C20, Hatton Sill, 61 20.07’ N/ 60 37.50’ W, launch target depth 696 m, 27 July 2021

This site on the Hatton Sill is colloquially known as “Mercer’s Monster”, named for Harry Mercer, the Fisheries Observer who submitted photos and samples of extensive coral bycatch at this site in May 2007. Previous dives took place here in 2016 and 2018, but collections were limited in 2016 by a failure of the SuMo ROV hydraulics, and in 2018 by the requirement to keep the SuMo ROV in its cage, allowing for a long video transect, but no sample collection (figure 25). The short 2016 dive had shown what appeared to be large numbers of dead Primnoa skeletons on the bottom, which became the intended sampling target for future ROV dives including this year’s dive. The 2018 dive, which gathered only video data, documented many *Primnoa* corals, but also documented extensive sponge habitats, including “ostur” (“cheese-ground”), the astrophorid sponge reefs typical of the NE Atlantic sponge grounds, seen to the west of the location of the 2021 dive.

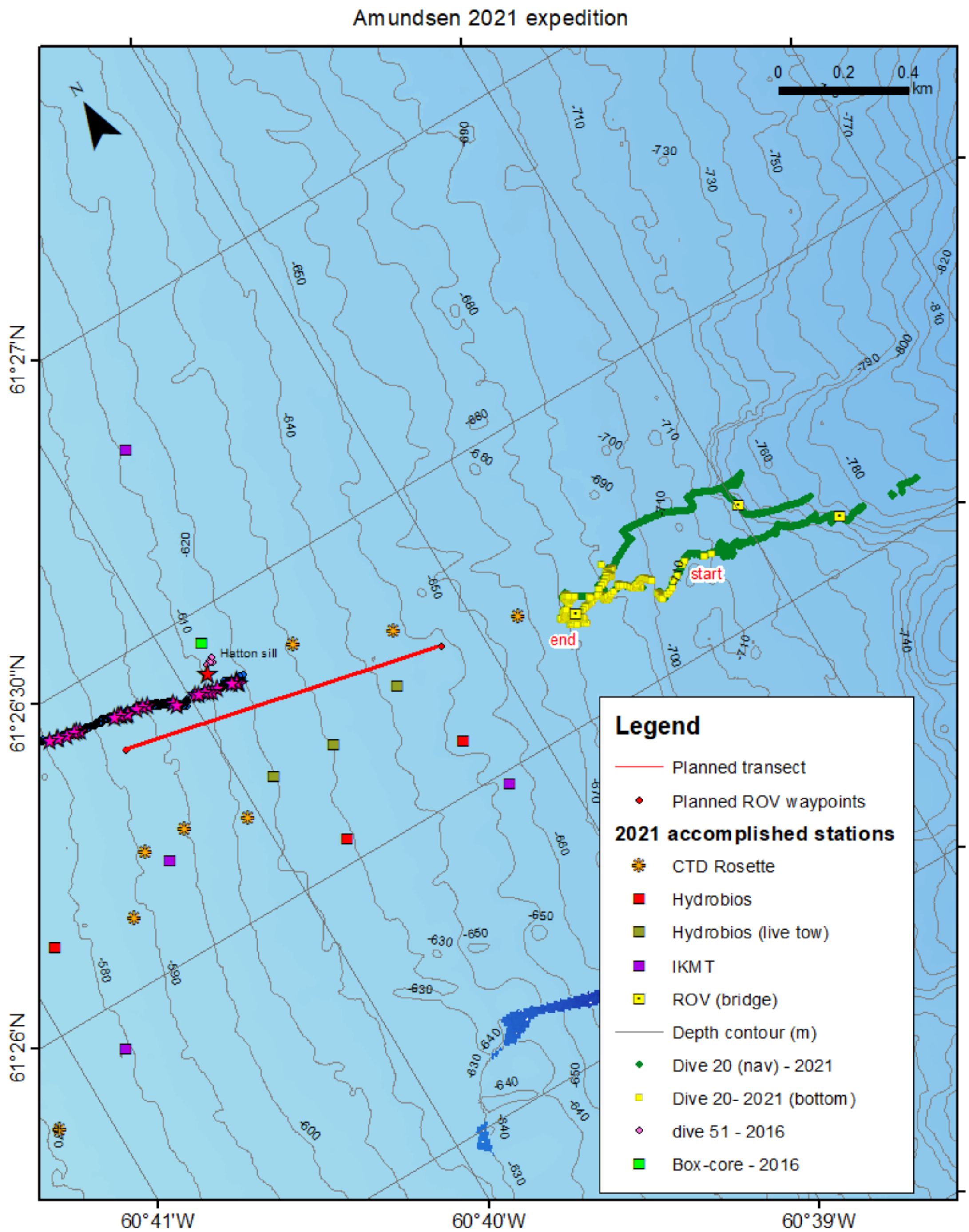


Figure 25. Map of planned and achieved dive at Hatton Sill. The dive was aimed at collecting live and dead corals from the ice-contact sediment zone, but the achieved dive was closer to the rill and gully zone. Stars indicate positions of Primnoa corals observed in the 2018 ROV dive (ROV in drop camera mode, maintained inside TMS cage).

Thus the goal of this dive in the 2021 cruise to primarily specimen collection, particular for live and dead *Primnoa* corals, and also for sponges for taxonomy. Like the NE Saglek Bank sites, the bottom currents here are strong, and are tied to the macrotidal regime in Frobisher Bay. Unlike in

NE Saglek Bank, we have no mooring data from this location with which to calculate predicted times and strengths of bottom currents. We attempted to predict the times of slack tides based on the NE Saglek Bank tidal current model, adjusting for the slight change in position to northward, and the greater proximity to Frobisher Bay (figure 26). As at NE Saglek Bank, we attempted to time the ROV dive to declining bottom current strengths, to maximize bottom time.

This site lies on the sill between the Hatton Basin, to the west, and the open Labrador Sea, to the east, at the position where the largest ice stream out of the Laurentide Ice Sheet flowed through Hudson Strait out into the Labrador Sea. Heinrich Events described in deep-sea sediment cores throughout the NW Atlantic are linked to carbonate rock debris being transported by icebergs through this area. The composition of the sediments on the shallowest portion of the Hatton Sill have been described as ice-contact sediment (Rashid & Piper 2007), while the deeper sediments to the east of the sill are composed of glacigenic debris flows. The ROV dive is in what is thought to be ice-contact sediments, but the rill-and-gully zone of eroding glaciomarine sediments seems to start in the 800-900 m depth range (citation?), based upon the 2006 multibeam sonar in this area. While the dive concentrated on the shallower portions of this dive, there was a deeper box core, piston core, and drop camera site about 900 m, near the top of the rill-and-gully zone. The box core and piston core around 900 m recovered extensive sponge mats, as described below.

Before commencing the ROV dive at Hatton sill we deployed three CTD instrumental casts to measure lateral bottom currents close to this site, in an effort to find the optimal time for an ROV dive. Despite our best efforts to plan the dive aiming for slack tide, we achieved only about 3 hours of bottom time before the dive had to be ended because the ROV could not move against the bottom currents.

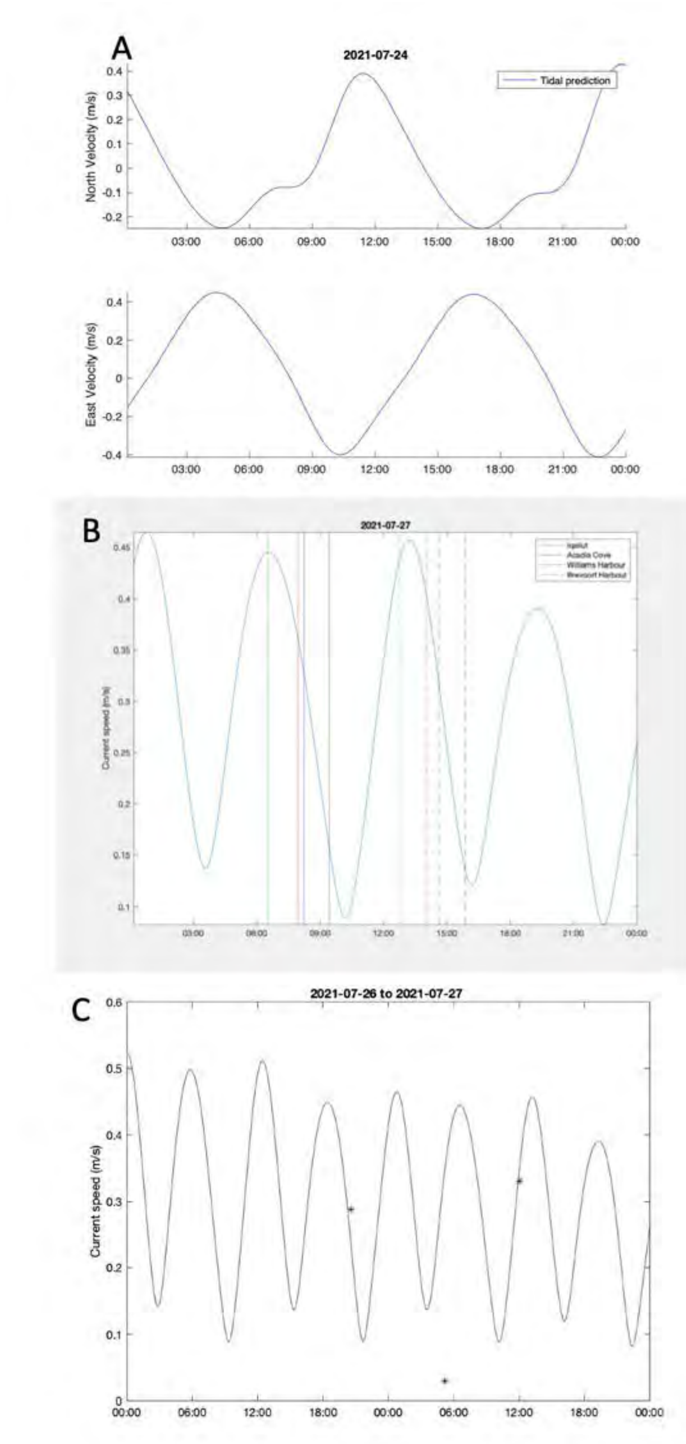


Figure 26. Bottom current observations at Hatton Sill applied to the tidal current predictions from NE Saglek Bank. (A). Bottom current strength predictions for Saglek Bank, on 24 July. (B) the time of the 27 July morning high tide in Brevoort Harbour, Iqaluit, Acadia Harbour (all Nunavut), and Williams Harbour N (N. Labrador) plotted on the tidal current model for NE Saglek Bank. All times in UTC. (C) the strength of the lateral bottom currents measured in the LADCP at different times on the evening of July 26 or morning of July 27., all times in UTC.

Observations on Dive C20.

Bottom type observations on dive C20 found a dominantly winnowed mud, sand and gravel bottom with occasional cobbles and boulders, but with apparently fewer boulders than at the NE Saglek Bank sites. Primnoa corals were limited to boulders. When the ROV settled onto the bottom, it stirred up clouds of fine sediment, indicating that the bottom was a winnowed mud-sand-and gravel mixture, again consistent with the interpretation as ice-contact sediments or a glacial outwash plain. Boulders were not evenly distributed, but rather occurred in clusters. Where boulders occurred, we often saw a small pile of sandy sediment in the current shadow of the boulder. One such cluster had an accumulation of dead *Primnoa* skeletons (figure 27).

Biologically, the dive at Hatton Sill was very strongly dominated by sponges, particularly astrophorid sponges (figure 27). We were able to collect 1 such sponge as a voucher specimen to verify it identity. *Primnoa* corals occurred only on boulders, and most boulders had some sort of coral growth on them. Geodia sponges were much less common than at the NE Saglek Bank, seeming to have been replaced by the astrophorids. A variety of soft corals occurred on gravel, cobbles, and boulders, and several species of sea pens were observed growing in the winnowed mud-sand-gravel bottom. An unusual occurrence was the sea-whip gorgonian coral *Radicipes* sp., which was observed several times in the muddy-sandy-gravel bottom. This species is generally known from soft bottoms, and usually from deeper water and lower-current environments than seen here.

Collections at the Hatton Sill dive included one dead *Primnoa* skeleton for paleoceanography, one sample of the sea whip *Radicipes*, an unusual *Pennatula* sea pen with structures not known from other sea pens in the NW Atlantic region, an astrophorid sponge as a voucher specimen, a near-bottom water sample for eDNA, and two cobbles for Sophie Wolvin's project about the epibiont fauna on cobbles in different depth zones and current regimes.

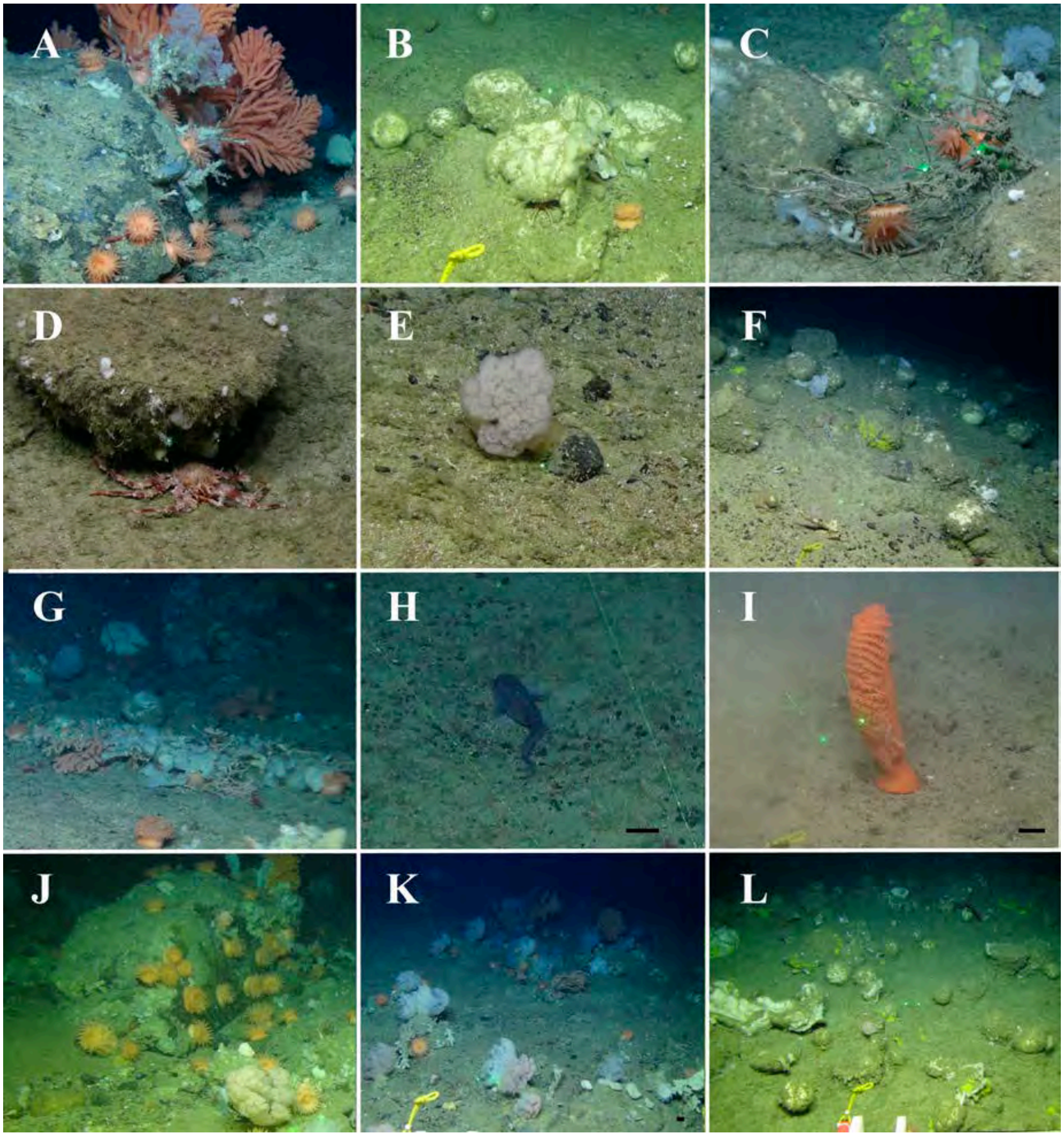


Figure 27-. Observations of the bottom type and fauna at Dive C20, Hatton Sill. A) large boulder with *Primnoa resedaeformis* colonies, Nephtheidae soft corals, B) close-up of *Geodia* sponges, C) *Geodia* sponges and dead coral skeleton, D) unidentified crab, E) Nephtheidae soft coral, F) sponge ground dominated by *Geodia* sp., G) *P. resedaeformis*, glass sponges (*Asconema* sp.), H) grenadier, I) *Pennatula* sp., J) large boulder colonized with sea anemones, *P. resedaeformis*, soft corals, K) soft corals, small colonies of *P. resedaeformis*, L) sponge ground.

Additional activities at Hatton Sill.

The Hatton Sill box core collected at about 900 m depth, in a site that was targeted by the GSC to look for muddy sediments with sponge otoliths, had abundant sponge mats in the box core (figure 28). These sponge-rich habitats were also imaged by the drop-video camera, and appeared to have a sponge-dominated fauna on a muddy-sandy-gravelly bottom, not so different from that seen during the ROV dive at about 650 m. Furthermore, the box-core collected a small Astrophorid sponge, which was preserved as a voucher specimen.

Figure 28. Photos of box core containing sponge mats, Hatton Sill, about 900 m. (a) the box core with the sponge mats in it. (B) Box-core sediment after washing, showing thick "fibreglass-like" sponge mats with abundant bamboo coral fragments in sediment. (d) Push core through box-core, containing several layers of sponge mats, e) Astrophorid sponge collected from this box core.

A second box-core at 614 m, closer to the top of the sill, and to the depth of the ROV dive, recovered well-washed muddy sandy gravel, still had quite a few sponge mats in it, with abundant bryozoans, and one dead stylasterid coral fragment.

Dive C21: Davis Strait (*Acanella* site), 63° 20.6094N / 58° 11.5092W, 1310 m

July 29, 2021

At this site, two 12-hour dives were planned, but due to inclement weather conditions on the first day at Davis Strait, only one dive was completed.

The planned transect for the Davis Strait site was about 1 km in length, starting at a depth of 1300 m and ending at 1282 m (Figure 29). The completed transect length during the dive was about 1400 m, and covered a depth range of 1336-1293 m. Bottom temperature at this site was 3.5°C and salinity was 34.8 PSU.

Dive Objectives

The main dive objectives for this site were:

1. To make the first attempt of deploying and recovering coral staining chambers with calcein solution on *Acanella* colonies.
2. To collect push-cores on *Acanella* colonies and 1-2 m away from *Acanella* colonies.
3. To sample *Acanella* corals, other invertebrates, and dropstones at this location for aging, growth rate and boron isotope analysis, DNA, and biodiversity in the area.
4. To collect video transect data to assess abundance, distribution, and density of *Acanella* corals at this site, as well as abundance and biodiversity of other invertebrates.

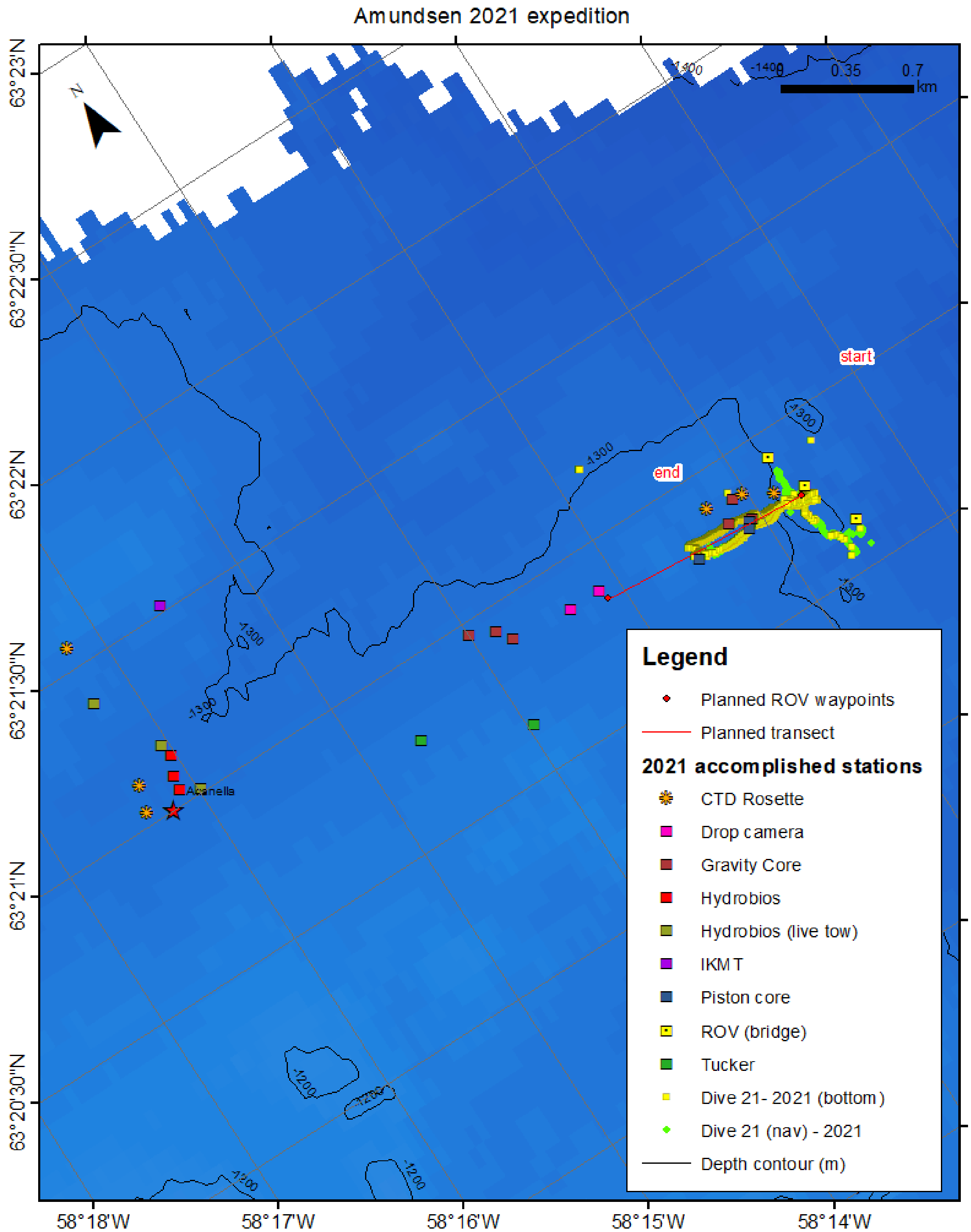


Figure 29. Map of ROV dive C21, at Davis Strait site.

Completed Operations

Two coral staining chambers were deployed during the dive, which had calcein solution inside a balloon at a concentration of 150mg/L, mixed with seawater. This was the first *in situ* attempt to stain bamboo corals with calcein in Canadian waters. Both staining chambers were deployed on small *Acanella* colonies. The first staining chamber contained an *Acanella* colony about 10 cm in height and 10 cm wide (Figure 30). At first attempt, the calcein solution was too buoyant and did not sink within the chamber (Figure 30A). The ROV then maneuvered the chamber, lifting it slightly off of the seafloor to mix the solution, which was successful. The first chamber stained the *Acanella* colony for about 7 hours before being recovered at the end of the dive.

The second chamber was deployed on a different *Acanella* colony, which was about 7 cm wide (Figure 30B). The balloon containing calcein was punctured before the chamber was on the seafloor in an attempt to make the solution sink better than attempt 1. Because of this, some of the calcein solution leaked out of the bottom of the chamber before being set down on the seafloor, meaning the final concentration of calcein solution within the second chamber is unknown. The second chamber was recovered at the end of the dive and stained the *Acanella* colony for about 6.5 hours. Three tent stakes were placed around each of the stained coral colonies and a floating marker was also placed near the colonies (Figure 30). Keratoisis corals at Disko Fan were stained with a similar procedure, but doubling the salinity of the staining solution to encourage mixing. The stained corals will be revisited and collected in 2023 for growth rate analysis.

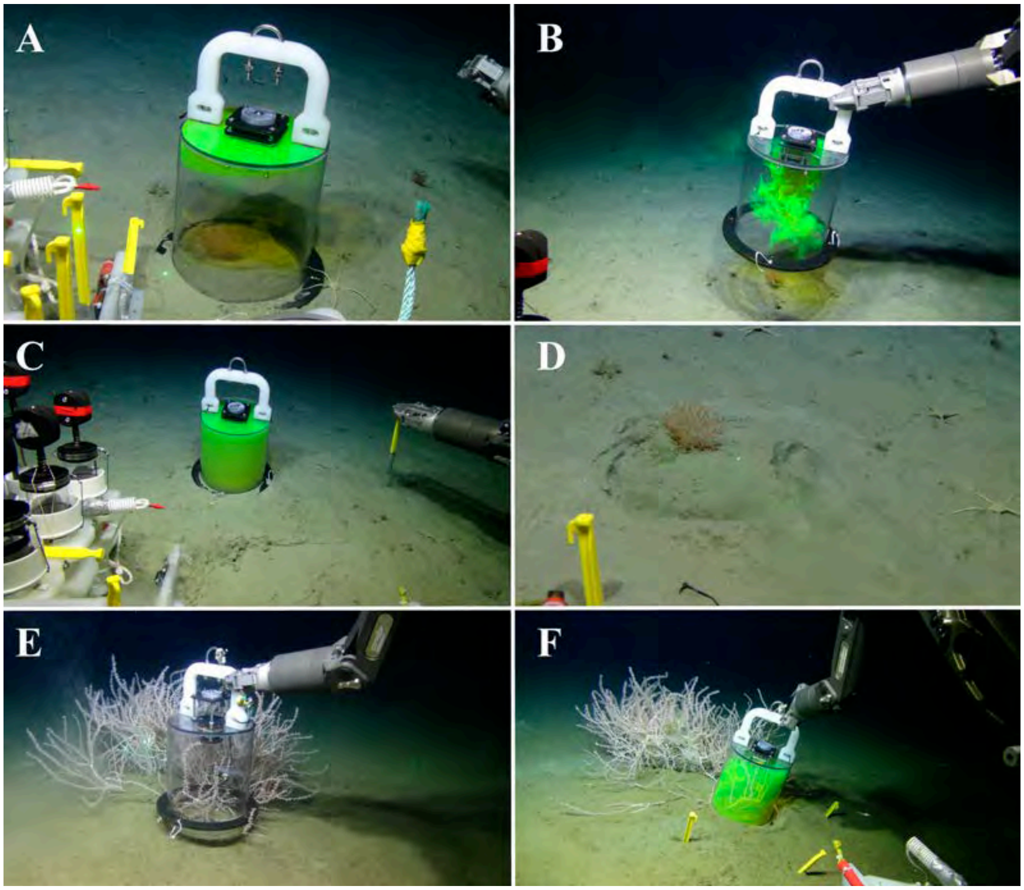


Figure 30. Staining chamber deployment. A. First deployment at Davis Strait, when stain solution remained buoyant in top of chamber. B. Second deployment at Davis Strait, opening stain before chamber fully lowered. C. Staining chamber in place, Davis Strait. D. *Acanella* coral, post-staining, Davis Strait. E. Placing the staining chamber on a Keratoisis coral at Disko Fan. F. Recovering the chamber after staining, at Disko Fan.

Six push cores were taken in pairs of two, with one core on top of an *Acanella* colony and one core 1-2 meters from the sampled colony (Figure 31). These cores will be used to analyze the fauna living in the sediment beneath *Acanella* colonies and fauna 1-2 m away from *Acanella* colonies for comparisons.

Transect data was collected throughout the dive at a speed of 0.2-0.3 m/s. The transect began at the location of the staining chambers and returned to the staining chambers along a parallel path for collection at the conclusion of the dive. Transect video was often paused to collect samples. 39 samples were collected during the dive, with a majority of them being *Acanella* corals (see appendix). Other samples collected include bottom water, a black coral, sea pens, sponges, and rocks with living fauna attached.

Main Observations

Main bottom type observations from the dive include a mostly muddy environment, with unexpected rocky, steep ridges also observed (Figure 31). In the rocky environments, bottom type was mainly gravel and boulders. The approximate steepness of the rocky ridges was about 30° based on observations. In the muddy environments, there were some small and large boulders observed occasionally within the mud. Some boulders had an abundance of fauna living on them, but not all.

Biologically, the site is diverse in terms of species observed throughout the dive. The main species observed was *Acanella arbuscula*, however an abundance of black corals of various sizes were also observed (*Stauropathes arctica*).The black corals were often similarly sized to the small *Acanella* corals, and were also commonly mistaken to be *Acanella.* Other species observed include sea pens (*Anthoptilum, Funiculina*), soft corals (*Anthomastus*), sponges (*Asconema, Geodia, Euplectella*), sea anemones and Cerianthids, many small fish and skates.

The *Acanella* corals observed at the site were consistently present throughout the dive, yet were never seen in dense coral forests as possibly expected based on bycatch data. All *Acanella* observed were singular colonies. They varied slightly in size, but were most commonly only 5-10 cm in height and width. There were at least two clusters of whole scallop shells observed towards the end of the dive as well. They appeared to be remains of shells congregated in specific locations, and the transport mechanism is unknown.

Post-Dive Experiment

With two collected *Acanella* corals, a test was done on board the ship for toxicity and effectiveness of the calcein solution. The samples were first photographed, and then placed in an aquarium with an aerator, with 150mg/L calcein solution in a 4°C room. The samples were stained for 6 hours, and then placed in a different aquarium, with an aerator and bottom water from the site. The samples were then monitored for 2 days before being removed from the seawater. Based on observation, the *Acanella* samples were alive, but their polyps were closed after being stained and when removed from the seawater. Fluorescence microscope analysis will be done at MUN to assess how the stain concentration marked the skeletons and the protein layers.

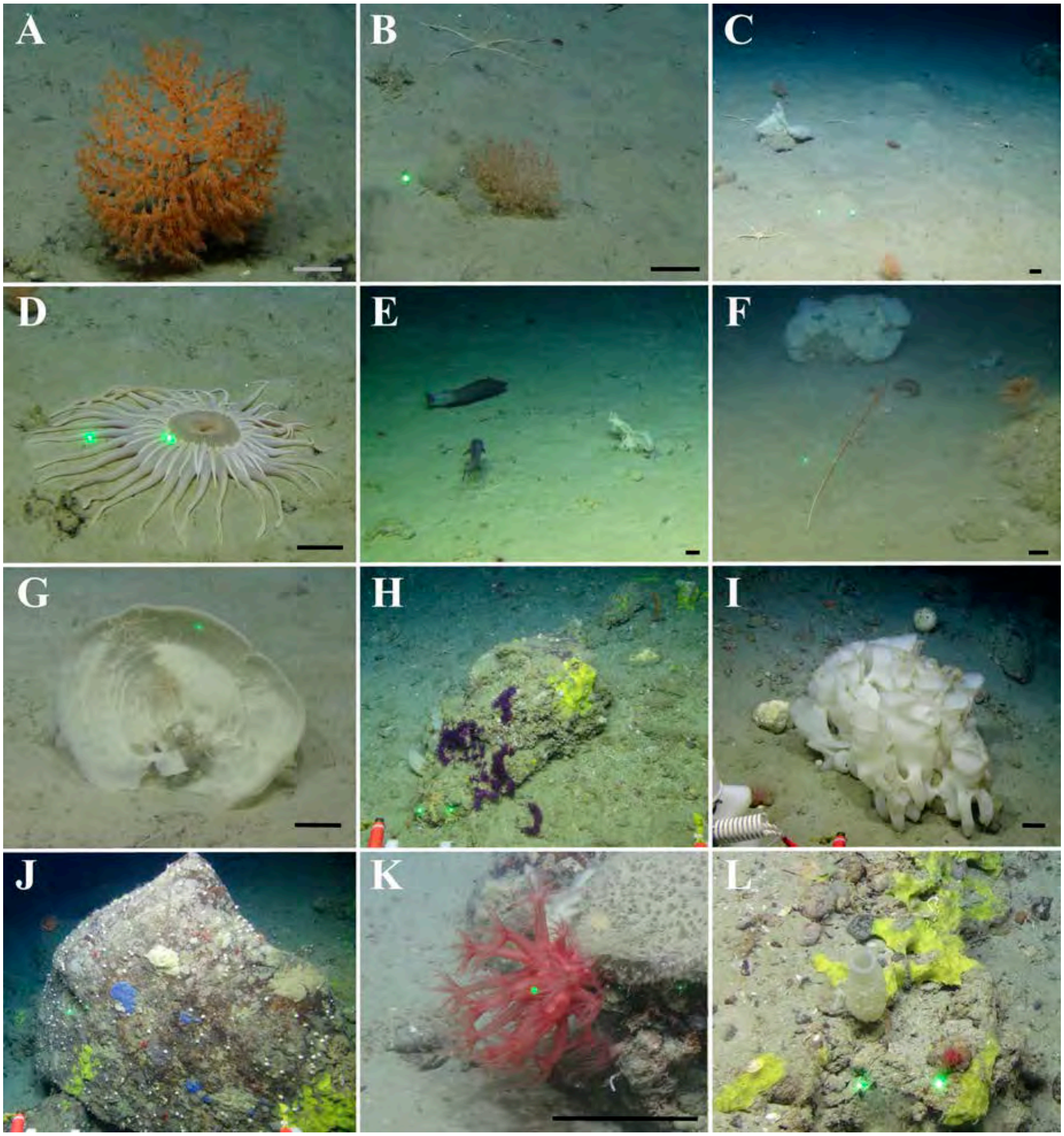


Figure 31. Photo-plate of ROV dive 21, at Davis Strait site. A) Black coral (probably *Stauropathes arctica*), B) bamboo coral *Acanella arbuscula*, C) soft bottom with some *A. arbuscula* colonies, D) large cerianthid, E) blue hakes, F) sea pen *Funiculina quadrangularis*, *Anthoptilum* sp., black coral, and glass sponge *Asconema* sp., G) unidentified sponge (sampled), H) stoloniferous coral (purple), probably Clavuraliidae, and encrusting yellow sponge, I) *Asconema* sp., J) boulder colonized with sponges, K) mushroom coral (likely *Anthomastus* sp.), L) vase sponge (?*Euplectella* sp., and encrusting yellow sponges).

Dive C22, Southwind Fjord.

The ROV dive in Southwind fjord was focused primarily on documenting and describing a submarine landslide that was triggered by an iceberg overturning, and that was mapped using sequential multibeam sonar datasets (Normandeau et al. 2021).

See GSC Amundsen report for this dive summary.

Dive C 23. Disko Fan.

The objectives of this dive were:

(1) To stain Keratoisis corals underwater for recovery after 2 years, similar to the *Acanella* staining experiment carried out at the Davis Strait site.
(2) To collect *Keratoisis* corals for sclerochronology (L. Piccirillo) to determine age and growth rates of this species and Boron isotope analysis of past ocean pH (T. Williams).
(3) To collect *Keratoisis* corals for genetic analysis, to determine the degree of relatedness of individual corals on opposite sides of a coral thicket.
(4) To collect voucher specimens for associated biodiversity living in or on the *Keratoisis* corals or their skeletons.
(5) To survey the coral forest to assess its bathymetric extent and geographic extent in the ~ 900 m depth range.
(6) To identify suitable targets for additional gravity coring and box-coring to determine the duration over which this habitat has existed.

Our initial plan had been to dive at the location where Fisheries Observers had reported very high bycatch values for the bamboo coral, *Keratoisis* spp., in 2005, about 10 nautical miles from the site where a DFO survey trawl encountered the *Keratoisis* coral forests in 1999, and where we have carried out ROV dives in previous years (Figure 32). Or arrival at this location, the ship still faced considerable surface ice concentrations, up to 5/10 ice coverage. The ice charts suggested that ice coverage would be lower in the vicinity of our 2016 dive site.

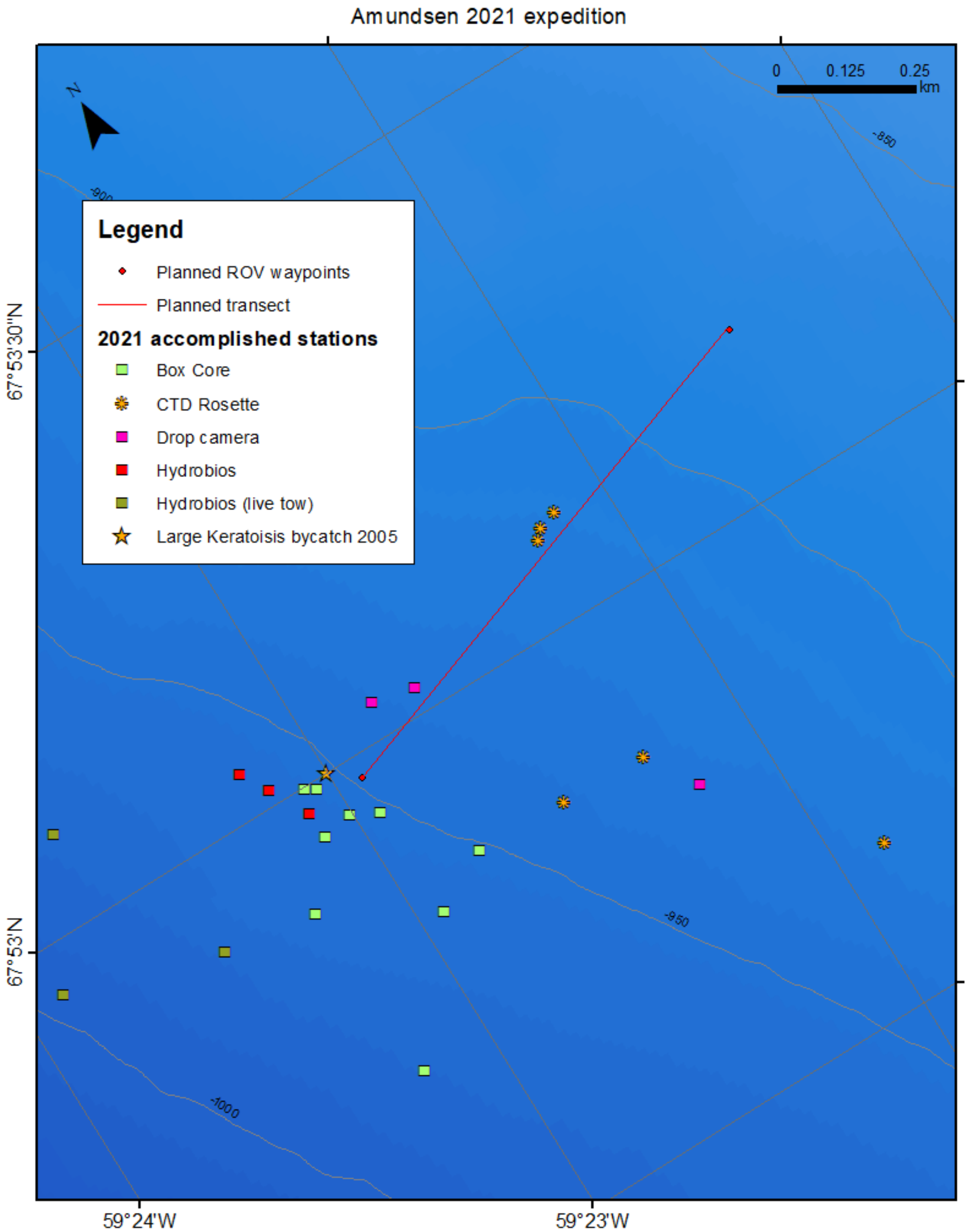


Figure 32. Map of box-core and drop camera deployments at the intended launch target for Disko Fan.

Furthermore, three box cores collected here contained no corals, and a 30-minute drop camera tow encountered no corals. The three box cores were collected for bioturbation experiments being carried out by University of Southampton PhD student Tom Williams. One push core from one of these box-cores was collected to analyze for coral fragments in the sediment column, and to assess sediment accumulation rates in a non-coral-dominated environment (GSC core 2021805020, “Laura’s core”).

Therefore, as per the dive plan, we returned to the approximate location of our previous dives in 2013, 2016 and gravity coring operations in 2018, and began dive C23 (Figure 33). Shortly after descent, we encountered coral forests and began to deploy the coral staining chambers and collect samples. The coral staning chambers used a hypersaline calcein solution (approximately 70 PSU) to encourage mixing, and had been modified to add a plunging unit to circulate the water inside the chamber manually if necessary.

After we had begun collecting corals, heading in a northward direction, the ship began to encounter heavier ice coverage with larger floes, which required the ship to take evasive action. These required the ROV to come off the bottom, and approximately 90 minutes of the dive were passed with the ROV in the water column while the ship tried to avoid ice enough to protect the ROV umbilical cable from abrasion on ice. This evasive action explains the long deviation from the planned ROV track shown in the map of this dive (figure 33).

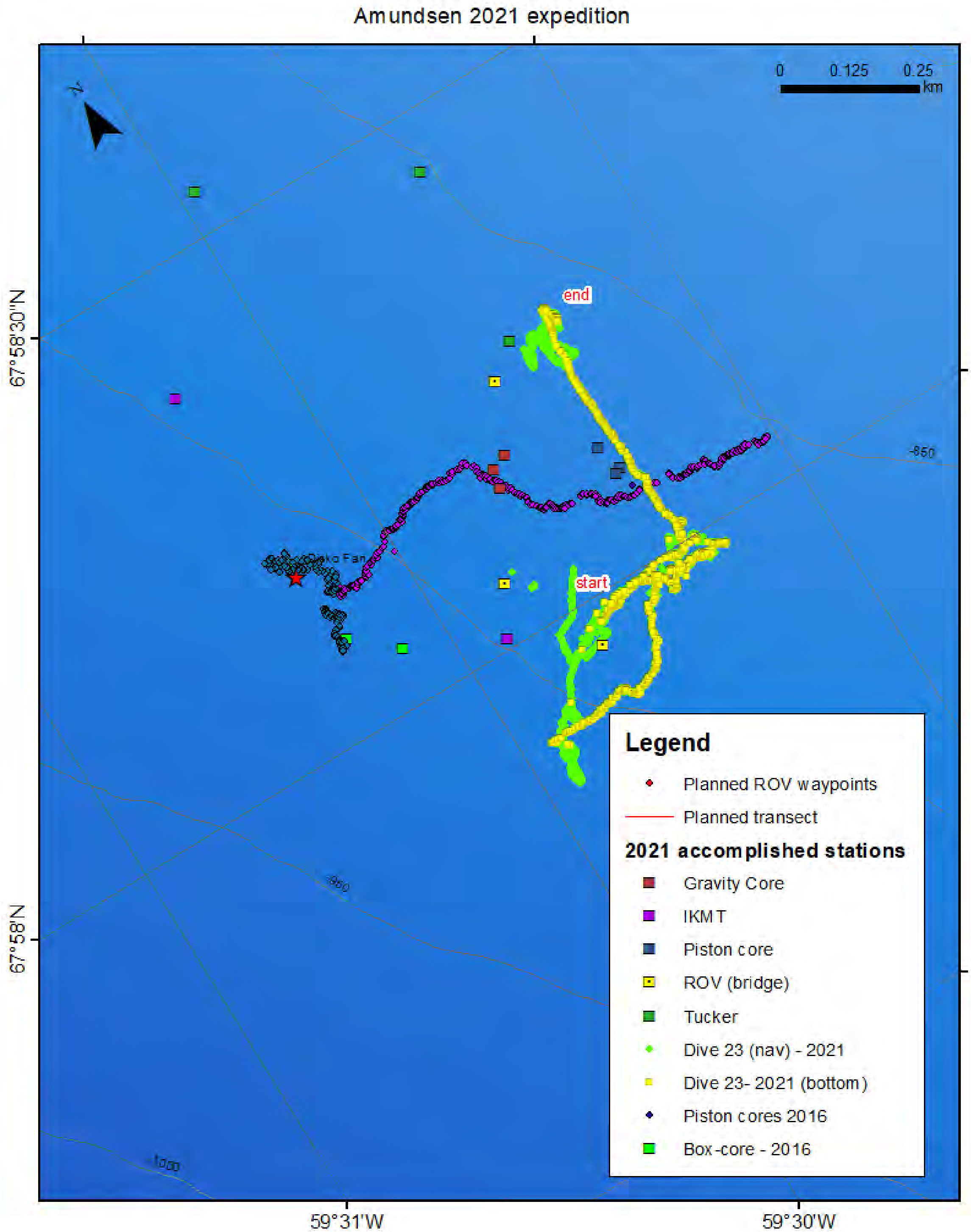


Figure (33) Map showing track of ROV dive C23, Disko Fan.

The evasive action was successful, but the ROV then had to return to the staining chambers immediately and recover them after 4 hours (rather than the intended 6-7 hours, following Lartaud et al. 2017), to avoid the risk of being unable to return to the position of the staining chambers and losing them entirely. During collection of the staining chambers, one coral colony was displaced when the chamber was lifted, and is no longer in its marked position. Furthermore, this coral may not survive the next 2 years, having been dislodged. Thus, the Keratoisis experiment will include only 1 living coral remaining on the sea floor. Targeted coral collections for sclerochronology were supplemented by 5 corals that were accidentally dislodged by the ROV and retained on the ROV porch during the ascent. Two of these were transferred to aquaria for staining, following a 6 hour staining at 150 mg/litre of calcein, similar to the *Acanella* staining in aquaria.

The biological observations at this site were largely as anticipated, a high abundance of *Keratoisis* corals, in dense, mono-specific stands (Figure 34). Our sample collection included two pairs of subsamples of *Keratoisis* colonies from opposite sides of a coral thicket to check genetic connectivity, and to assess the possibility that each thicket could be a clone of genetically identical stems. This would indicate asexual reproduction, i.e. growth, rather than sexual reproduction, i.e recruitment, to explain the growth of each thicket.

Other biological observations of the *Keratoisis* thickets are indicated in the photo-plates, and included skate, spotted wolffish, zoanthid parasites or commensals of *Keratoisis*, sea pens, and a variety of sponges, generally occupying the bare spaces between coral thickets. The thickets are dense enough that we were unable to see what fauna were occupying their centres.

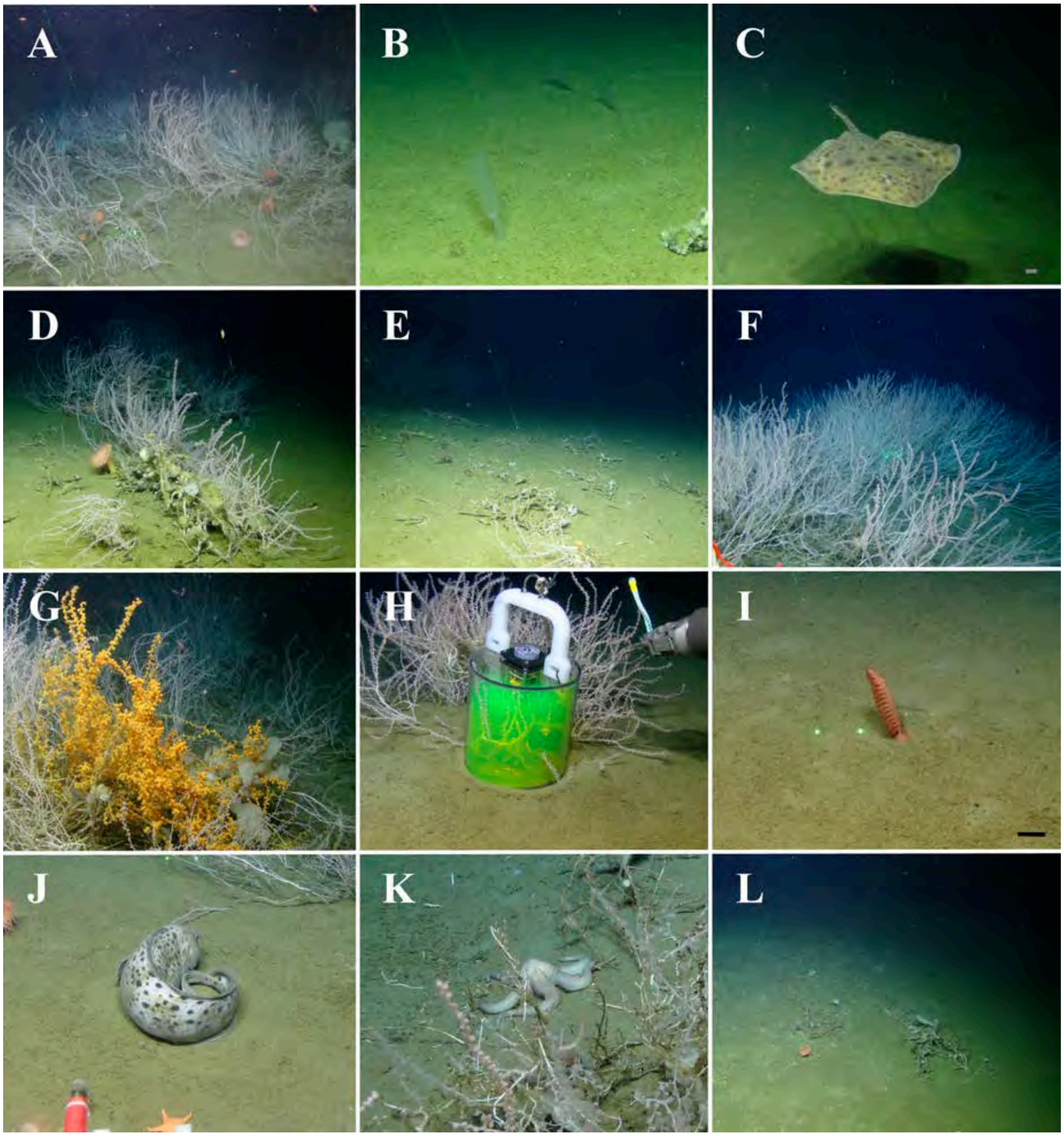


Figure 34. Photo-plate of physical environment and fauna observed in dive C23, Disko Fan. A) *Keratoisis* patch, B) ascidian, C) skate, D) small patch of *Keratoisis* with small sponges and sea anemones, E) fragments of *Keratoisis* on the seafloor, F) large patch, G) *Keratoisis* with yellow zoanthid and *Asconema* sponges, H) staining chamber on top of *Keratoisis*, I) sea pen *Pennatula* sp., J) spotted wolfish, K) large sea star (sampled), L) fragments of *Keratoisis* on the seafloor.

Towards the end of the dive, we began to collect video transect data to assess the extent of the coral forests. Our plan had been to run the transect directly up-slope to measure the bathymetric extent of the coral forests, but the currents were just strong enough that the only direction we could proceed was north, which was along-contour. We measured approximately 500 m of transect, and used this transect to identify one target location for a piston core to assess the thickness of the sediment pile accumulated by the coral forests baffling sediment. The target location was a particularly large and long ridge of sediment baffled by coral.

Although the sub-bottom profile collected by the ship over this location indicated a thickness of 5 m of mud above any hard reflectors (image not recorded, due to an error or malfunction of the sub-bottom profiler software), the coral recovered less than 1 m of muddy sediment (GSC core 2021805021, apparent penetration 300 cm, actual recovery 44 cm in PC, 39 cm in Trigger Weight Core).. Unfortunately, the achieved bottom position of the piston core was about 80 m distant from the target location identified from the ROV video (figure 35). The second gravity core at this site was targeted using the results of the video analysis from the 2016 video transect (GSC core 2021805022). Although this gravity core was collected much closer to its intended target, the recovery was still quite limited, approximately 45 cm, and coral fragments were not visible from the outside of either core.

Figure 35. Map showing location of piston and gravity cores relative to ROV transect data and intended coring targets.

Scott Inlet, Dives C24-C27. 4-6 August, 2021.

The primary purpose for the ROV dives in Scott Inlet were two. The primary scientific goal was to sample microbial mats that occur above hydrocarbon seeps for microbial fauna that are capable of digesting hydrocarbons. The sampling scheme for these was meant to collect replicate push cores from within microbial mats, and at increasing distances from microbial mats. This sampling was achieved on the first dive, C24, in addition to running video transects to assess the spatial distribution of the transects (figure 36)

The second purpose of diving in Scott Inlet was to recover a CTD/rosette sampler that was lost overboard in 2019. This lost equipment was successfully recovered in dive C25, and was completed by early afternoon on August. 5. While we considered another cive that afternoon to investigate a site with high bottom (?) or surface (?) methane concentrations sampled in CTD in 2019, we opted to survey this site with the drop video camera rather than the ROV, because the drop video camera is able to survey a much broader area in a 3-hour period than the ROV weould have been able to do. Unfortunately, the drop video camera survey found no evidence of microbial mats, and we did not return to this site for an additional dive,

Therefore, we assigned the last day of ROV diving in Scott Inlet two two bathymetric features related to the Scott Trough, and possibly related to the hydrocarbon seeps. Dive C26 targeted a linear bathymetric depression and the immediately adjacent raised bedrock massif in the Scott Trough, considering that the linear depression likely represented the trace of a fault, which lined up with the location of the known seep. Unfortunately, no microbial mats indicating seeps were observed, although exposed bedrock, probably igneous or high-grade metamorphic preCambrian basement rock, was observed both in the depression (the probable fault trace) and on the bedrock massif. It is unknown how deeply into the bottom the the Tertiary beds that are the likely source of thermogenic methane extend, and whether or not those Tertiary beds underly the Scott trough at the location of this probable fault.

Dive C27 targeted a steep eroding S margin of the Scott trough where bathymetric features indicative of cyclic steps within a turbidity current system suggested that the margin of the trough was rapidly eroding. The survey of this site ran up through the depositional area, characterized by the cyclic steps, to the erosional margin of the trough, where we observed cliffs of partially consolidated sediment, often with authigenic carbonate crusts in it, which were indurated enough to maintain a near-vertical slope. In adjacent areas laterally, the scarp appeared less indurated and was eroding more rapidly.

Dive C24. Microbial mat sampling and local distribution surveying. 4 Aug 2021.

This dive began with intensive push-core sampling of microbial mats and the sediments underlying them in the vicinity of the largest concentration of microbial mats, and of methane gas escape from the bottom, known in the Scott Inlet area (figure 37). M.Sc. student Meng Ji directed sampling, specifically push-coring of microbial mats and sediments under them. Despite the fact that the surface of the sediment throughout much of the Scott Inlet area has angular pebbles and cobbles covering it, push-cores descended easily into the muddy sediments at the microbial mats. Nine push cores were deployed to sample the microbial mats and nearby sediments, with 3 cores dedicated to one set of microbial mats, 3 cores to another set, and a final 3 cores dedicated to sediment sampling in mud near, but not in, microbial mats. All of this sampling was carried out within a 30 m radius of the largest concentration of mats observed in previous years, and published in Cramm et al. 2021.

An additional two cores with pre-drilled holes for pore-water sampling were collected from the two microbial mats that were sampled. The results of the coring, and of the pore-water measurements, are described in the cruise reports by Meng Ji, and Chris Algar, respectively.

After push-coring the microbial mats and underlying hydrocarbon-laden sediments, we proceeded with other biological sampling in the vicinity of the microbial seeps, including deploying the shrimp trap and collecting soft-corals, crinoids, and other organisms that might have seep-derived lipids or other compounds in their tissues. Finally, we proceeded with a video survey to search for more microbial mats. A 500 m video transect to the SE encountered no more microbial mats or seeps. We then moved southward by 200 m, encountering one set of microbial mats along the way. A 500 m video transect back toward the location where we cored the seeps also encountered few or no seeps or authigenic carbonates. This may be an indication that the dominant distribution of microbial mats follows faults perpendicular to the orientation of the Scott Trough, and that our transects had missed those faults. Alternatively, this may indicate that seeps are increasingly rare with distance from the main seep field. The bottom types on these video surveys were dominantly mudsdy sand with gravel patches, and occasional clusters of cobbles and boulders, probably derived from ice-rafted debris. The cobbles and boulders tended to be barren on their upper surfaces, with a veneer of sediment, and heavily encrusted with serpulid worms on their sides. Other fauna observed were quite depauperate, mainly echinoderms, especially crinoids, and rare sponges and basket-stars (*Gorgonocephalus*), on cobbles and boulders, and ophiuroids and rare sea stars on the flatter bottoms. The fish fauna was also quite depauperate. After returning to the main seep field sampled to collect the shrimp trap (which contained no shrimp), we surveyed an additional 150 m to the SW, encountering one cluster of microbial mats with methane bubbles coming from them, about 130 m southwest from the first cluster that was sampled.

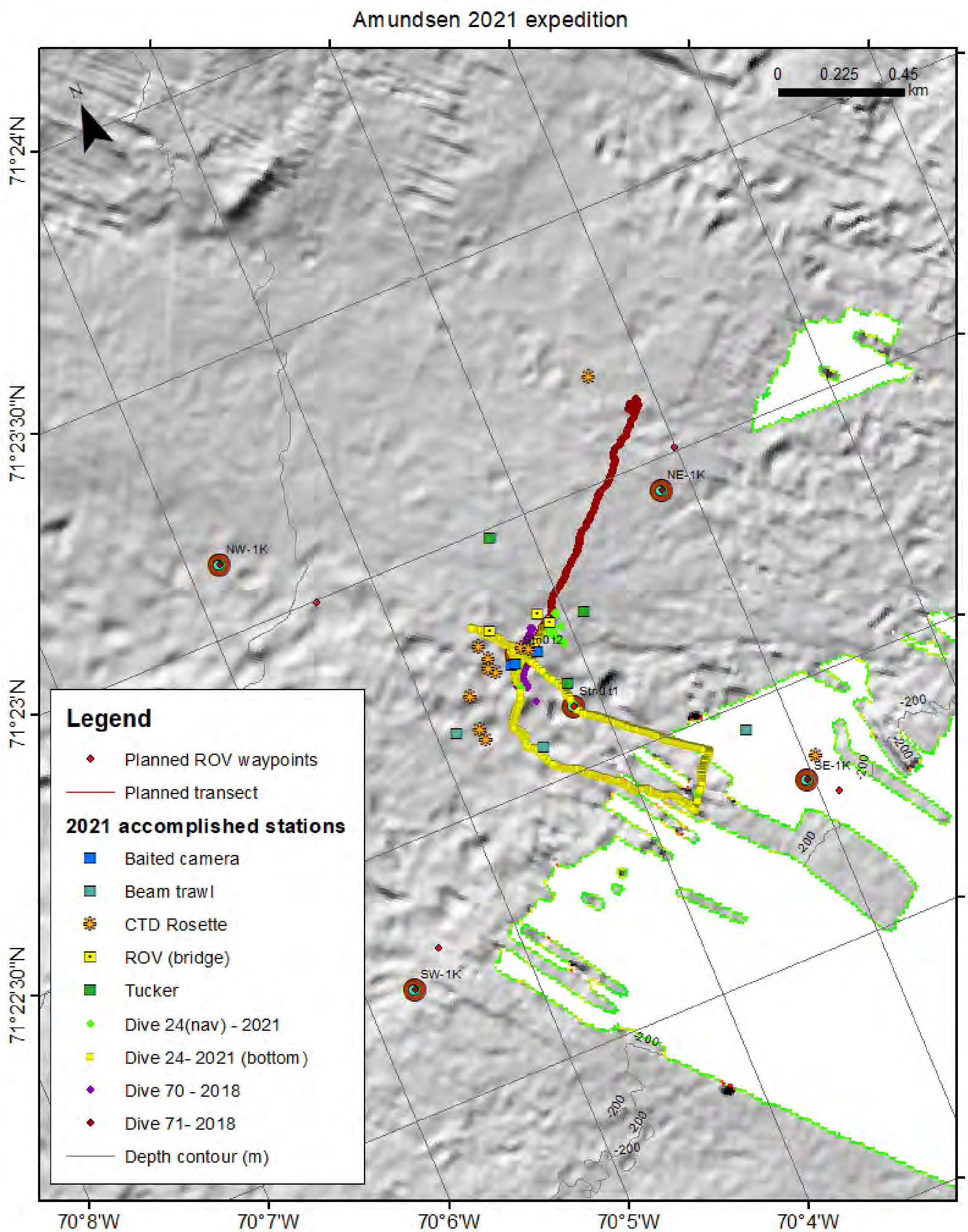


Figure 36. Map of dive C24.

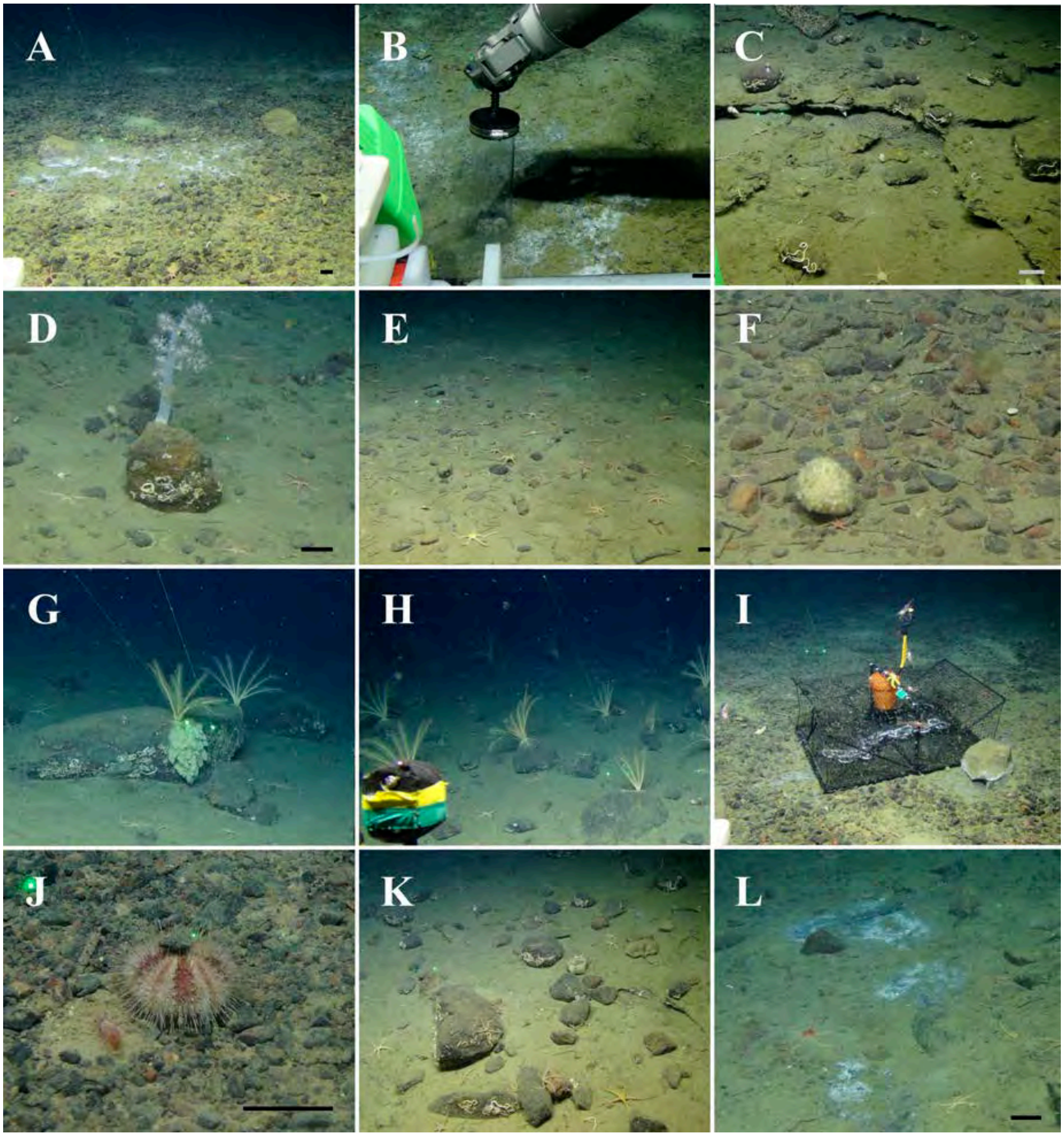


Figure 37. Photoplate of bottom types and fauna observed in dive C24, Scott Inlet 1. A-B) bacterial mats, mat being sampled with ROV push-core (B), C) authigenic carbonate crust, serpulid worm tubes growing on rocks, D) Nephtheidae soft coral and encrusting serpulid tubes on cobble, E-F) seafloor and close-up showing sponge, ophiuroids, and polychaete tubes, G) crinoids and sponges on boulder, upper surface of boulder covered in sediment veneer, with encrusting fauna on sides H) crinoid field, I) shrimp trap with shrimp showing outside of it, J) sea urchin and shrimp, K) rocks and authigenic carbonate crust, L) bacterial mat.

Dive C25. Rosette Recovery. (position, depth). 5 Aug 2021, morning.

The rosette recovery was not logged by science personnel. The rosette recovery was quick and efficient. Finding the rosette underwater took about 40 minutes. The rosette was sitting on top of the sediment, and was not buried in mud at all (figure 38), such that attaching the ropes and pulling the rosette to the surface with the ship's capstan was straight-forward. The rosette recovery dive was completed within less than 4 hours.

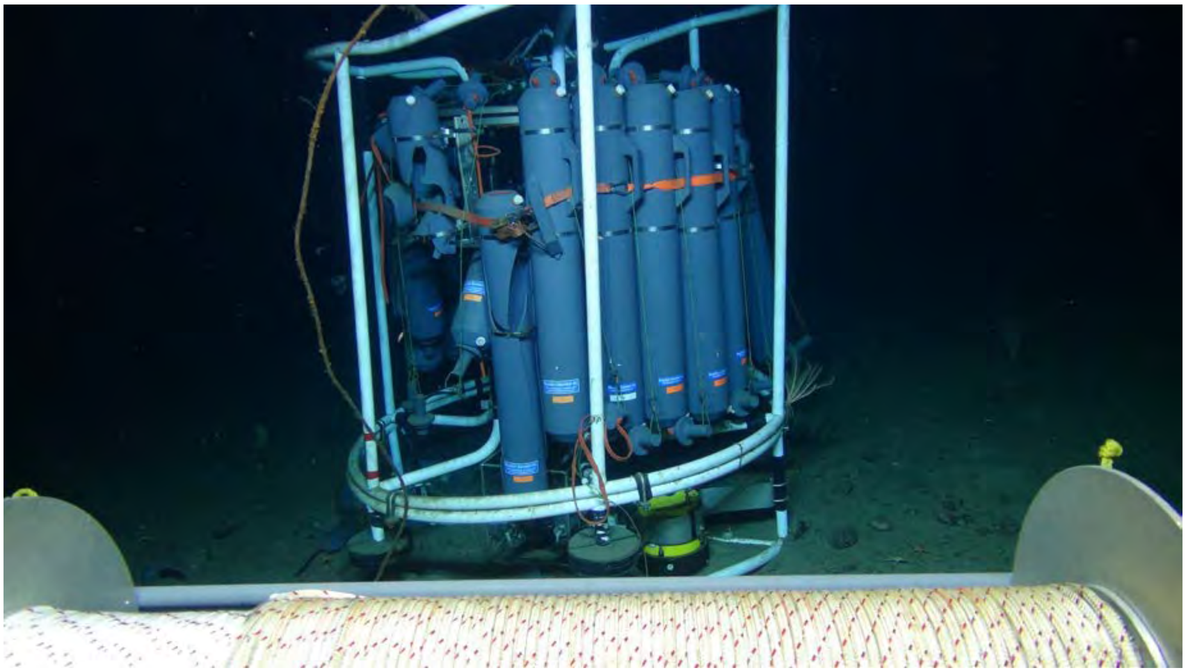


Figure 38. Image of lost rosette on sea floor as found by ROV, just before recovery.

Dive C26. Survey of probable fault and bedrock massif in Scott Trough. 6 Aug 2021, morning.

Dive C26 targeted a linear bathymetric depression and the immediately adjacent raised bedrock massif in the Scott Trough, considering that the linear depression likely represented the trace of a fault, which lined up with the location of the known seep (figure 39). It is unknown how deeply underground the Tertiary-aged sedimentary rocks that are the likely source of thermogenic methane extend, and to what extent those Tertiary beds underlie the Scott trough at the location of this probable fault. Given the persistent oil slicks that have been observed on both the north and south sides of the Scott Trough, this apparent fault is a likely conduit for hydrocarbons. The dive was planned with two short transects, each crossing the apparent fault, then rising up the slope of the bedrock massif on the N side of the apparent fault.

Unfortunately, no microbial mats indicating seeps were observed on any portion of this dive. Exposed bedrock, probably igneous or high-grade metamorphic PreCambrian basement rock, was observed both in the depression (in the probable fault trace) and on the bedrock massif, where it was rounded, as expected for glaciated bedrock in a shelf-crossing trough (Figure 40). The rock observed did not have clear bedding planes, and was quite hard when poked with the ROV arms.

Although no microbial mats or methane bubbles were seen, the carnivorous sponge *Cladorhiza* sp. was observed frequently throughout this dive, both in the vicinity of the apparent fault, and on the adjacent bedrock massif. This genus of carnivorous sponge has a statistical association with hydrocarbon seeps (citation), although Cladorhiza sponges have been observed in ROV investigations of deep rocky habitats in several sites around the eastern Canadian Arctic (Dinn et al. 2020). The top of the bedrock massif had a particularly dense and diverse sponge fauna. The location of this dive was very close to the location of the baited camera deployment where a diverse fish fauna was observed, including Greenland Shark.

Collections on this dive include water and sediment collections in the apparent fault, and three collections of *Cladorhiza* sponge colonies, to assess possible methane-derived metabolites in the sponges. Additinally, we collected 5 cobbles for S. Wolvin's study on the epibiont fauna on ice-rafted debris at different depths, to contrast with those collected in shallower water in the Pacific water mass, in Dives 24 and 27.

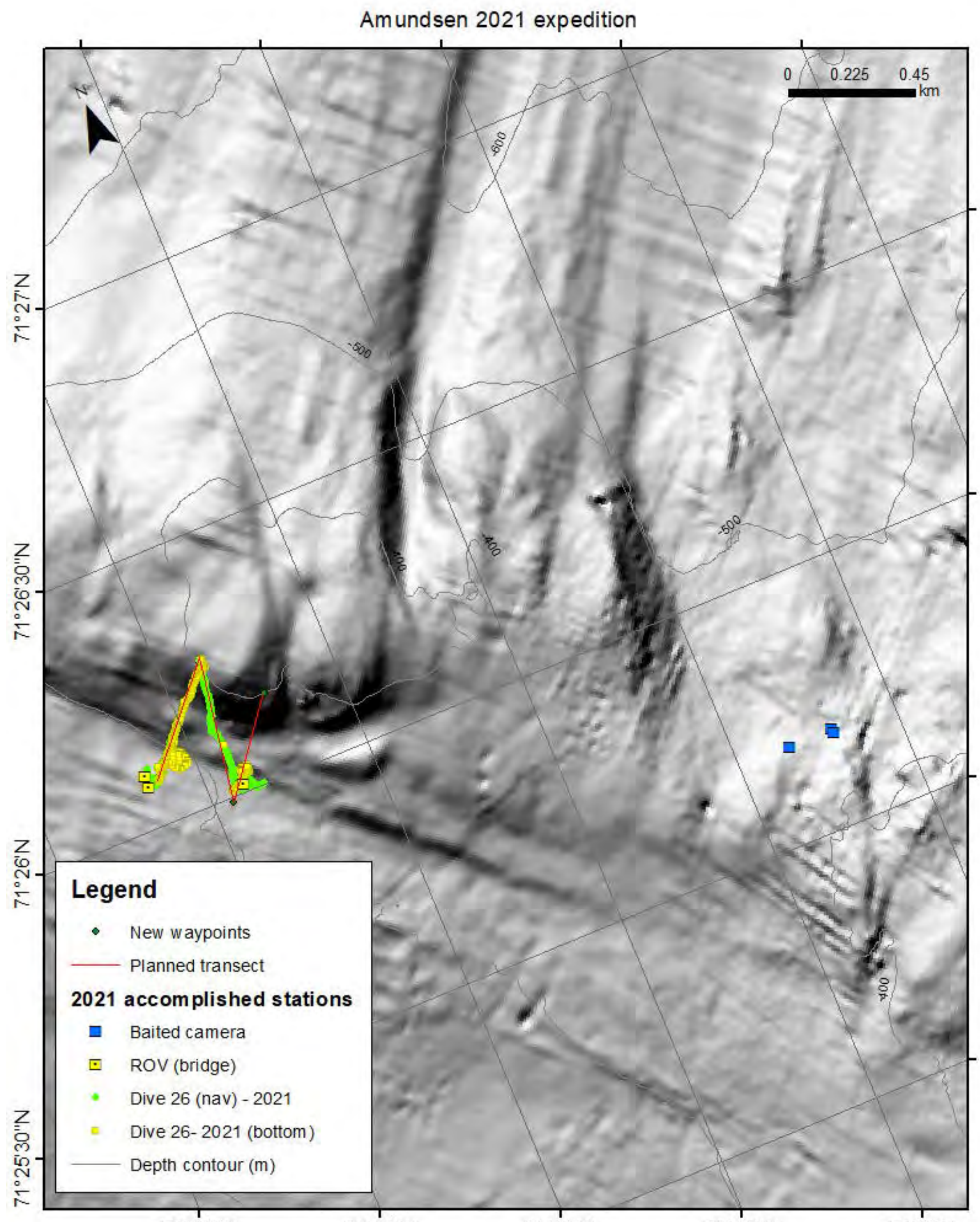


Figure 39. Map of ROV dive C26.

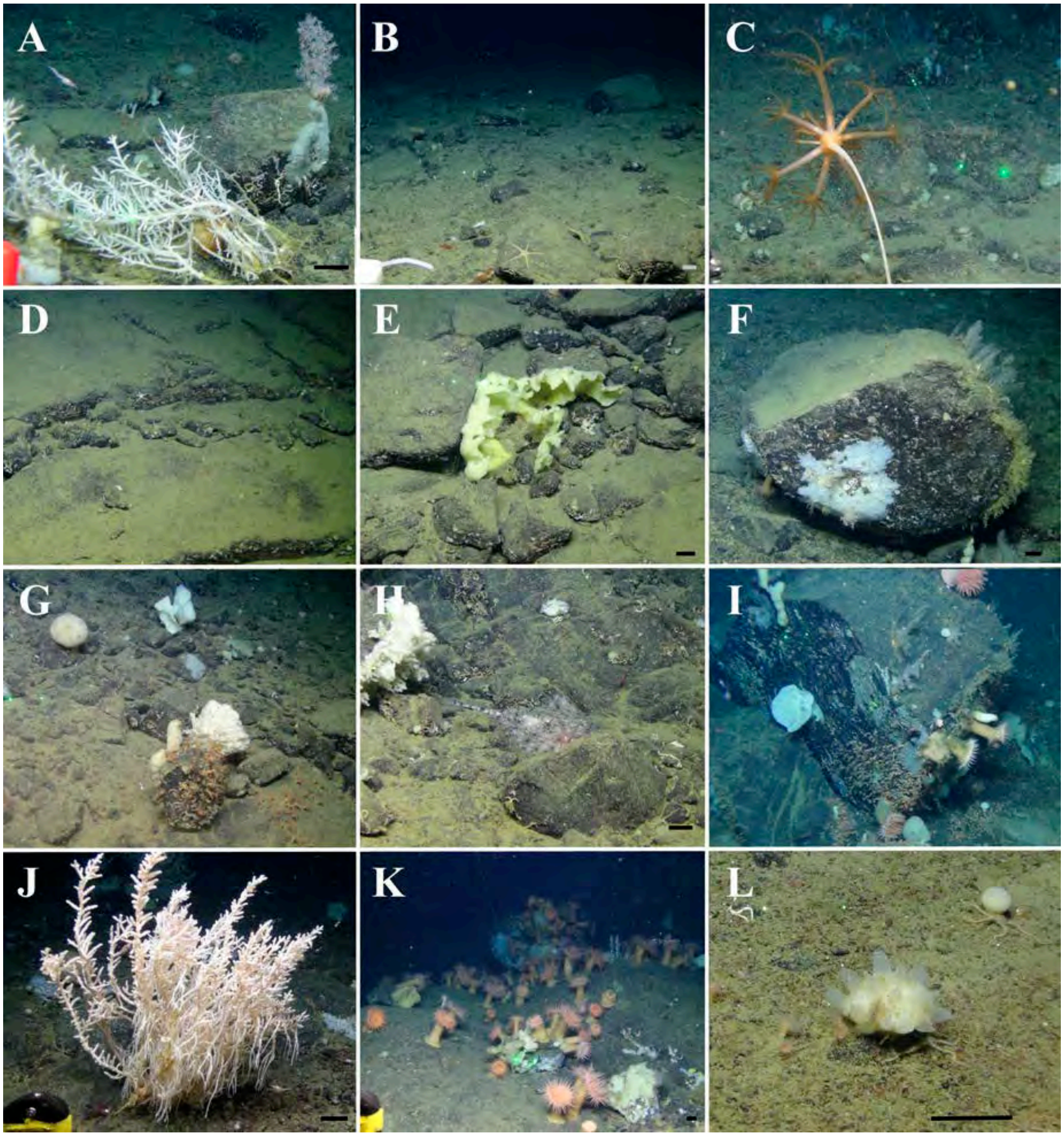


Figure 40. Photo-plate of ROV dive C26. A) Carnivorous sponge *Cladorhiza* sp. and Nephtheidae soft coral, B) overall view of the seafloor on the SW side of the probable fault trace, C) *Umbellula* sp. sea pen (only one seen), D) bedrock covered with sediment near the location of the probably fault trace, E) large sponge on bedrock, F) boulder, with sediment veneer on top surface, and encrusting fauna on sides G) different sponge species and sea anemones on rock, H) skate, I) different sponge species and sea anemones on rock, J) large *Cladorhiza* sp. sponge, K) field of sea anemones, L) close-up of potential *Polymastia* sp. sponge.

Dive C27. Survey of steep eroding margins of Scott Trough. (position, depth, 6 Aug 2021, afternoon. Dive site chosen by A. Normandeau, GSC.

Dive C27 targeted a steep eroding SW margin of the Scott Trough where multibeam bathymetry acquired in 2020 and 2021 indicated cyclic steps, sandy bedforms found within the middle to lower parts of a turbidity current system (figure 41). These cyclic steps, roughly 2-3 m in height and with bedform wave lengths of 10-30 m, and the steep bathymetry along the margins of the trough suggested that the margin of the trough was rapidly eroding, and that current hydrocarbon seep activity could be related to generating slope instability. In seeming contradiction, past seep activity could have be responsible for early cement and authigenic carbonate crust formation near the top of the cliff, stabilizing the slope where it is most indurated and steepest.

The ROV survey of this site began in the depositional area of the turbidity current channels, characterized by the cyclic steps. Using the GPS feed from the ROV overlaid onto the high-resolution multibeam sonar map of the site to determine sample locations, three push cores were collected from the stoss and lee sides of a cyclic step, and the trough between them, respectively, to assess the depth of muddy sediment over the top of the sandy bedforms. The push cores, and a later box-core with push cores over this site, found approximately 10 cm depth of mud atop the sandy turbidite-related sediments. The push cores do not have core-catchers, and some of the sandy sediment comprising the cyclic steps themselves was lost from the bottom of the core. Radiogenic isotope dating of the muds in the push cores will be used to assess the time since these bedforms have been buried, and possibly the time since these turbidity currents were active.

Proceeding up the dive toward the erosional margin of the trough, where we observed cliffs of partially consolidated sediment, often with authigenic carbonate crusts in it, which were indurated enough to maintain a near-vertical slope (figure 42). Some of the carbonate crusts showed vertically disposed box-work morphology, rather than horizontally disposed crusts, as were observed in most other areas. Rarely, we saw partially indurated horizontally bedded sediments within the cliffs, or elsewhere, talus composed of partially consolidated sediment, rather than rocks. In adjacent areas laterally along the top of the cliff, the scarp appeared less indurated and was eroding more rapidly.

Immediately above the scarp, at about 220 m depth, the seafloor returned to muddy sand with gravel, cobbles and rare boulders, with a very high abundance of crinoids. Three crinoids were collected to assess the possibility of thermogenic methane in their tissues. No microbial mats or active seeps were observed along the top of the cliff, but the available time to search for them was very limited. We collected water samples and surface sediment samples from the rapidly eroding cliff-top, and collected five cobbles for the S. Wolvin study on epibionts on ice-rafted debris cobbles.

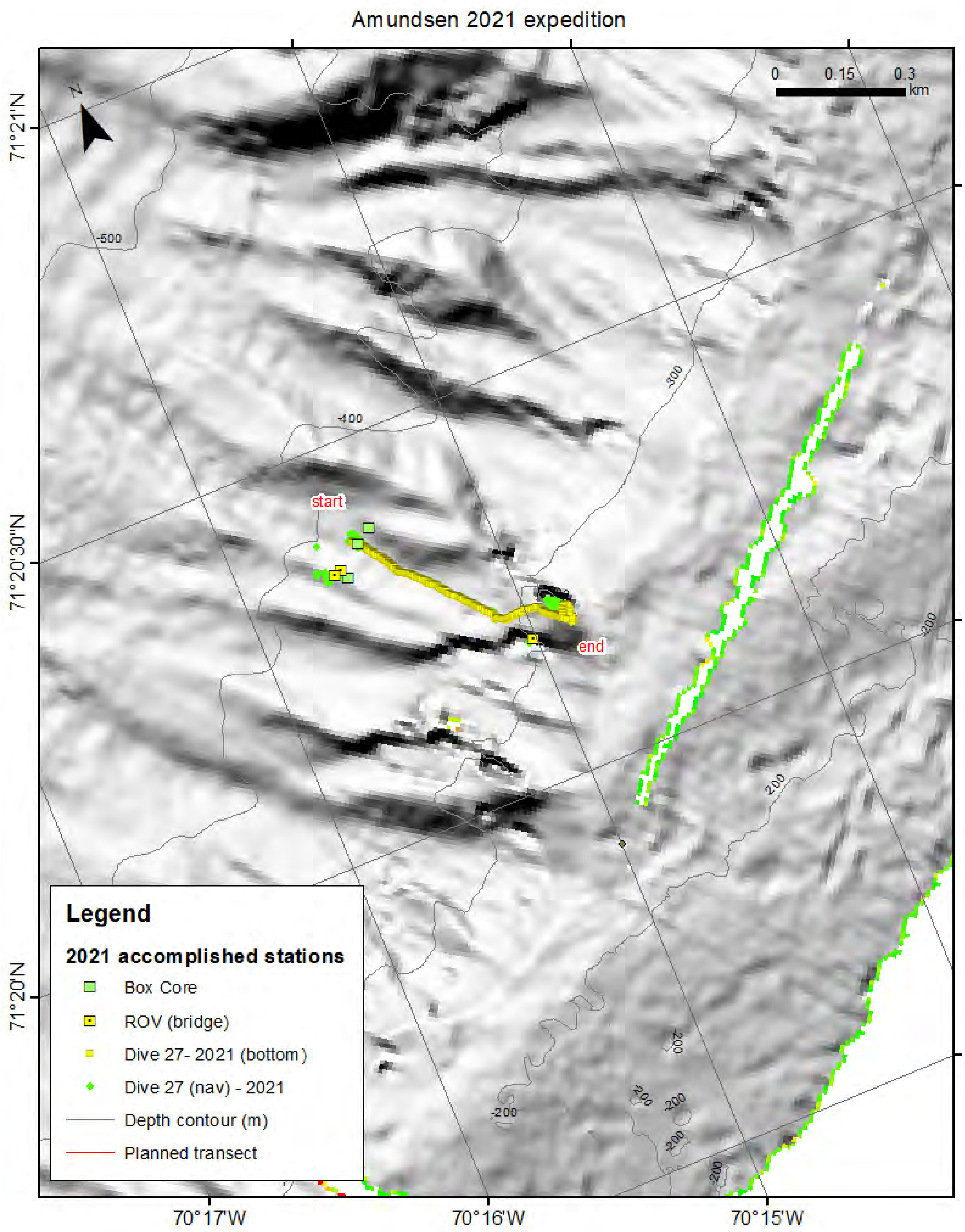


Figure 41. Map of ROV dive C27, Scott Inlet 3.

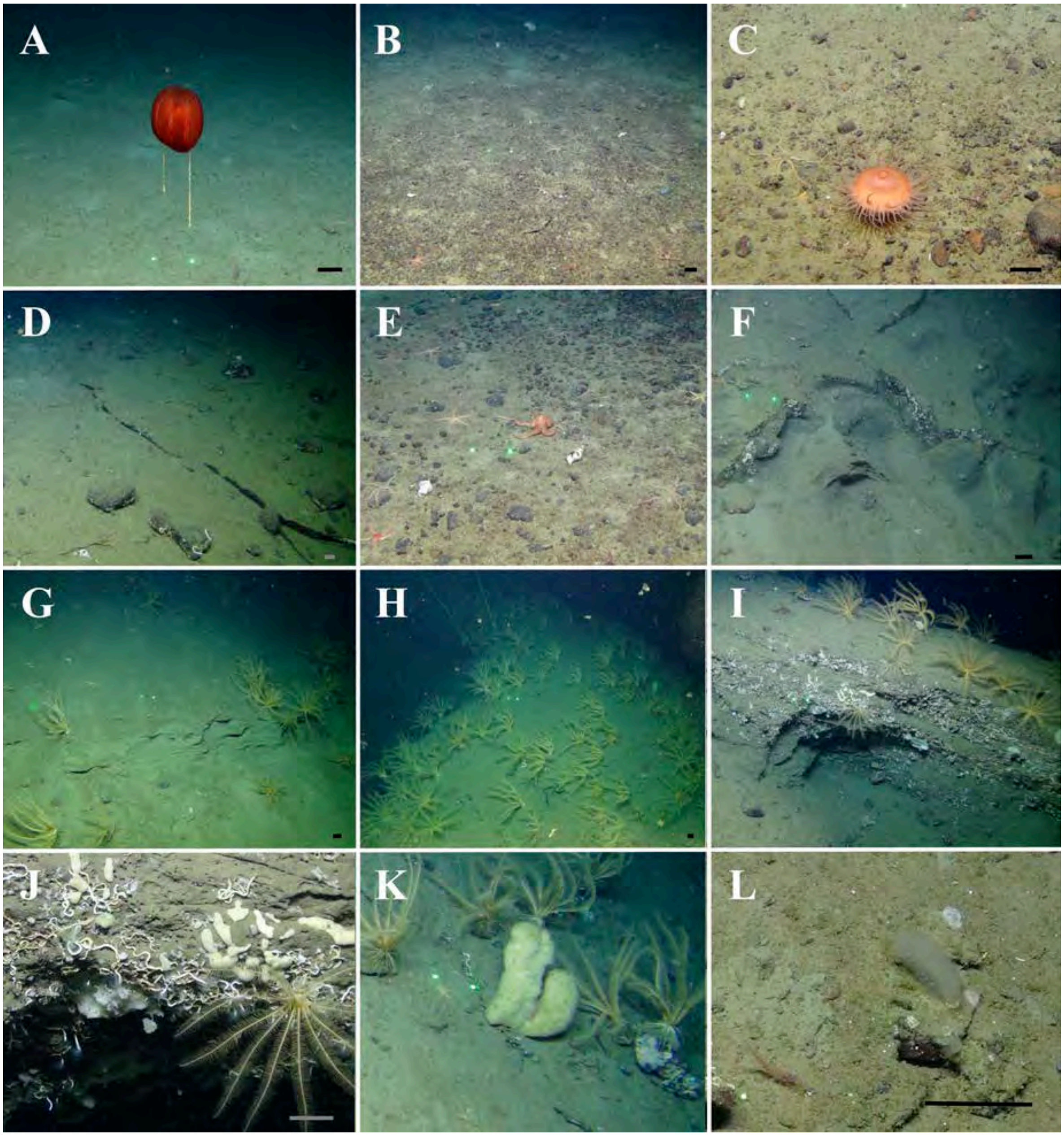


Figure 42. Photo-plate of observations on ROV dive C27, Scott Inlet 3.A) Ctenophore, B) gravelly bottom with little megafauna, C) close-up of sea anemone, D) potential carbonate crust, E) gravelly bottom with a common sea star in the area, F) vertically-disposed ?authigenic carbonate crusts in boxwork morphology. G) horizontally bedded partially consolidated sediments, probably glaciomarine, with crinoids, H) dense crinoids, I) dense crinoids on indurated or cemented sediments at top of steeply sloping cliff, J) close-up of serpulid worms and crinoid, K) crinoids and sponge, L) rock being sampled (note small ascidian and shrimp).

List of samples collected with the Comanche 38 ROV on this cruise leg.

Number	**Type**	**Method**	**Description (first observation displayed)**	**Latitude**	**Longitude**	**Depth**
R13-1	sponge	ROV arm	white leafy sponge subsample from rock wall stowed in sample well SA1	N55° 31.8786′	W58° 57.6408′	634m
R13-2	Anthoptilum	ROV arm	Anthoptilum sea pen sample collected from sediment patch found along a dominantly hard bottom slope. Stowed in well Stbd Fwd 2	N55° 31.875′	W58° 57.6618′	616m
R13-3	sediment	Push-core	Porewater push-core (yellow)	N55° 31.8228′	W58° 57.768′	519m
R13-4	sediment	Push-core	Optode push-core (red-yellow)	N55° 31.824′	W58° 57.7722′	518m
R13-5	sediment	Push-core	Optode push-core (red-green)	N55° 31.8216′	W58° 57.7668′	519m
R13-6	sediment	Push-core	Optode push-core (red)	N55° 31.8216′	W58° 57.768′	519m
R13-7	water	Niskin	Forward Niskin bottle collected. Depth is incorrect - we were still on the bottom when bottles fired.	N55° 31.8228′	W58° 57.7662′	509m
R13-8	water	Niskin	Niskin-2-Aft	N55° 31.8228′	W58° 57.7536′	504m
R14-1	sediment	Push-core	Push-core (red-G)	N55° 30.9948′	W58° 56.5884′	692m
R14-2	sediment	Push-core	Push-core (red-black-J)	N55° 30.9954′	W58° 56.5866′	692m
R14-3	sediment	Push-core	Push-core (yellow-green)	N55° 30.9942′	W58° 56.5872′	692m
R14-4	dead coral	ROV arm	Dead coral (Port-forward).	N55° 31.002′	W58° 56.6862′	665m
R14-5	Primnoa	ROV arm	Primnoa sample - Port-aft	N55° 30.9954′	W58° 56.7102′	612m
R14-6	water	Niskin	Niskin (aft bottle)	N55° 30.9894′	W58° 56.7054′	592m
R15-1	water	Niskin	Niskin-FW	N55° 31.0284′	W58° 56.7294′	586m
R15-2	Primnoa	ROV arm	Primnoa sample growing rock wal about about 570 m. Precise location not known due to navigation system problems. Will be stowed in Port Fwd box.	N55° 31.0368′	W58° 56.697′	525m

Number	Type	Method	Description (first observation displayed)	Latitude	Longitude	Depth
R15-3	Primnoa	ROV arm	Third Primnoa sample being collected. Port AFt.	N55° 31.0368′	W58° 56.697′	525m
R15-4	water	Niskin	562 m. Niskin bottle fired in Sponge-dominated environment.	N55° 31.0368′	W58° 56.697′	525m
R15-5	sponge	ROV arm	sponge. SF-1	N55° 31.0368′	W58° 56.697′	525m
R15-6	sponge	ROV arm	yellow-white sponge with crinoid. SF-2.	N55° 31.0368′	W58° 56.697′	525m
R15-7	Primnoa	ROV arm	SF-1 Primnoa sub-sample stowed with sponges	N55° 31.0368′	W58° 56.697′	525m
R15-8	sea star	ROV arm	Sea star sampled, but may be crushed by jaw. Stowed in SF-2	N55° 31.0368′	W58° 56.697′	525m
R15-9	Paragorgia	ROV arm	Paragorgia for genetic analysis. PF box.	N55° 31.0368′	W58° 56.697′	525m
R15-10	Primnoa	ROV arm	Whole Primnoa colony for aging. PF box.	N55° 31.0368′	W58° 56.697′	525m
R15-11	sea star	ROV arm	unknown sea star, sampled for voucher specimen. SA-1.	N55° 31.0368′	W58° 56.697′	525m
R15-12	sponge	ROV arm	Mycale (?) sponge, to be stowed on stbd side. SF-2	N55° 31.0368′	W58° 56.697′	525m
R16-1	water	Niskin	Niskin-Forward (~25 m away from bottom - check overlay video)	N60° 31.3578′	W61° 14.4576′	617m
R16-2	water	Niskin	Niskin-Aft (~25 m away from bottom - check overlay video)	N60° 31.3554′	W61° 14.448′	611m
R17-1	Primnoa	ROV arm	Primnoa in PF (port-forward)	N60° 31.1484′	W61° 14.6784′	631m
R17-2	Primnoa	ROV arm	Primnoa in PF (Port-Forward)	N60° 31.149′	W61° 14.6814′	631m
R17-3	Primnoa	ROV arm	Primnoa in SF-1	N60° 31.1502′	W61° 14.6784′	631m
R17-4	Primnoa	ROV arm	Primnoa in PA	N60° 31.1472′	W61° 14.7198′	628m
R17-5	Primnoa	ROV arm	Primnoa on PF (has base)	N60° 31.1472′	W61° 14.7222′	628m

Number	Type	Method	Description (first observation displayed)	Latitude	Longitude	Depth
R17-6	Paragorgia	ROV arm	Dislodged piece of Paragorgia - in box SA 1	N60° 31.1466′	W61° 14.7222′	628m
R17-7	Primnoa	ROV arm	Primnoa piece with thin base in SA-1	N60° 31.1472′	W61° 14.721′	628m
R17-8	Primnoa	ROV arm	Dead primnoa in SF-1	N60° 31.149′	W61° 14.7318′	627m
R17-9	Primnoa	ROV arm	dead primnoa in SA-1 thin piece	N60° 31.1514′	W61° 14.7384′	627m
R17-10	sponge	ROV arm	sponge in SF-2	N60° 31.152′	W61° 14.7354′	627m
R17-11	Asconema	ROV arm	asconema in SF-2	N60° 31.1544′	W61° 14.7438′	626m
R17-12	Primnoa	ROV arm	primnoa - something white growing on it. Stored in PF.	N60° 31.149′	W61° 14.7624′	625m
R17-13	Geodia	ROV arm	geodia on PA	N60° 31.1316′	W61° 14.7942′	624m
R17-14	water	Niskin	Niskin	N60° 31.1298′	W61° 14.7942′	624m
R17-15	Primnoa	ROV arm	dead primnoa on SA-2	N60° 31.1394′	W61° 14.8236′	621m
R17-16	Primnoa	ROV arm	Dead primnoa in SF-2 (with some tissue)	N60° 31.14′	W61° 14.8254′	621m
R17-17	water	Niskin	Niskin aft, before sediment scoop	N60° 31.1394′	W61° 14.8224′	621m
R17-18	sediment	scoop	sediment sampled using scoop - coral bycatch	N60° 31.1412′	W61° 14.8242′	622m
R17-19	Primnoa	ROV arm	Primnoa sampling growing on black rock collected while picking up sediment with scoop. Placed in Port Aft box	N60° 31.1436′	W61° 14.829′	620m
R17-20	Primnoa	ROV arm	primnoa-live in arm	N60° 31.1478′	W61° 14.8428′	620m
R18-1	water	Niskin	Forward Niskin bottle fired near bacterial mat	N60° 29.8584′	W61° 13.8648′	804m
R18-2	rock	ROV arm	First rock collected - SA-1	N60° 29.9148′	W61° 14.0274′	755m

Number	Type	Method	Description (first observation displayed)	Latitude	Longitude	Depth
R18-3	rock	ROV arm	Second rock being collected - SF-2	N60° 29.9136′	W61° 14.0298′	755m
R18-4	rock	ROV arm	3rd rock collected for Sophie - SF-2	N60° 29.9124′	W61° 14.0304′	755m
R18-5	rock	ROV arm	4th rock to be collected for Sophie - SF-2	N60° 29.9196′	W61° 14.04′	756m
R18-6	skeleton	ROV arm	Dead coral skeleton - will be stowed in Port box	N60° 29.9772′	W61° 13.9482′	789m
R18-7	rock	ROV arm	fifth rock sample for Sophie - SF-1	N60° 29.9766′	W61° 13.9476′	789m
R18-8	rock	ROV arm	6th rock sample for Sophie	N60° 29.9772′	W61° 13.9476′	789m
R18-9	sea pen	ROV arm	collecting sea pen	N60° 29.9772′	W61° 13.9512′	789m
R18-10	rock	ROV arm	7th rock sample for Sophie - collected close to sea pen	N60° 29.9766′	W61° 13.9506′	789m
R18-11	water	Niskin	Aft Niskin fired about 7 m off bottom.	N60° 29.9712′	W61° 13.923′	780m
R19-1	dead coral	ROV arm	Dead Coral stick being collected for Owen.	N60° 29.8122′	W61° 13.629′	821m
R19-2	rock	ROV arm	Rock 1 for Sophie. We got pulled away by current, we will have to try again	N60° 29.7984′	W61° 13.6356′	822m
R19-3	rock	ROV arm	Rock 1 for Sophie.	N60° 29.8068′	W61° 13.6194′	822m
R19-4	rock	ROV arm	Rock 2 for Sophie - also going in SF1	N60° 29.8068′	W61° 13.62′	822m
R19-5	sea star	ROV arm	orange sea star, white tips (Hippasteria?) in SF-1	N60° 29.8092′	W61° 13.6224′	822m
R19-6	rock	ROV arm	Rock 3 for Sophie Wolvin, stowed in SF-1	N60° 29.8074′	W61° 13.6188′	822m
R19-7	dead coral	ROV arm	dead coral base - I think Primnoa, but could be a Paragorgia	N60° 29.8092′	W61° 13.6596′	820m
R19-8	sea pen	ROV arm	sea pen - Anthoptilum, not a rock pen	N60° 29.544′	W61° 13.6116′	818m

Number	Type	Method	Description (first observation displayed)	Latitude	Longitude	Depth
R19-9	mat	ROV arm	attempting to sample these microbial mats with the scoop. Samples will be placed in Stbd Aft if possible	N60° 29.8458′	W61° 13.7826′	811m
R19-10	water	Niskin	Forward Niskin	N60° 29.8524′	W61° 13.8456′	806m
R19-11	water	Niskin	Aft Niskin bottle fired. Both Niskins collected at same location where we are close to a number of microbial mats. Need double volume of water in order to pick up microbes and methane in water samples.	N60° 29.8518′	W61° 13.848′	806m
R19-12	mat	ROV arm	Microbial mat sampled with scoop - sediment plus pebbles with mat directly on them.	N60° 29.8512′	W61° 13.8456′	806m
R19-13	mat-covered rock	ROV arm	Small pebble with mat on surface placed in SA-1 with sediment sample	N60° 29.8524′	W61° 13.8474′	806m
R19-14	soft coral	ROV arm	soft coral on port drawer	N60° 29.8524′	W61° 13.848′	806m
R19-15	coral on rock	ROV arm	This coral going in SF-2. Will be used in aquarium staining experiment.	N60° 29.8752′	W61° 13.92′	784m
R19-16	coral on rock	ROV arm	Small Primnoa sample on a small rock for aquarium staining experiment.	N60° 29.8812′	W61° 13.9368′	776m
R19-17	dead coral	ROV arm	dead Primnoa skeleton - Port box	N60° 29.901′	W61° 14.016′	760m
R19-18	crust	ROV arm	sampling piece of ? authigenic crust - it is very friable.	N60° 29.9004′	W61° 14.022′	759m
R19-19	coral	ROV arm	small Primnoa sample for aquarium study.	N60° 29.9004′	W61° 14.0244′	759m
R19-20	crust	ROV arm	small piece of ?authigenic crust (crust 2) - stowed in Port box	N60° 29.901′	W61° 14.0244′	759m
R19-21	Primnoa	ROV arm	Coral collected from carbonate crust - we will use this for genetics and isotopic studies to see if microbes play a role in nutrition.	N60° 29.9112′	W61° 14.0538′	758m
R20-1	unknown	ROV arm	Placing this object in SA-1	N61° 26.1576′	W60° 38.7084′	686m
R20-2	Radicipes	ROV arm	Radicipes sampled, bottom broke off, in box SF1	N61° 26.1558′	W60° 38.667′	687m
R20-3	dead coral	ROV arm	dead primnoa skeleton with anemones on it, in port side box with piece sticking out	N61° 26.1792′	W60° 38.7114′	684m
R20-4	sponge	ROV arm	piece of pancake sponge, in SF1	N61° 26.1786′	W60° 38.7108′	684m

Number	Type	Method	Description (first observation displayed)	Latitude	Longitude	Depth
R20-5	rock	ROV arm	rock 1 with soft coral on it, going in SF1	N61° 26.2014′	W60° 38.682′	685m
R20-6	water	Niskin	forward niskin fired	N61° 26.2026′	W60° 38.6736′	685m
R20-7	Pennatula	ROV arm	Pennatula	N61° 26.1726′	W60° 38.4972′	698m
R20-8	rock	ROV arm	rock 2 with soft coral on it, in SF2	N61° 26.1564′	W60° 38.4564′	696m
R21-1	sediment	push-core	push-core (red-I) around an Acanella coral	N63° 20.7816′	W58° 11.8278′	1318m
R21-2	sediment	push-core	Second core (Red-H) at 2:00 from first core	N63° 20.781′	W58° 11.8278′	1318m
R21-3	sediment	push-core	core (core D - with coral)	N63° 20.7828′	W58° 11.8332′	1318m
R21-4	sediment	push-core	Core C - about 1 m away from core with Acanella in it	N63° 20.784′	W58° 11.8344′	1318m
R21-5	water	Niskin	aft niskin	N63° 20.7834′	W58° 11.8326′	1318m
R21-6	sediment	push-core	first core of 3rd pair of cores - over a smal Acanella (core B).	N63° 20.7828′	W58° 11.8398′	1317m
R21-7	sediment	push-core	Core A - no coral, about 1 m away from core B with coral	N63° 20.7828′	W58° 11.8392′	1317m
R21-8	Acanella	ROV arm	Small Acanella for aging - going to Stbd Aft 1 - SA1	N63° 20.793′	W58° 11.9094′	1314m
R21-9	Acanella	ROV arm	Acanella #2	N63° 20.7918′	W58° 11.9112′	1314m
R21-10	Acanella	ROV arm	3rd Acanella sample - this one seems a little bigger	N63° 20.793′	W58° 11.9472′	1314m
R21-11	black coral	ROV arm	black coral, about 10 cm high, groig in sediment	N63° 20.8296′	W58° 12.4986′	1294m
R21-12	Acanella	ROV arm	about 8 cm wide acanella, in port side box, for tom	N63° 20.8224′	W58° 12.4758′	1297m
R21-13	Acanella	ROV arm	Acanella with roots attached, going in SF2, for tom	N63° 20.8164′	W58° 12.4698′	1298m

Number	Type	Method	Description (first observation displayed)	Latitude	Longitude	Depth
R21-14	Acanella	ROV arm	smaller acanella, in SF2, for tom	N63° 20.802′	W58° 12.4536′	1299m
R21-15	Acanella	ROV arm	acanella with roots attached, going in SA2	N63° 20.8008′	W58° 12.456′	1299m
R21-16	Acanella	ROV arm	20cm acanella in SF1	N63° 20.8038′	W58° 12.4638′	1299m
R21-17	Acanella	ROV Arm	About 10 cm Acanella, going into SA-2	N63° 20.802′	W58° 12.4644′	1298m
R21-18	Acanella	ROV arm	about 8cm acanella, in port box, for tom	N63° 20.8008′	W58° 12.4728′	1297m
R21-19	Acanella	ROV Arm	this sample has a root SA-1	N63° 20.7996′	W58° 12.4794′	1297m
R21-20	Acanella	ROV Arm	Estimated size 8 cm, SA-1	N63° 20.8002′	W58° 12.4812′	1297m
R21-21	Acanella	ROV Arm	About 7 cm coral - SF-1	N63° 20.799′	W58° 12.4824′	1297m
R21-22	Acanella	ROV arm	14cm acanella, going in port	N63° 20.8008′	W58° 12.4872′	1296m
R21-23	Acanella	ROV arm	10 cm Acanella - SA-2	N63° 20.8002′	W58° 12.501′	1295m
R21-24	Anthoptilum	ROV arm	anthoptilum - port	N63° 20.7984′	W58° 12.5046′	1294m
R21-25	Acanella	ROV arm	Acanella sample, 10 cm diam, to go into box SF-1	N63° 20.7876′	W58° 12.4578′	1299m
R21-26	sponge	ROV arm	white leafy Sponge sample will be put into SF-1	N63° 20.7852′	W58° 12.4074′	1302m
R21-27	sponge	ROV arm	sponge sub-sampled, to be palced in Port box. We got the whole sponge	N63° 20.7786′	W58° 12.3798′	1302m
R21-28	Funiculina	ROV arm	probably a Funiculina - going to Port box	N63° 20.775′	W58° 12.3474′	1303m
R21-29	water	Niskin	Forward Niskin bottle fired.	N63° 20.7732′	W58° 12.3036′	1301m
R21-30	rock	ROV arm	first of several cobble samples for Sophie	N63° 20.7702′	W58° 12.1956′	1307m

Number	Type	Method	Description (first observation displayed)	Latitude	Longitude	Depth
R21-31	rock	ROV arm	Cobble #2 will also go into SF-2	N63° 20.7708′	W58° 12.1974′	1307m
R21-32	rock	ROV arm	cobble #3 - will also go to SA-2	N63° 20.7702′	W58° 12.1968′	1307m
R21-33	rock	ROV arm	cobble #4 - we will try to place in SF-2	N63° 20.772′	W58° 12.1956′	1307m
R21-34	rock	ROV arm	Cobble #5 - will go to SA-2	N63° 20.7714′	W58° 12.1944′	1307m
R21-35	sponge	ROV arm	White glass sponge - will be stowed in SF-1 (ended up in SA-1)	N63° 20.7756′	W58° 12.1944′	1308m
R21-36	Acanella	ROV arm	potentially dead acanella - SA-1	N63° 20.7774′	W58° 12.042′	1311m
R21-37	kelp stipe	ROV arm	Collecting piece of kelp stipe for Paul Snelgrove	N63° 20.7618′	W58° 11.7642′	1317m
R21-38	Anthomastus	ROV arm	Anthomastus sample for taxonomy - going to Port box	N63° 20.7504′	W58° 11.6784′	1318m
R21-39	Euplectella	ROV arm	Euplectella sponge on port	N63° 20.7456′	W58° 11.6484′	1320m
R22-1	water	Niskin	Forward niskin	N66° 45.0588′	W62° 18.7836′	35m
R22-2	water	Niskin	Aft niskin	N66° 45.0576′	W62° 18.774′	33m
R22-3	dead fish	ROV arm	collecting dead fish from displaced block of sediment. ("Dead fish" turned out to be a live snail).	N66° 45.0858′	W62° 18.8136′	45m
R22-4	seaweed	ROV arm	seaweed - not sure which box it will go into	N66° 45.0846′	W62° 18.804′	45m
R23-1	Keratoisis	ROV arm	Keratoisis colony from basal internode. Small sponge on keratoisis base. Placed in port side box.	N67° 57.9774′	W59° 29.4414′	885m
R23-2	sediment	push-core	regular core - red and blue, A.	N67° 57.966′	W59° 29.439′	885m
R23-3	sediment	push-core	Core C, Porewater, Yellow-blue	N67° 57.9666′	W59° 29.4402′	886m
R23-4	water	Niskin	aft-niskin	N67° 57.966′	W59° 29.439′	886m
R23-5	zoanthid	ROV arm	zoanthid in SF-2	N67° 57.9666′	W59° 29.4288′	885m

Number	Type	Method	Description (first observation displayed)	Latitude	Longitude	Depth
R23-6	Keratoisis	ROV arm	Second keratoisis colony sampled for Tom. Will try to obtain as close to base as possible (whitest branch). Has been broken up in the process of sampling. In the port side box. Has a sea anemone on it.	N67° 57.9786′	W59° 29.394′	883m
R23-7	sediment	push-core	Regular core (B, red)	N67° 57.9804′	W59° 29.364′	881m
R23-8	sediment	push-core	Porewater core (D, yellow)	N67° 57.9822′	W59° 29.3628′	881m
R23-9	pennatula	ROV arm	Pennatula in SF-1	N67° 57.9804′	W59° 29.3628′	881m
R23-10	Keratoisis	ROV arm	Isolated Keratoisis colony to collect for Tom W - will be stowed in Port box. Has big anemone on it	N67° 57.9786′	W59° 29.337′	880m
R23-11	Keratoisis	ROV arm	This coral was loose on the "front porch" of the ROV - excavated by accident. Should be suitable for aging and size-wt analysis	N67° 57.9798′	W59° 29.3364′	875m
R23-12	Keratoisis	ROV arm	keratoisis-patch-genetics-1-right	N67° 57.9786′	W59° 29.3292′	879m
R23-13	Keratoisis	ROV arm	keratoisis-patch-genetics-1-left	N67° 57.9798′	W59° 29.3268′	878m
R23-14	Keratoisis	ROV arm	Large colony with yellow base, multiple branches, collected for aging & carbonate production studies. Port box. Lots of dirt on base	N67° 57.9762′	W59° 29.3136′	879m
R23-15	sediment	push-core	regular push-core (blue, blue)	N67° 57.981′	W59° 29.2788′	875m
R23-16	Keratoisis	ROV arm	4th coral colony collected for Tom W - gone to Port sample well	N67° 57.978′	W59° 29.2608′	876m
R23-17	Keratoisis	ROV arm	keratoisis---genetics---2---right. Starboard aft 1.	N67° 57.9792′	W59° 29.4666′	886m
R23-18	Keratoisis	ROV arm	keratoisis---genetics---2---left. Starboard aft 2.	N67° 57.9816′	W59° 29.4624′	886m
R23-19	sediment	push-core	Single blue stripe,, no letter, core taken from inside coral patch, being placedin left rear holster	N67° 57.9816′	W59° 29.463′	886m
R23-20	sea star	ROV arm	white sea star in Keratoisis thickets	N67° 57.9924′	W59° 29.3664′	880m
R23-21	sea star	ROV arm	orange sea star going into SF-1.	N67° 58.0188′	W59° 29.3328′	876m
R23-22	sea star	ROV arm	White sea star - can go in one of SA wells.	N67° 58.0176′	W59° 29.3286′	876m

Number	Type	Method	Description (first observation displayed)	Latitude	Longitude	Depth
R23-23	water	niskin	forward-niskin	N67° 58.2504′	W59° 29.3502′	864m
R24-1	sediment	push-core	Porewater push-core. Stripes on core tube are yellow green. Trying to put core tube directly over bubbles.	N71° 22.7622′	W70° 4.3692′	264m
R24-2	sediment	push-core	Regular push core. Stripes on core are green green.	N71° 22.7622′	W70° 4.3692′	264m
R24-3	sediment	push-core	Regular push-core. Stripes are red green. Port forward core. Trying to put core in microbial mat.	N71° 22.7622′	W70° 4.3692′	264m
R24-4	sediment	push-core	Regular push core. Stripes are green yellow red. Trying to place in microbial mat.	N71° 22.7634′	W70° 4.3698′	264m
R24-5	crust	ROV arm	Carbonate crust going in SA-1 about 5cm piece.	N71° 22.7556′	W70° 4.3788′	263m
R24-6	water	Niskin	Forward niskin fired. 0.6m	N71° 22.7622′	W70° 4.3674′	263m
R24-7	sediment	push-core	Porewater tube. Stripes are yellow-yellow. Actually looks to be yellow-black-yellow stripes.	N71° 22.7604′	W70° 4.3698′	264m
R24-8	sediment	push-core	Regular push-core. Stripes just red.	N71° 22.7604′	W70° 4.3698′	264m
R24-9	sediment	push-core	Regular push-core. Stripes are red-black-red.	N71° 22.7598′	W70° 4.3698′	264m
R24-10	sediment	push-core	Regular push-core. Stripes are red-yellow-green. Trying to place in mat, wherever corable.	N71° 22.761′	W70° 4.368′	264m
R24-11	water	Niskin	AFT Niskin fired.	N71° 22.764′	W70° 4.3788′	264m
R24-12	sediment	push-core	Porewater push-core. Stripes are yellow-red. Amendment: will not be treated as pore water core.	N71° 22.764′	W70° 4.3776′	264m
R24-13	sediment	push-core	Regular push-core. Just one yellow stripe. Note: looks like pore water but is not.	N71° 22.7646′	W70° 4.3776′	264m
R24-14	sediment	push-core	Regular push-core. Stripes are green-red.	N71° 22.7646′	W70° 4.3758′	264m
R24-15	coral	ROV arm	Coral on rock. SF-1	N71° 22.6542′	W70° 4.1712′	253m
R24-16	crinoid	ROV arm	Sampling crinoid. Not attached to rock. Placed in SF-2.	N71° 22.6434′	W70° 4.1724′	250m
R24-17	sponge	ROV arm	small white sponge on cobble, will be placed in SF-2	N71° 22.4442′	W70° 3.5226′	227m

Number	Type	Method	Description (first observation displayed)	Latitude	Longitude	Depth
R24-18	sponge	ROV Arm	long sponge with potential rock in SF-2	N71° 22.416′	W70° 3.5874′	227m
R24-19	sponge	ROV Arm	golf ball sponge in SF-2	N71° 22.4166′	W70° 3.5874′	227m
R24-20	rock	ROV arm	Rock with possible benthic ctenophore and white sponges. Ctenophore swam away. Placed in SF-2.	N71° 22.3788′	W70° 3.657′	223m
R24-21	rock	ROV arm	Rock collected for Sophie Wolvin. Soft coral on top. Placed in SF-2.	N71° 22.3488′	W70° 3.7308′	218m
R24-22	crinoid	ROV arm	Crinoid. Placed in SA-2. rocky substrate	N71° 22.3482′	W70° 3.7308′	218m
R24-23	rock	ROV arm	Rock for Sophie Wolvin. Large white sponge on top. Placed in SA-2.	N71° 22.347′	W70° 3.7308′	218m
R24-24	rock	ROV arm	Rock collected for Sophie Wolvin. Placed in SA-2. Possible ascidian on top.	N71° 22.3656′	W70° 3.762′	222m
R24-25	rock	ROV arm	Rock collected for Sophie Wolvin. Small soft coral on top. Placed in SA-2.	N71° 22.3662′	W70° 3.7644′	222m
R24-26	sediment	scoop	scoop of sediment with tubes in SA-1	N71° 22.4226′	W70° 3.9594′	234m
R24-27	sea anemone	scoop	sea anemone growing on/near a seep. Sample lost.	N71° 22.752′	W70° 4.3326′	264m
R24-28	Sea star	ROV arm	sea star sampled near/at seep, going in SF1	N71° 22.7526′	W70° 4.3224′	263m
R24-29	sea urchin	scoop	sea urchin near/at seep, has a piece of gravel on top, going in SF1	N71° 22.7526′	W70° 4.3188′	264m
R24-30	Sea star	ROV arm	Sea star, going in SA1	N71° 22.7586′	W70° 4.326′	263m
R24-31	sediment	scoop	Mat scooped for Meng using green scooper, going in clear box on front of starboard porch	N71° 22.7538′	W70° 4.3434′	263m
R26-1	Cladorhiza	ROV arm	Cladorhiza sponge - PF well	N71° 26.0982′	W70° 12.2064′	506m
R26-2	Cladorhiza	ROV arm	smaller piece of Cladorhiza with a different growth form - going to SA-2	N71° 26.1336′	W70° 12.1032′	503m
R26-3	rock	ROV arm	small rock with sponges - SF-1	N71° 26.019′	W70° 11.8092′	498m
R26-4	rock	ROV arm	another cobble, it was not buried until ROV pushed it slightly while collecting a different rock. SF-1	N71° 26.0196′	W70° 11.805′	498m

Number	Type	Method	Description (first observation displayed)	Latitude	Longitude	Depth
R26-5	rock	ROV arm	small cobble with Polymastia sponge, SF-1	N71° 26.0274′	W70° 11.781′	497m
R26-6	rock	ROV arm	4th cobble for Sophie Wolvin (SF-2)	N71° 26.0286′	W70° 11.7804′	497m
R26-7	rock	ROV arm	5th cobble sample for Sophie Wolvin - will go into SF-2	N71° 26.028′	W70° 11.772′	496m
R26-8	water	Niskin	Aft niskin bottle fired	N71° 26.0418′	W70° 11.7408′	490m
R26-9	water	Niskin	forward niskin at same location as aft niskin	N71° 26.0436′	W70° 11.7324′	487m
R26-10	sediment	ROV arm	sediment scooped from patch of sediment - cobbles over mud in bottom of linear ?fault trace	N71° 26.0388′	W70° 11.7366′	492m
R26-11	Cladorhiza	ROV arm	Cladorhiza sponge - small colony -	N71° 26.0442′	W70° 11.7252′	486m
R27-1	sediment	push-core	Push core through stoss side of cyclic step. Good penetration. Core is in Stbd aft position	N71° 20.3544′	W70° 15.4596′	376.8m
R27-2	sediment	push-core	Red-yellow-green core tube, in Port Fwd holster, collected from crest of cyclic steo	N71° 20.3346′	W70° 15.417′	368.1m
R27-3	sediment	push-core	Core Green-yellow-red will be sampled next - another stoss side of cyclic step	N71° 20.3292′	W70° 15.408′	368.1m
R27-4	water	Niskin	Niskin 1.2 m above sea floor	N71° 20.1858′	W70° 14.8512′	240.4m
R27-5	water	Niskin	Aft Niskin - 1.2 above sea floor	N71° 20.1852′	W70° 14.8476′	240.8m
R27-6	sediment	scoop	sediment scoop	N71° 20.1828′	W70° 14.8404′	239.7m
R27-7	crinoid	ROV arm	crinoid in PA	N71° 20.1822′	W70° 14.8398′	239.3m
R27-8	crinoid	ROV arm	crinoid in PF	N71° 20.1822′	W70° 14.8392′	239.3m
R27-9	rock	ROV arm	rock #1 in SF2	N71° 20.1828′	W70° 14.8398′	239.6m
R27-10	rock	ROV arm	rock #2 in SF2	N71° 20.1828′	W70° 14.8404′	239.7m
R27-11	rock	ROV arm	rock #3 in SF2	N71° 20.1816′	W70° 14.838′	238.6m

Number	Type	Method	Description (first observation displayed)	Latitude	Longitude	Depth
R27-12	rock	ROV arm	rock #4 with crinoid (SF-2)	N71° 20.1816′	W70° 14.838′	238.5m
R27-13	rock	ROV arm	rock #5 (SF-2)	N71° 20.1822′	W70° 14.8374′	238.6m