James Bay Expedition

University of Manitoba

Cruise Report
1-17 August 2021

CEOS
Centre for Earth Observation Science

Executive Summary

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Abstract:

With funding support from NSERC ($168,000) and Oceans North ($126,000), a research consortium led by the University of Manitoba carried out an oceanographic research expedition to James Bay during August 1-17, 2021. The expedition is the first of two planned expeditions intended to update our knowledge of the oceanography of James Bay. The second phase is planned for summer 2022. In addition to the University of Manitoba, scientists from the Freshwater Institute, Fisheries and Oceans Canada, University of Sherbrooke (QC), L'Université du Québec à Rimouski (UQAR), and Université Laval participated in the research program. The Cree Marine Research Needs Working Group chaired by Oceans North provided regional support and advice, and consultations with Chiefs and Councils of coastal communities helped plan the cruise. No community visits were completed due to restrictions related to COVID-19.

The research program was multidisciplinary and included sampling in support of physical oceanography, chemical oceanography, biogeochemistry (both organic and inorganic), biological oceanography (primary production), invertebrates and fish, environmental DNA (eDNA), and sediment geochemistry (box coring). Accomplishments include deployment of seven oceanographic moorings (five in James Bay) that are to remain for one full year. All moorings carry sensors for temperature, salinity, and current profiles, and selected moorings carry instruments for measuring ecological properties (light, fluorescence of dissolved organic matter and chlorophyll, pH) and collecting settling particulate matter (i.e., sediment traps). Hydrographic sections were completed that included more than 173 conductivity-temperature-depth (CTD) casts to profile the water column. Near-continuous measurements of salinity and temperature were obtained from a flow-through system connected to the ship's thermosalinograph. The ship's zodiacs were used to extend sampling sections towards the coast and various river mouths.

An Algae Online Analyser implemented on the flow-through system provided estimates of phytoplankton community abundance. Additionally, more than 120 water samples were obtained from various depths and locations and processed to allow subsequent analysis of various chemical and biological parameters. Nets were used to obtain samples with which to characterize the biodiversity and distribution of zooplankton and fish communities in James Bay and assess taxon-specific fatty acids and stable isotopes signatures of key forage species and benthic invertebrates. Five sediment box cores were sectioned for dating and geochemical analysis. Overall, the research cruise represents a significant step towards obtaining new data that will update understanding of the oceanography of the James Bay marine system.

Acknowledgments

We wish to thank the following people and organizations: Captain David McIsaac and the entire crew of RV William Kennedy for their hard work and long hours to support the research efforts of this cruise, while also ensuring researchers onboard were safe, comfortable, and well fed; the Arctic Research Foundation for their support of the Kennedy's activities; Chris Debicki and Oceans North for financial support and general collaboration in support of James Bay marine science; Dr. Jennie Knopp and all members of the *Cree Marine Research Needs Working Group* for their dedication and guidance concerning the James Bay Expedition; Maude Durand of Oceans North for leading video preparation and media relations; Heather Grant of Oceans North for communications support; Annie Eastwood of Oceans North for logistical support in Winnipeg; Stephanie Varty and Angela Coxon of the Eeyou Marine Region Wildlife Board for coordination of community consultations; Anna Baggio and Megan Chen of Wildlands League for coordination of community consultations and assistance with poster preparation; Alan Penn of the Cree Nation Government for helping prepare plain language background material; Vern Cheechoo and Lawrence Martin of Mushkegowuk Council for motivating the project and helping guide the research efforts for this cruise.
Executive director Lauren Candlish, scientific director Dr. David Barber, and many members of CEOS were instrumental in making the cruise possible. Special thanks to Emmelia Stainton and Heather Stark for managing equipment, shipping, and assisting with logistics; Dr. Sergei Kirillov for overseeing mooring preparation; Stephen Ciastek and Janine Hunt for preparing other equipment and instruments; Devin Hammett for other logistical support. Students Elizabeth Kitching, Alessia Guzzi, Yekaterina Yezhova, and Jillian Reimer also were instrumental in preparing and packing for the cruise.
Financial support for the expedition was provided by Oceans North, NSERC, and the CFI-funded University of Manitoba's Churchill Marine Observatory (CMO). Additional support was provided by ArcticNet NCE, Niskamoon Corporation, University of Manitoba GETS program, Canadian Foundation for Innovation (CFI), and NSERC Discovery Grants and Research Tools and Instruments program. Preparation of this report was led by Michelle Kamula. Olivia Mussells (Oceans North) helped produce the maps.

Project Team

University of Manitoba Expedition Participants

Dr. CJ Mundy, Co-lead and Chief Scientist onboard
Dr. Zou Zou Kuzyk, Co-lead and PI onboard
Dr. Jens Ehn, PI onboard
Dr. Sergei Kirillov, research professional and head of moorings
Janine Hunt, technician
Alessia Guzzi, student
Lauri Corlett, student
Elizabeth Kitching, student
Yekaterina Yezhova, student
Jillian Reimer, student

Other expedition participants

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Maude Durand, Oceans North

Other university collaborators

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Fisheries and Oceans Canada – Freshwater Institute

Dr. David Capelle
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Cree Marine Research Needs Working Group Members

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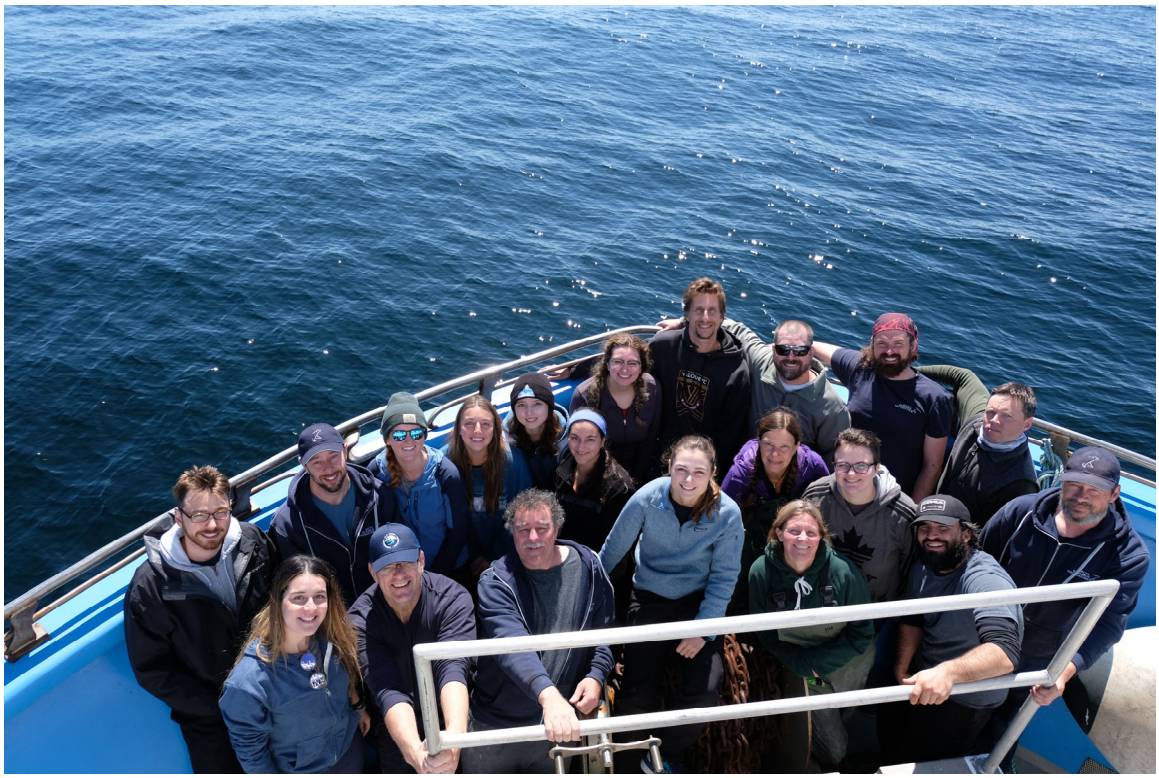
Vern Cheechoo and Lawrence Martin, Mushkegowuk Council Lands and Resources
Angela Coxon and Stephanie Varty, Eeyou Marine Region Wildlife Board
Melvin Wesley, Eeyou Marine Region Planning Commission
Chantal Otter Tétreault and Alan Penn, Cree Nation Government
Chantal Ouimet, Parks Canada

William Kennedy Crew

David McIsaac (captain)
Daniel McIsaac (first mate)
Tyson Arsenault (bridgewatch)
Matthew Rose (bridgewatch)
Dylan Hardy (small boat operator)
Billy Gaudet (cook)

Arctic Research Foundation
Adrian Shimnowski
Christine Cox
Tom Henheffer



Participants in the James Bay Expedition 2021 aboard the Research Vessel William Kennedy (Photo credit: Maude Durand, Oceans North)

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1. Introduction

James Bay (Figure 1) remains one of the least studied water bodies in Canada despite its vast size (~68,000 km^2), resident beluga whale population, and rich coastal habitats that seasonally host hundreds of thousands of migratory birds (Stewart and Lockhart, 2005). It is home to a large Cree First Nation population in nine coastal communities (Figure 1). Situated at the southern margin of the Arctic, adjacent to Hudson Bay and with a vast watershed that includes the peatlands of the James Bay Lowlands, James Bay is uniquely positioned to respond to climate change. It is also a locus of freshwater river runoff, receiving more than 200 km^3/yr, which influences virtually all its properties. Because of its large freshwater inputs, James Bay exerts a strong influence on properties within Hudson Bay (cf., Eastwood et al., 2020) and contributes to modifying Arctic Ocean outflow as it gets transported to the North Atlantic Ocean, ultimately influencing ocean properties and productivity in downstream areas as far away as the Labrador Sea.

The James Bay watershed hosts large industrial (hydroelectric) development that has altered the timing and volume of river inflow to the Bay. Throughout most of James Bay, our knowledge of basic ocean properties such as the saltiness (salinity) of the waters and the circulation patterns date back to the early 1970s. Based on observations (El-Sabh and Koutitonsky, 1977; Peck 1978; Prinsenberg 1982) and recent modelling (Eastwood et al. 2020; Ridenour et al., 2019), James Bay may be considered a large estuary, connected to but oceanographically distinct from its neighbour Hudson Bay. That decade was the last time an offshore research vessel carried out a dedicated scientific mission in James Bay. Since then, we know James Bay has changed substantially, with Cree community members observing first-hand changes in river mouth morphology and in the plants and animals that comprise coastal ecosystems. Although a comprehensive coastal habitat research program got underway in Eeyou Istchee (east James Bay) in 2017 to study eelgrass habitat and its use by geese, the offshore areas remain unstudied.

To better understand the oceanography and ecology of James Bay as a whole system, the project team conducted a 17-day scientific mission along the southwest coast of Hudson Bay and throughout James Bay in August 2021. This scientific research expedition was conducted aboard the Research Vessel *William Kennedy*. The August 2021, cruise was the first of two cruises with the second cruise planned for August 2022. The objective of the cruise in August 2021 was to update the baseline oceanographic data, including observations of physical, chemical and biological features (e.g., salinity, temperature, currents, phytoplankton, zooplankton), with emphasis on offshore waters. Original cruise plans were modified because of travel restrictions associated with the Covid-19 pandemic, which severely limited interactions with communities. The 2021 cruise plan was thus shortened to shift more days into 2022, and emphasis during the shortened cruise was placed on installing a series of oceanographic moorings that would monitor currents and various water properties for a one-year period. The plan is to retrieve these moorings during the cruise planned for August 2022. Appendix A, B, C, and D provide logs of ship operations, zodiac operations, primary production sampling, and eDNA sampling, respectively.

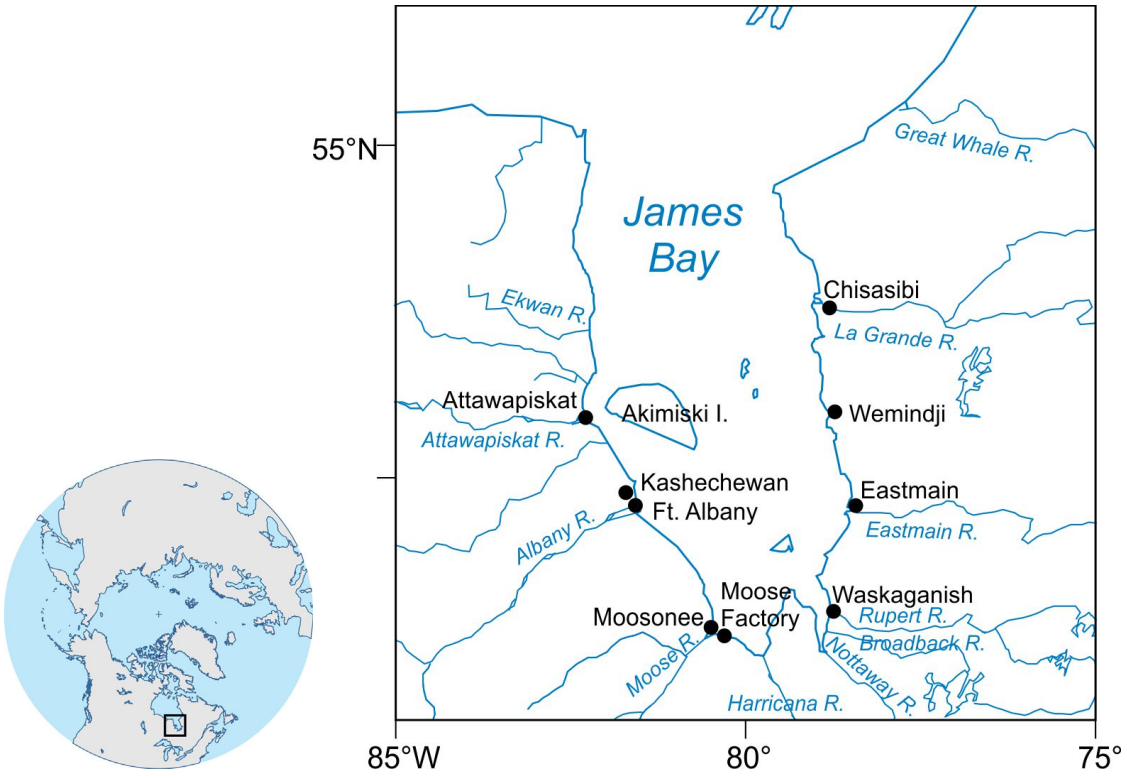

Figure 1. James Bay and its major communities and rivers.

A goal of the study is to provide new knowledge to help address marine research needs of the coastal Cree communities and regional organizations, including Mushkegowuk Council, Cree Nation Government, Eeyou Marine Region (EMR) Wildlife Board and EMR Planning Commission. Communication and outreach were important components of the project. From the ship, near real-time updates were provided using the University of Manitoba Coastal Oceanography Group Facebook page and Facebook Messenger. Posters describing the expedition plan were translated and distributed to communities before the ship disembarked. Presentations were given to Chiefs and Council and regional organizations to discuss the plans and gain community input. Appendix E lists the presentations and includes images of the posters.

The cruise was made possible by funding from NSERC ($168,000), Oceans North ($126,000), and by the CMO-IOF operating fund dedicated to mooring operations ($120,000). Additionally, operating funds from MEOPAR NCE, NSERC, ArcticNet NCE, CMO-IOF, DFO, and NSERC contributed by individual principal investigators (Mundy, Kuzyk, Ehn, Papakyriakou, Gueguen, Gosselin, Marcoux, Loseto, Howland, Niemi) helped to make the project a success. EMR, Mushkegowuk Council, and Wildlands League staff all contributed their time for communication and outreach. The 2021 Scientific Cruise was supported by a Nunavut Research Licence (# 03 009 19R-M) and a DFO Licence to Fish for Scientific Purposes (S-19-20 1046-NU). The intention is that the collected data will be completely accessible to all research partners. As they become available, data from the project will be housed at U. Manitoba within the Canadian Watershed Information Network (CanWIN) (http://lwbi.cc.umanitoba.ca/).

2. Physical Oceanography and Mooring Deployment

Cruise Participants: Janine Hunt, Sergei Kirillov, Jens Ehn, CJ Mundy, Zou Zou Kuzyk, Dave Capelle
Principal Investigators: Jens Ehn

Introduction:
While the east coast of James Bay (Quebec) has been studied in relation to hydroelectric development and more recently eelgrass habitat, the offshore and west coast (Ontario) has received little attention. Previous systematic hydrographic observations occurred in the 1970s and early 1980's (El-Sabh and Koutitonsky, 1977). Since the 1970s, James Bay has undergone significant change both in terms of persistence of sea ice and sea surface temperatures (SST) (Kirillov et al., 2020). Prior to the James Bay 2021 research cruise, virtually no information has been available for assessment of changes to subsurface hydrographic baseline conditions or surface conditions (e.g., salinity) that are not accurately assessed from space (i.e., satellite data). With the deployment of seven oceanographic moorings (five in James Bay), that are to remain for one full year, at least 173 Seabird CTD casts, and continuous flow-through sampling using the ship's thermosalinograph, this research cruise represents a significant step towards better understanding the oceanography of the James Bay marine system.

Data Collection:
Hydrographic Profiles
Hydrographic profiles were collected using conductivity, temperature and depth (CTD) sondes (Figure 2). Two separate, but identical, pump-type Seabird 19plus V2 CTDs with Biospherical scalar photosynthetically active radiation (PAR), Seabird SBE-43 dissolved oxygen sensors and Seabird/WetLabs ECO fluorometer sensors for CDOM and Chl-a, were used. One instrument was a stand-alone Seabird 19plus V2 CTD with its own stainless-steel cage (Figure 2, left panel) and the other was a Seabird 19plus V2 mounted horizontally on the ship's rosette (Figure 2, right panel). The standalone CTD also included a Seabird/WetLabs C-Star transmissometer, while the ship's rosette had an independently logging Seabird/Satlantic SUNA nitrate sensor. The recording rate for both CTDs and all sensors was every 0.25 seconds.

CTD profiles were obtained across the width of James Bay at three latitudes (approximately 52.4°N, 53.8°N, and 54.3°N) and along the length of James Bay both west and east of the mid-bay islands to assess water column structure and composition (Figure 3). Preliminary surface salinity, temperature, chlorophyll *a*, and CDOM data from the CTDs are shown using colour-coded circles in Figure 3. In general, surface salinity was higher in northern James Bay than southern James Bay, with the exception of an area immediately south of Akimiski Island (Figure 3a). Surface waters also were colder in the northern half of James Bay (<10°C; Figure 3b). In the plots showing fluorescence of CDOM and chlorophyll a, higher values were observed in the estuaries of the Moose River and Eastmain River (Figure 3c,d).

At each location shown in Figure 3, vertical profiles of water properties were obtained by conducting CTD "casts", wherein the CTD was lowered down through the water column to the bottom. Water column depth profiles of temperature, salinity, and chlorophyll *a* collected from the rosette and caged Seabird CTD are shown along a south to north transect in central James Bay

(Figure 4) and eastern James Bay (Figure 5). In the central transect, from south to north there is an increase in salinity in both the surface waters and subsurface waters (Figure 4a). Subsurface waters were colder in the northern half of the bay (Figure 4b). Chlorophyll *a* was elevated throughout the top 10 m of the water column throughout the southern two-thirds of the bay (Figure 4c). In the eastern transect, saltier and colder waters are apparent in the northern portion of James Bay (Figure 5a,b). The chlorophyll *a* distribution is very different on the eastern transect compared to the central transect with elevated levels in northern James Bay (Figure 5c).

There were more than 173 CTD profiles collected in total representing the most extensive oceanographic observation coverage for James Bay to date. Locations and time of casts can be found in *Appendix A: Ship Log*. Salinity samples were collected from the rosette casts (see section 3a) and will be used to calibrate salinities recorded by the CTD casts.

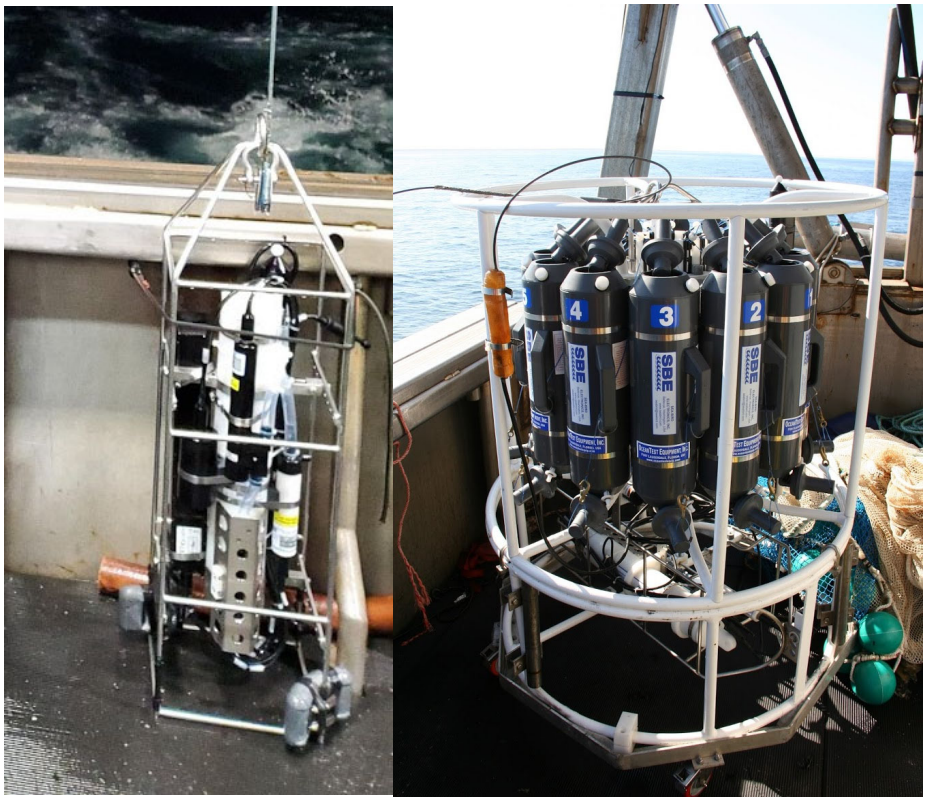

Figure 2. Pictures of the stand alone CTD (left) and rosette-mounted CTD (right, mounted horizontally below rosette).

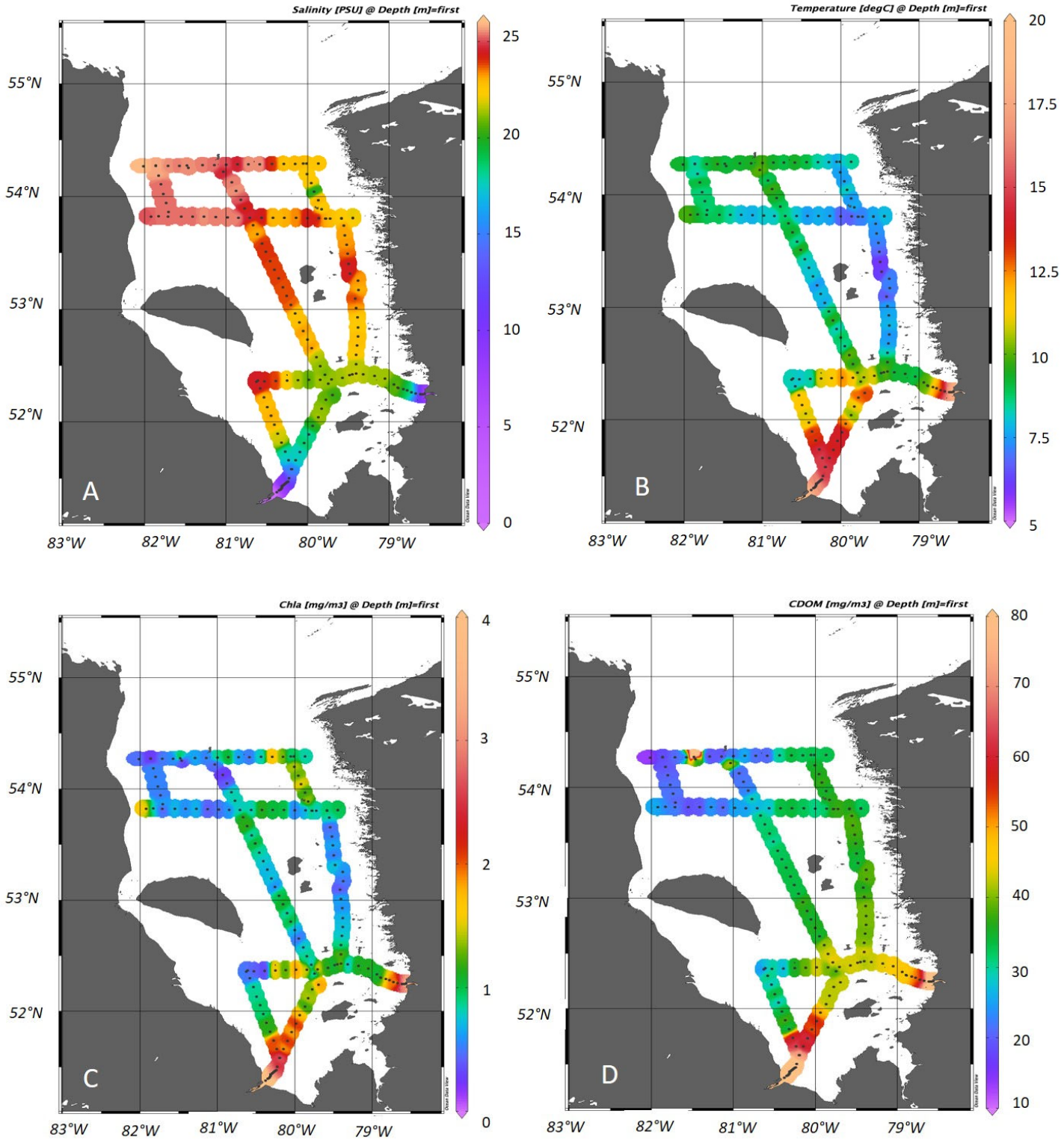

Figure 3. Black dots show CTD deployment locations and colours show surface-most salinity (A), temperature (B), chl-a (C), and CDOM (D) obtained from 173 CTD deployments. Note that the data is uncorrected raw data and was collected from the Seabird 19plus V2 CTD.

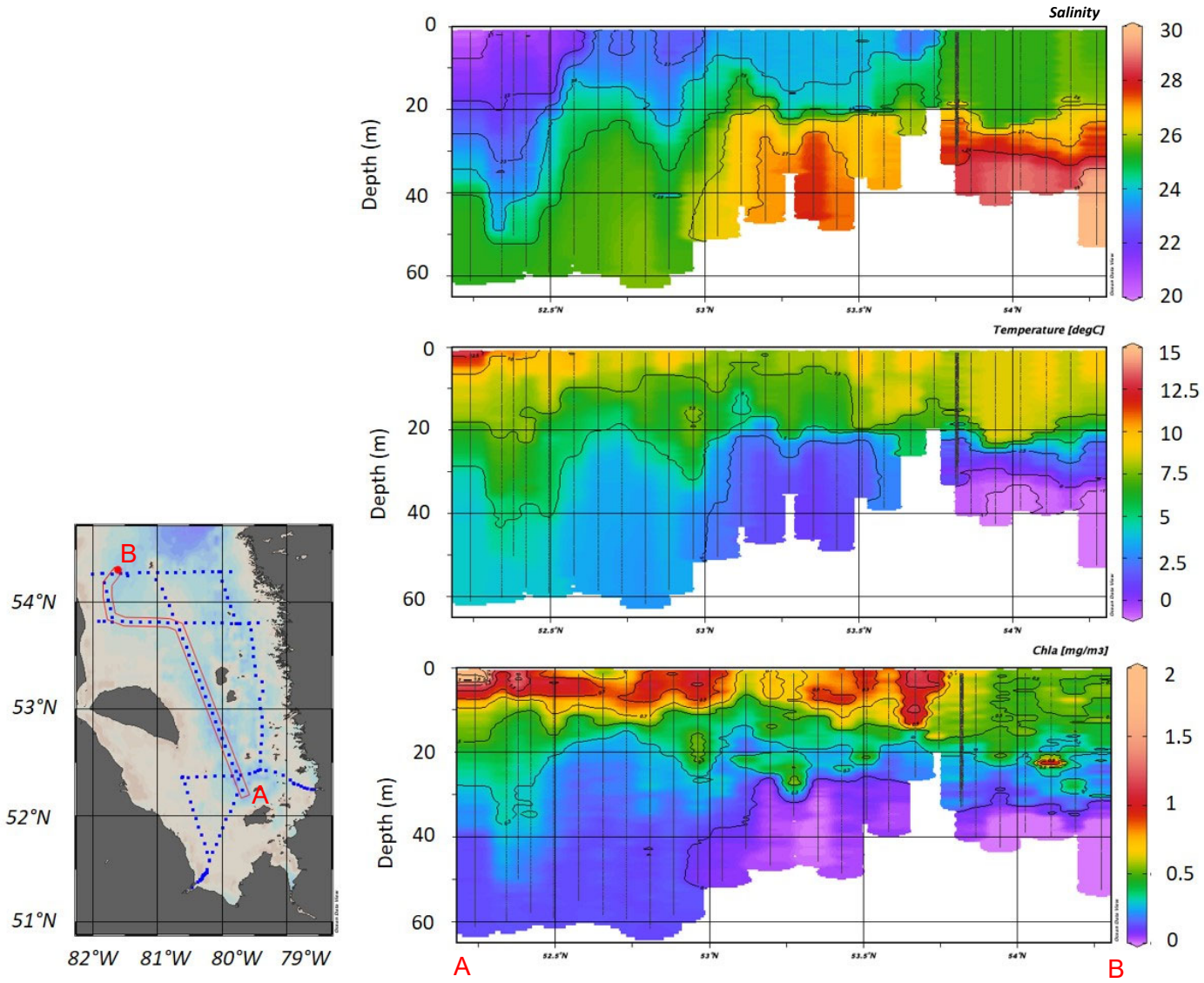

Figure 4. Vertical (depth) profiles of salinity, temperature, and chl-a collected from the Sea bird CTD are shown as a cross section along a S-N transect from "A" to "B" in central James Bay. Note that the data is uncorrected raw data collected from the Seabird 19plus V2 CTD.

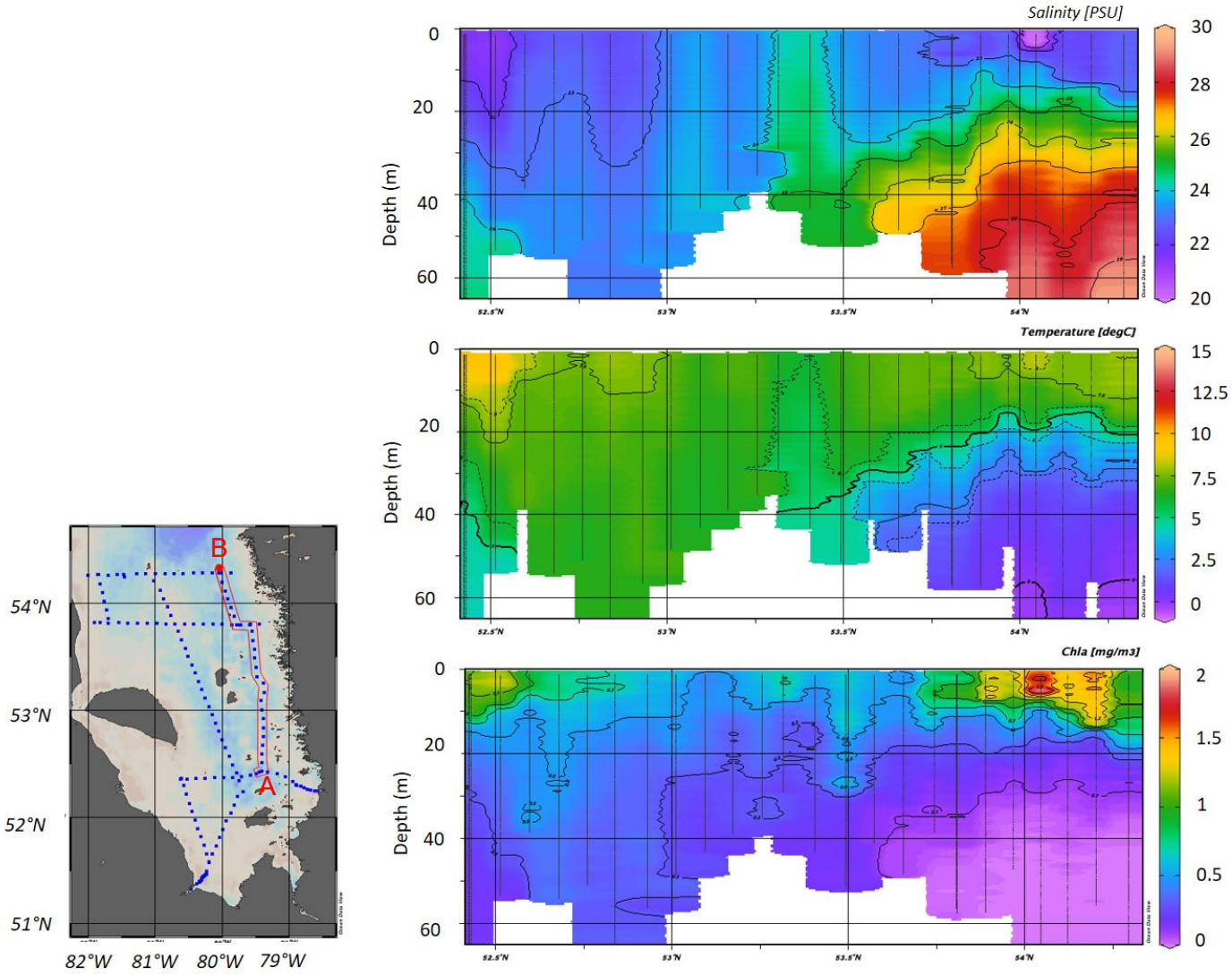

Figure 5. Vertical (depth) profiles of salinity, temperature, and chl-a are shown as a cross section along a S-N transect from "A" to "B" in eastern James Bay. Note that the data is uncorrected raw data and was collected from the Seabird 19plus V2 CTD.

Mooring Deployment

Oceanographic moorings were deployed in James Bay and across Hudson Bay as part of the oceanographic monitoring component of this study. The locations of these moorings are shown in Figure 6 and listed in Table 1. Two moorings were deployed along the shipping lane in Hudson Bay as part of the CMO project (CMO-A and CMO-B); the remaining five moorings were deployed in James Bay as part of the James Bay Expedition.

Figures 7 a-h present schematics of the instrument arrays on the oceanographic moorings deployed during the cruise. Mooring JB_M5 consisted of two lines JB_M5a and MB_M5b (Figure 7e and f, respectively). The five moorings deployed within James Bay contained a combination of equipment supplied by CMO and individual researchers within DFO and CEOS. The schematics include instrument type and serial numbers, as well as acoustic release codes. Each mooring was programmed to accommodate > 12 month deployment, with recovery planned for August 2022. Moorings JB-M2, M3, M5a and AN CMO_A contained sequential sediment traps (Baker-style, ten vials per trap, manufactured by Gurney Instruments; Figure 8), which were set to rotate to a new vial position after approximately 35 days.

The success of the deployment insofar as bottom position and vertical orientation in the water column was verified shortly after each deployment by passing across the mooring location while scanning with the WASSP multibeam sonar system (Figure 9). The moorings were generally assembled on the stern deck (Figure 10). They were deployed anchor last from the stern of the *RV William Kennedy* using the A-frame and crane, except for mooring JB-M5b, which was deployed from the starboard side using only the crane (Figure 11).

Figure 6. Positions of moorings deployed in James Bay and Hudson Bay during August 2021.

Table 1. Mooring deployment information.

Site	Bottom depth (m)	Latitude [deg N]	Longitude [deg W]	Date of Deployment	Depth of top float (m)	Sediment trap serial number (if present)
JB-M1	33	54 16.420	81 51.639	05-Aug-21	27	none
JB-M2	62	54 16.622	81 28.763	07-Aug-21	18	No. 718635
JB-M3 (CMO)	68	54 17.664	80 03.543	06-Aug-21	19	No. 718643
JB-M4	50	53 25.567	80 27.606	08-Aug-21	13	none
JB-M5a	63	52 16.316	79 42.079	09-Aug-21	16	No. 718633
JB-M5b	62	52 14.307	79 41.613	08-Aug-21	20	none
CMO-A	105	59 58.689	91 56.402	16-Aug-21	16	No. 718631
CMO-B*	179	61 45.613	84 18.172	25-Aug-21	22	none

* Note that this mooring was set up on deck before disembarking at Churchill and deployed by ship's crew on 25 August during return trip from Churchill to Halifax. The location reported by crew was 61° 45.700' N, 084° 18.100' W.

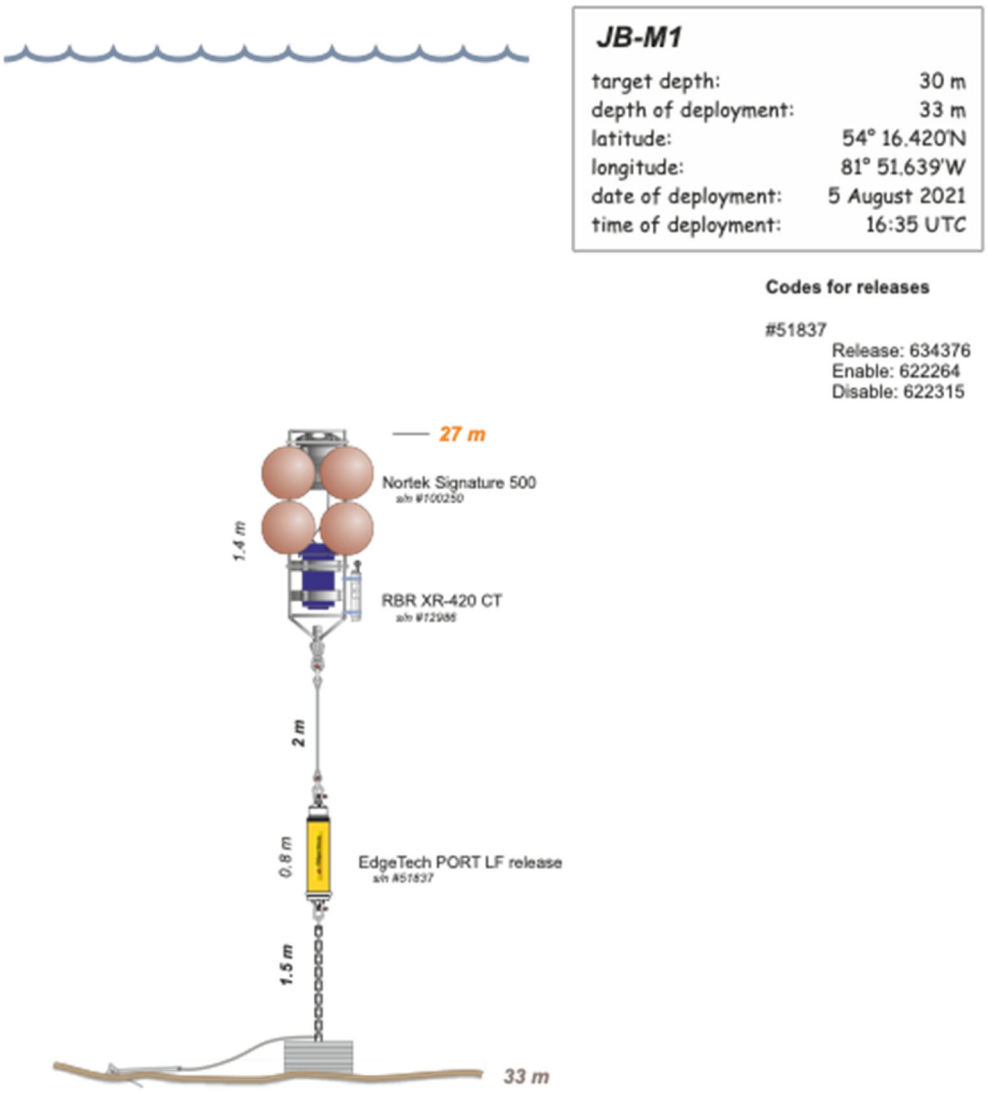

Figure 7. (a) Configuration and instrument serial numbers for mooring JB-M1.

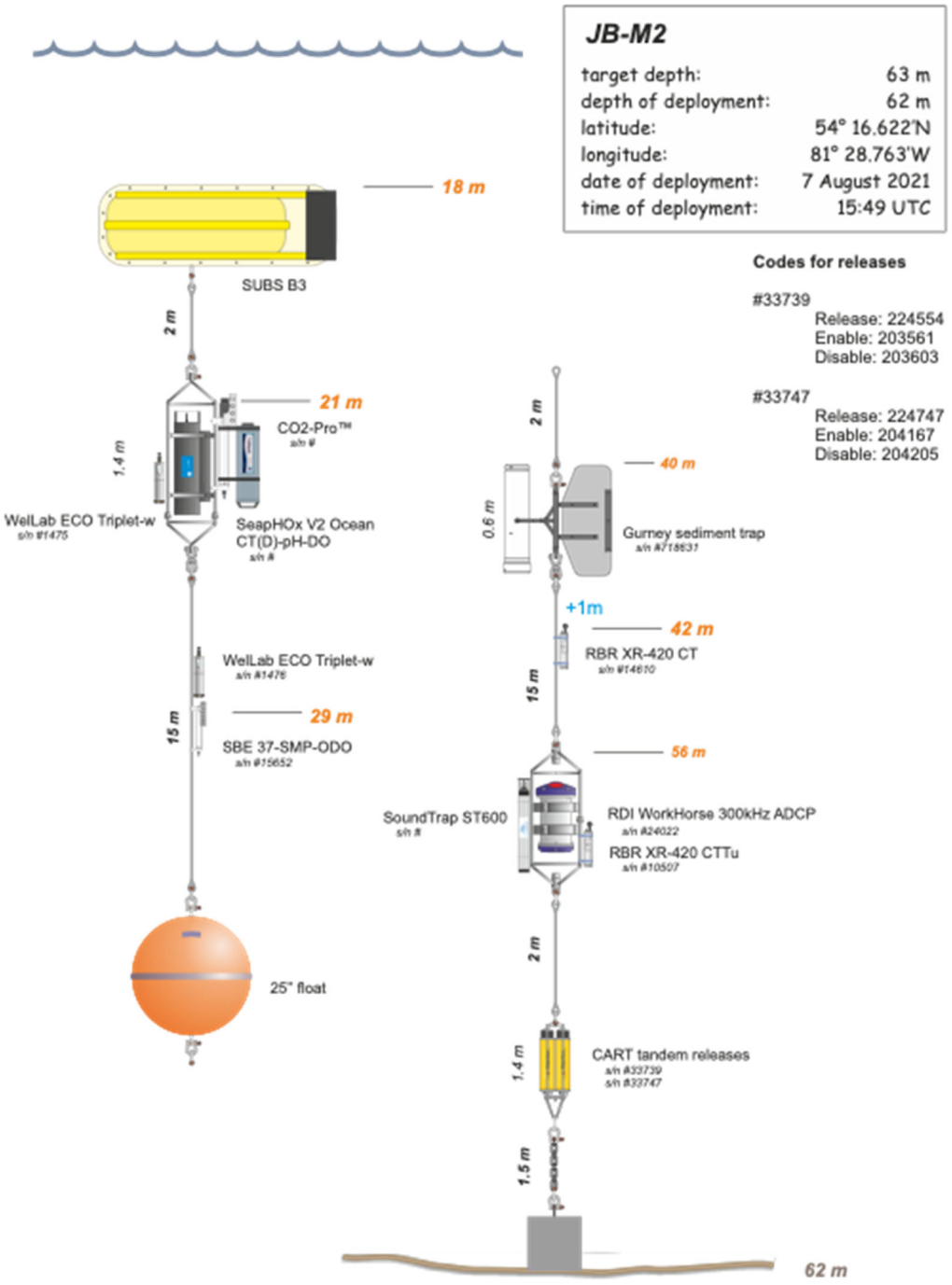

Figure 7. (b) Configuration and instrument serial numbers for mooring JB-M2.

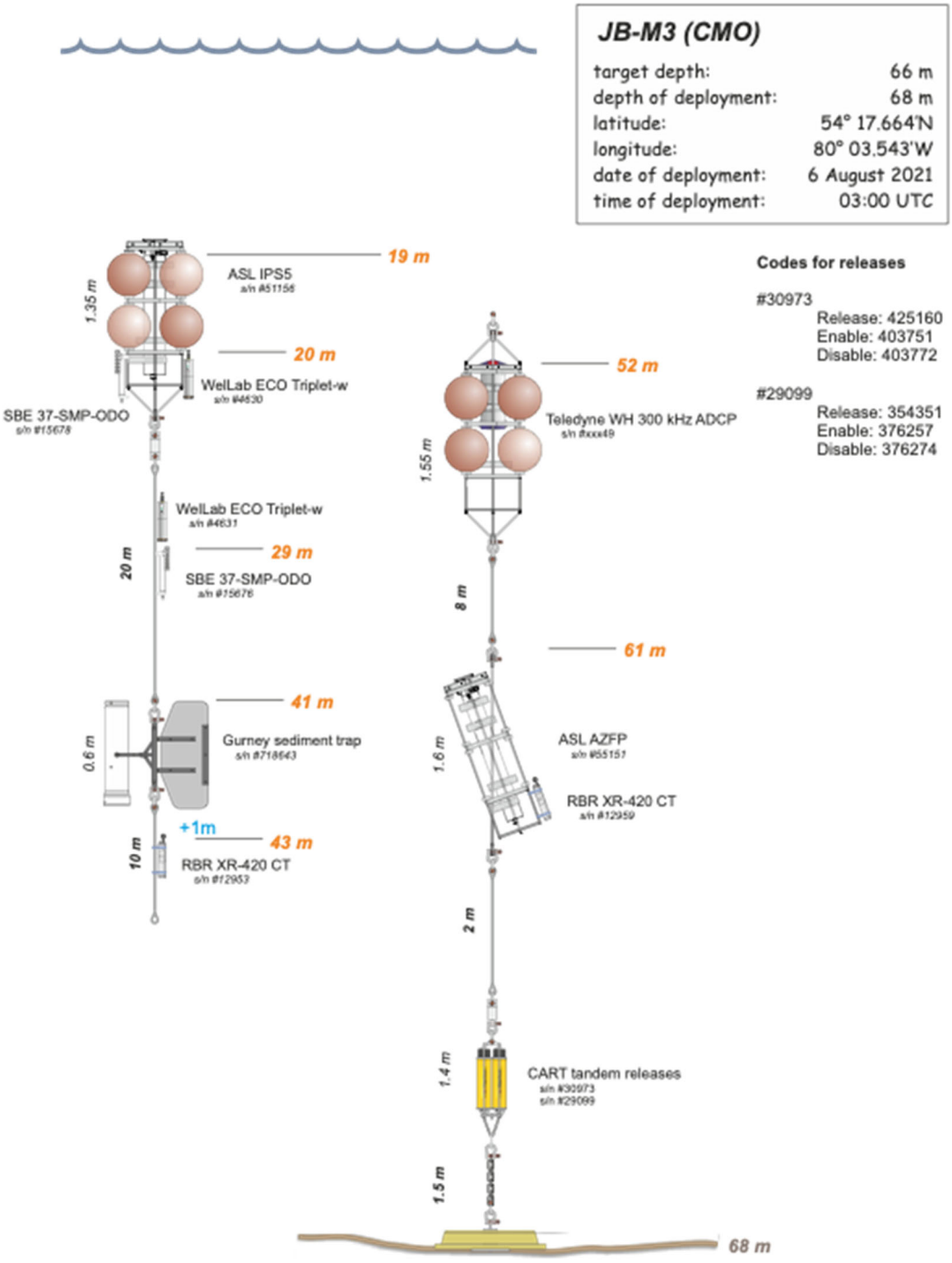

Figure 7. (c) Configuration and instrument serial numbers for mooring JB-M3.

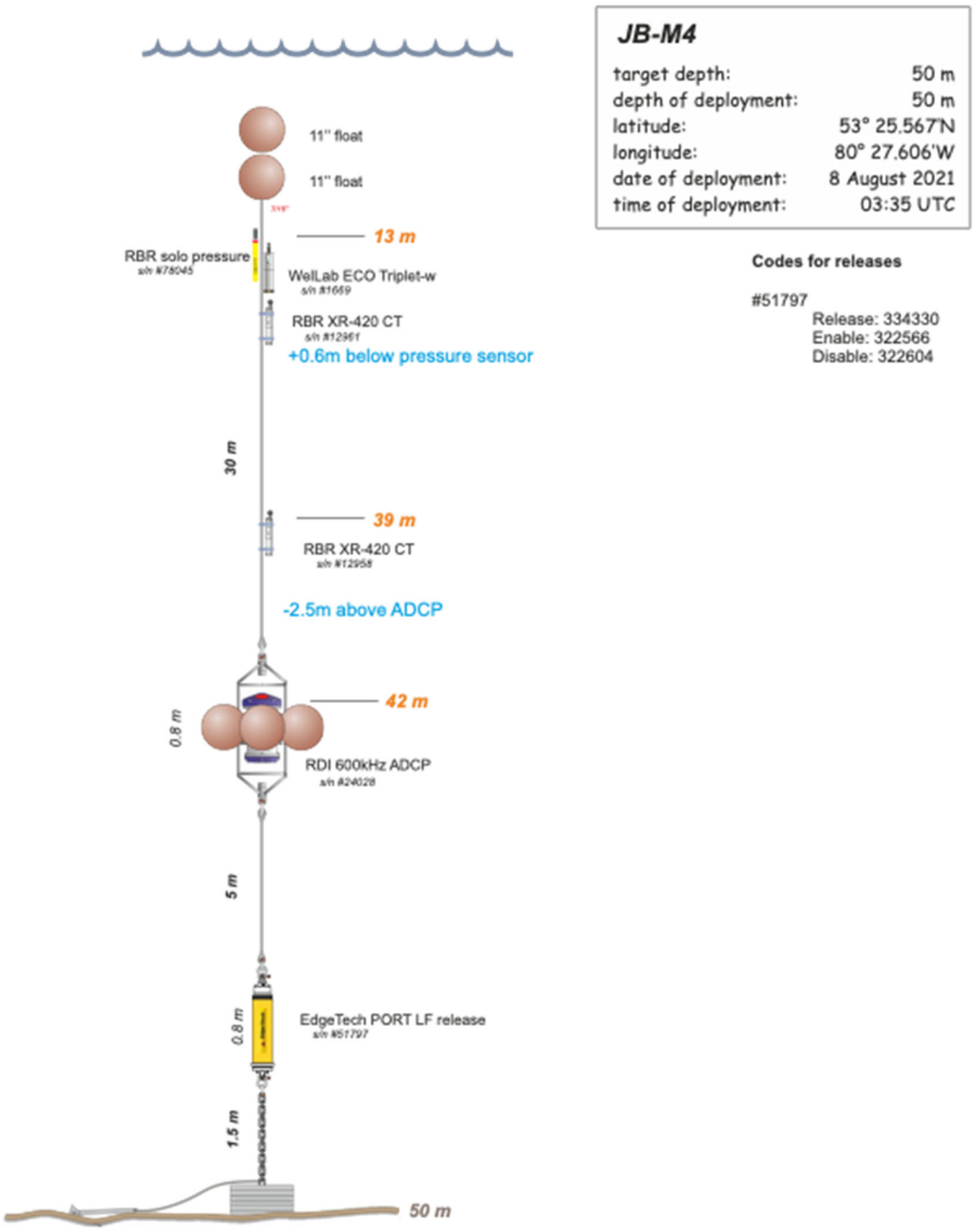

Figure 7. (d) Configuration and instrument serial numbers for mooring JB-M4

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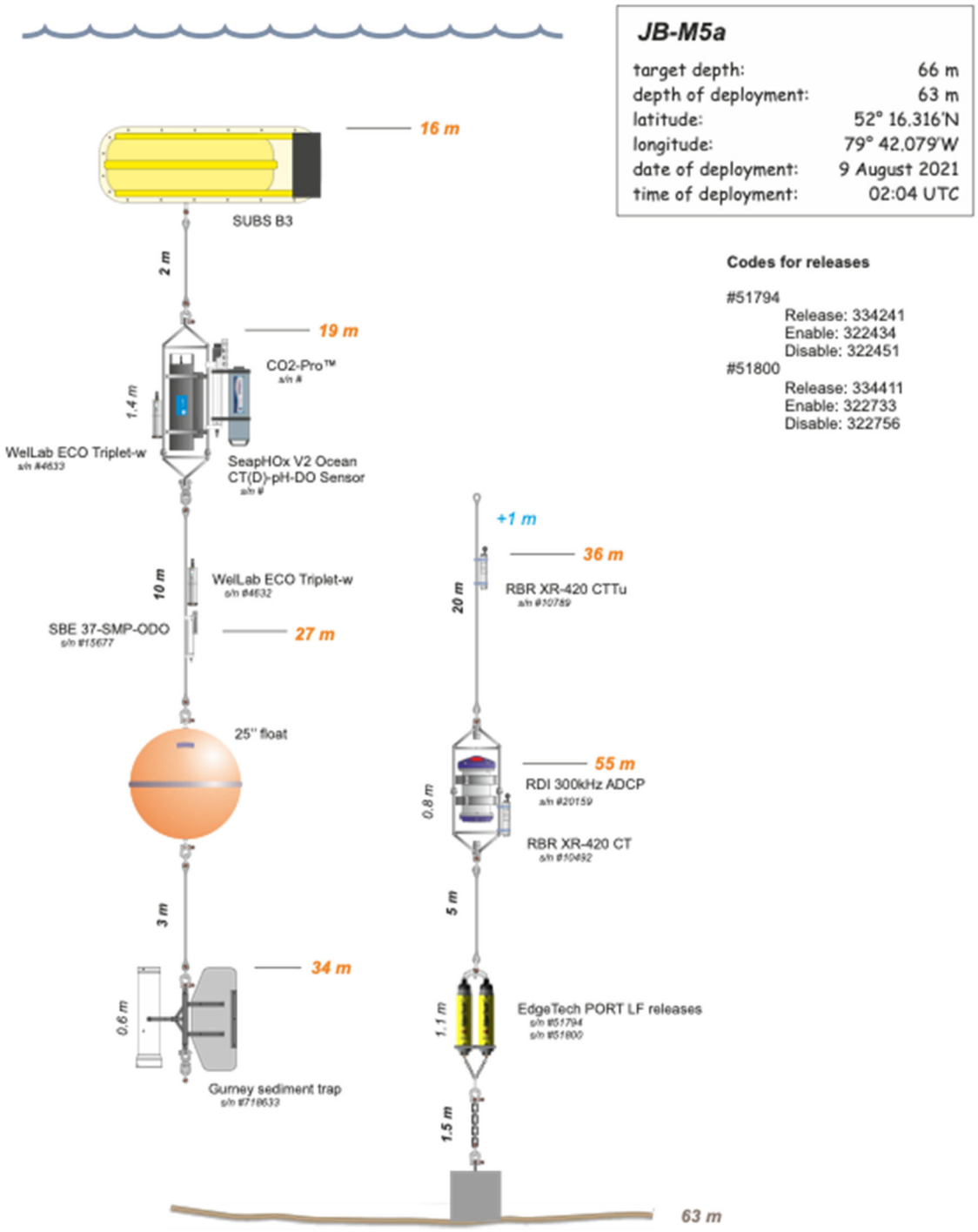

Figure 7. (e) Configuration and instrument serial numbers for mooring JB-M5a.

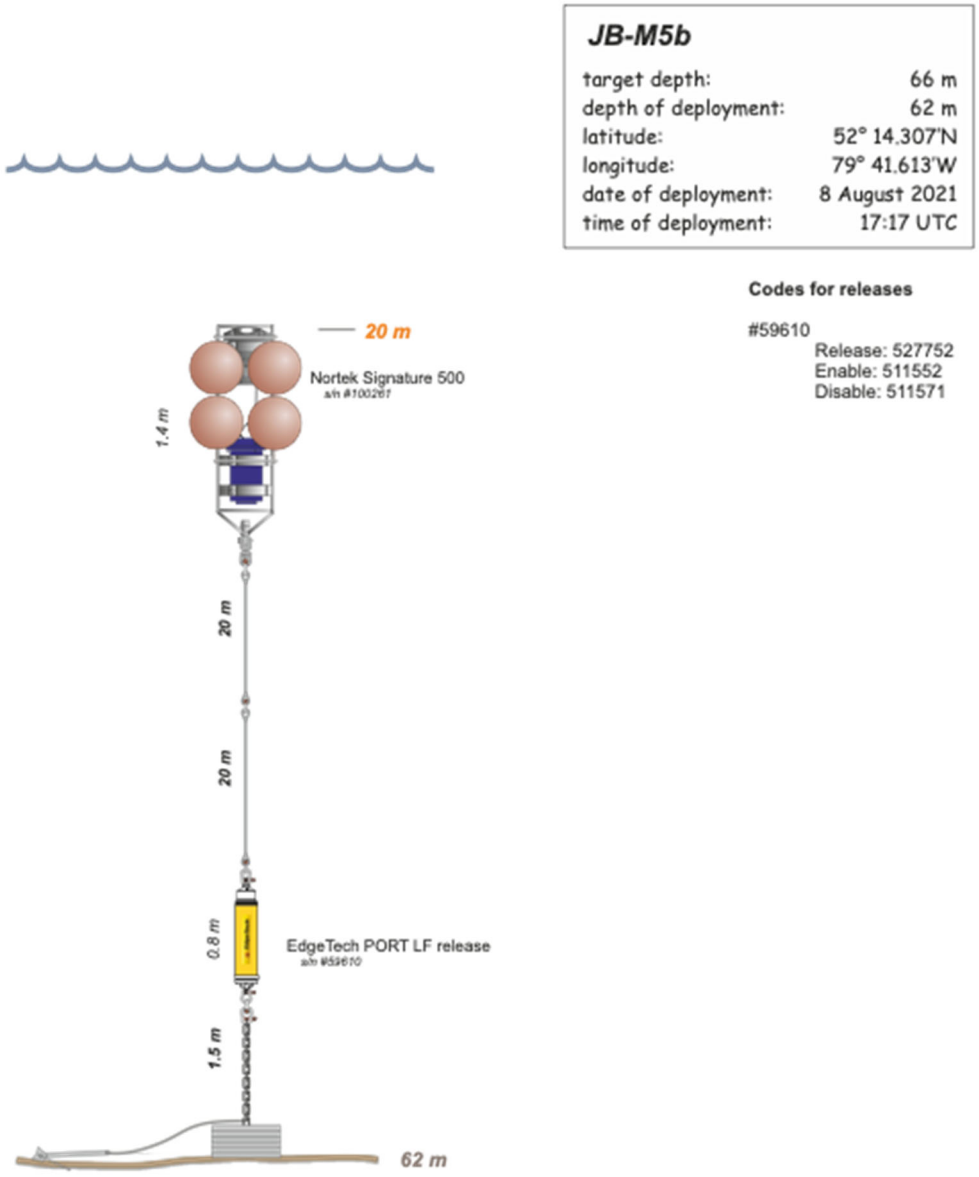

Figure 7. (f) Configuration and instrument serial numbers for mooring JB-M5b.

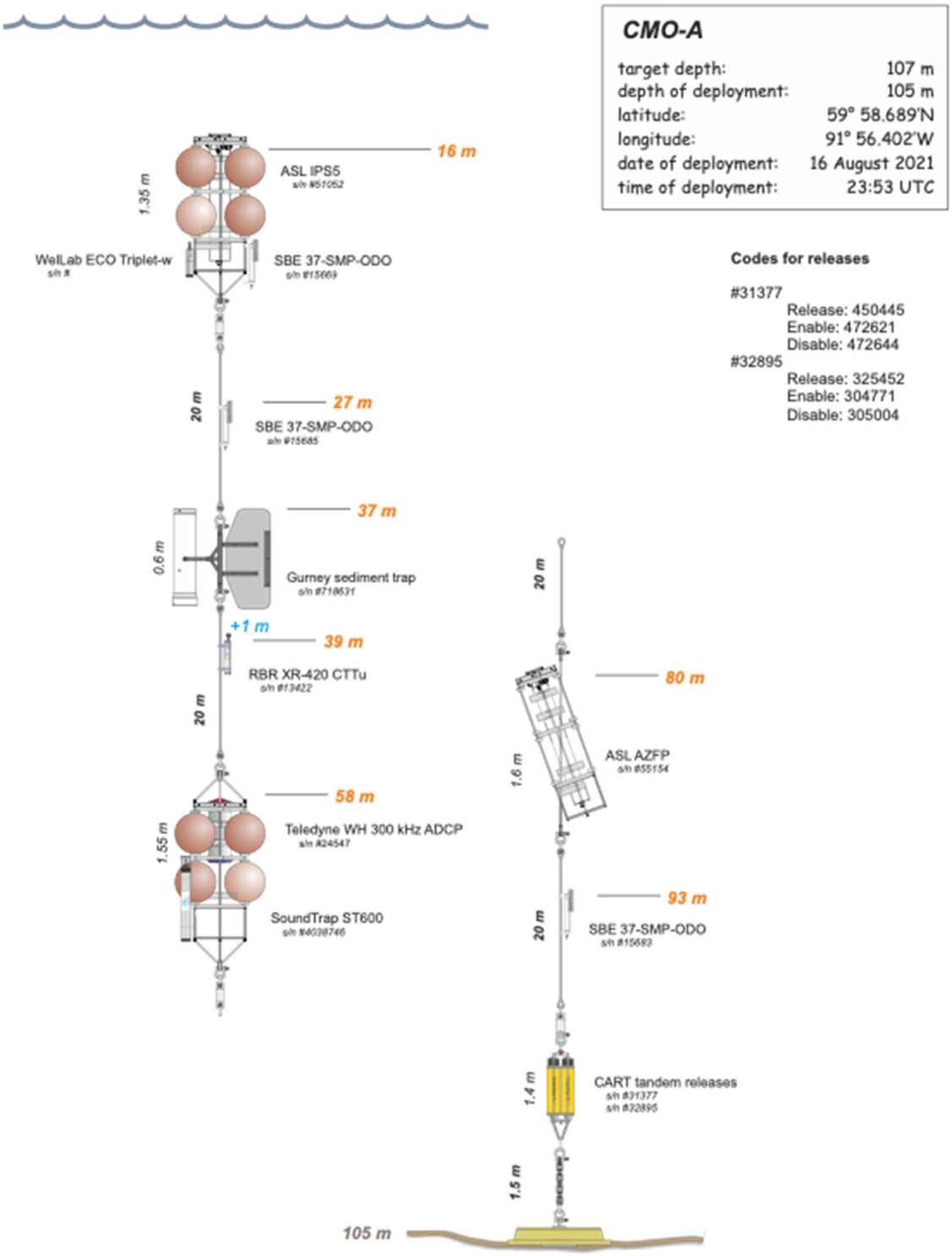

Figure 7. (g) Configuration and instrument serial numbers for mooring CMO-A at the AN01 location.

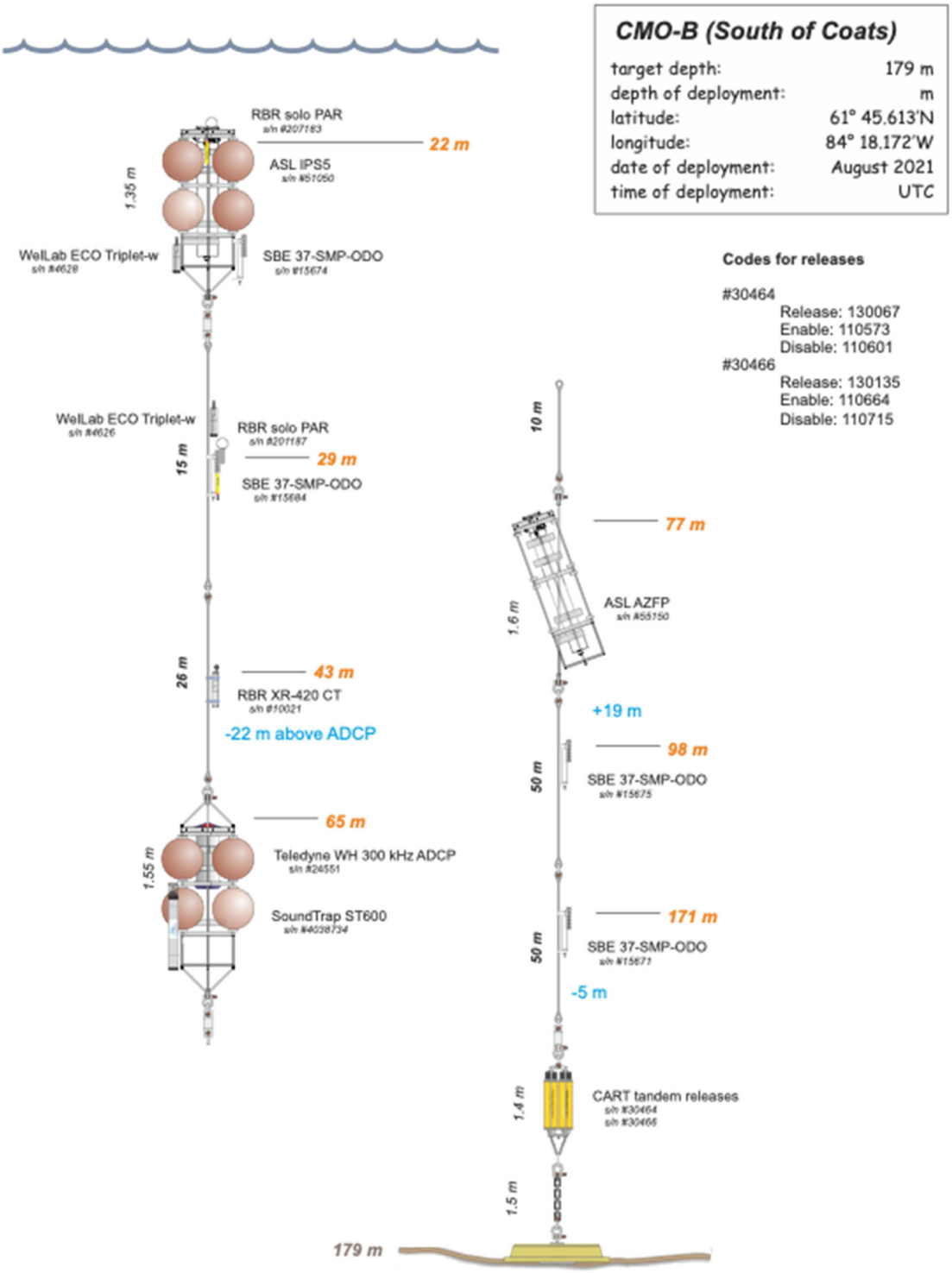

Figure 7. (h) Configuration and instrument serial numbers for mooring CMO-B. Note that this mooring was set up on deck before disembarking at Churchill and deployed by ship's crew on 25 August during return trip from Churchill. The location reported by crew was 61° 45.700' N, 084° 18.100' W.

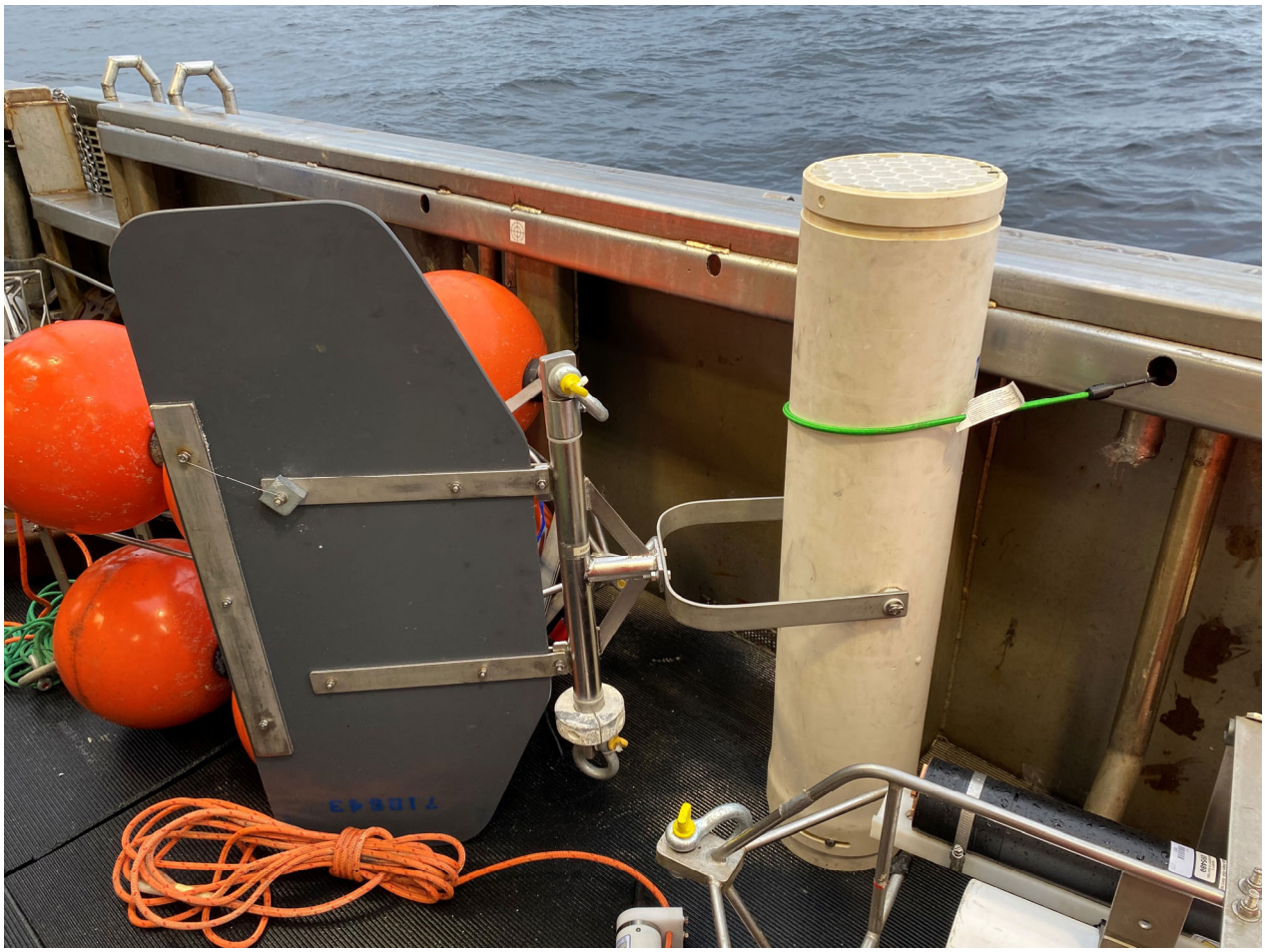

Figure 8. Baker style sediment trap assembled on stern deck before deployment. White cylinder contains a funnel-shaped apparatus that focuses the settling particles down into collection vials mounted on a carousel at the bottom. There are ten separate collection vials. The grey fin helps keep the trap vertical and stable on the mooring line.

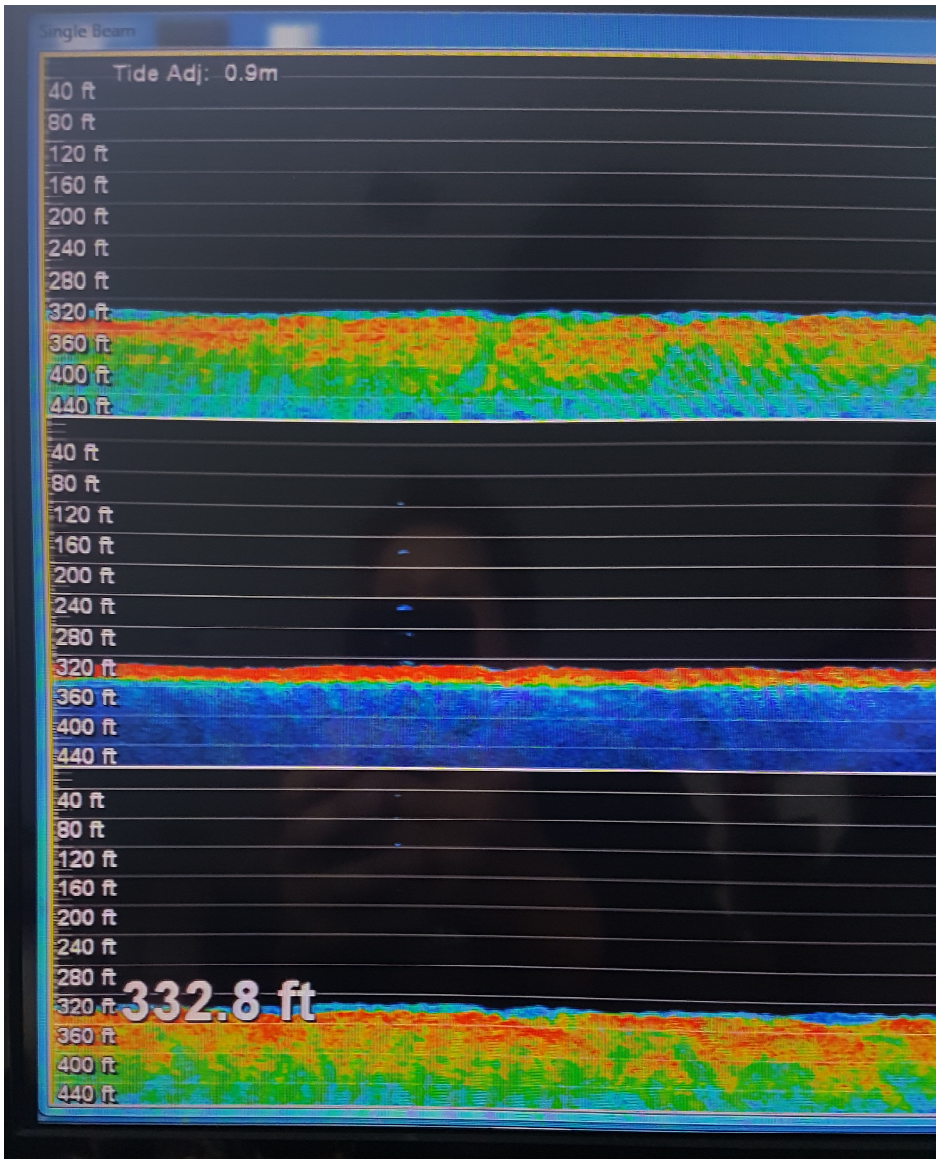

Figure 9. Photo of multibeam screen while passing over CMO-A mooring shortly after deployment. Middle panel shows acoustic backscattering signal (blue dots) that reveal depths of mooring components.

Figure 10. Instruments arrayed along stern deck during mooring preparation. Train wheel (anchor) is visible in foreground.

Figure 11. Deployment of the Nortek Signature 500 ADCP and upward looking sonar as part of the JB-M5b mooring on 8 August 2021.

3. Sample Collection

Offshore and coastal samples were collected throughout James Bay and southwestern Hudson Bay from MV William Kennedy and the vessel's two large zodiacs. Sample collection included water, phytoplankton, zooplankton, benthic invertebrates, benthic fish, and sediment. The sample collection and subsequent onboard processing are described in detail in the following sections according to the research objectives that related to chemical oceanography (water mass tracing), biogeochemistry, inorganic carbon system, primary production, eDNA, invertebrates and fish, and sediments.

From the RV *William Kennedy*, full data collection stations were conducted at eight offshore sites throughout James Bay (Figure 12; Table 2). Full data collection stations included collection of a CTD profile and water samples from throughout the water column using the 12 five-litre Niskin bottles on the Seabird Rosette sampler (see section 3a-d and 3f). The rosette typically was deployed twice to obtain sufficient water for all the samples (Table 2). Following the rosette, a series of nets was deployed (see section 3e). After the nets came back onboard, the final activity at each station was the collection of a sediment grab sample followed by a box core, provided the substrate was suitable (see section 3g). One exception to the full station sampling procedure was station 7, which was too shallow to deploy the rosette. Water samples brought onboard were filtered or otherwise processed in the lab for later analysis in southern labs (section 3a-c) and used for incubation experiments (section 3d). Invertebrates and fish caught in the nets were rinsed out into fish totes and sorted by hand and using sieves. Sediment grab samples similarly were sieved and sorted. Sediment cores were sectioned (section 3g).

Water samples were also collected from 55 locations along the southwestern Hudson Bay coast (Figure 13) during transit from Churchill to James Bay, and throughout James Bay using the ship's flow-through underway system. And in-line algal analyser and an automated incubator was installed on the flow through system in the lab area to estimate NPP, GPP, and GR along the cruise track (see section 3d).

Using the vessel's two zodiacs, near shore and river samples were collected in four coastal areas around James Bay (Figure 14). The coastal areas included: A) north of Ekwan River, B) within the Moose River and Moose River Estuary, C) Eastmain River and coastal areas, and D) south and north of the La Grande River (see Figure 3.3 A-D). Coastal sampling conducted from the zodiacs included CTD profiles using a Castaway and/or a RBR Concerto CTD, collection of water using a single Niskin bottle deployed on a weighted line, and collection of surface sediment samples and benthic invertebrate samples using a Ponar grab. The list of coastal stations accessed by zodiac is provided in Table 3.

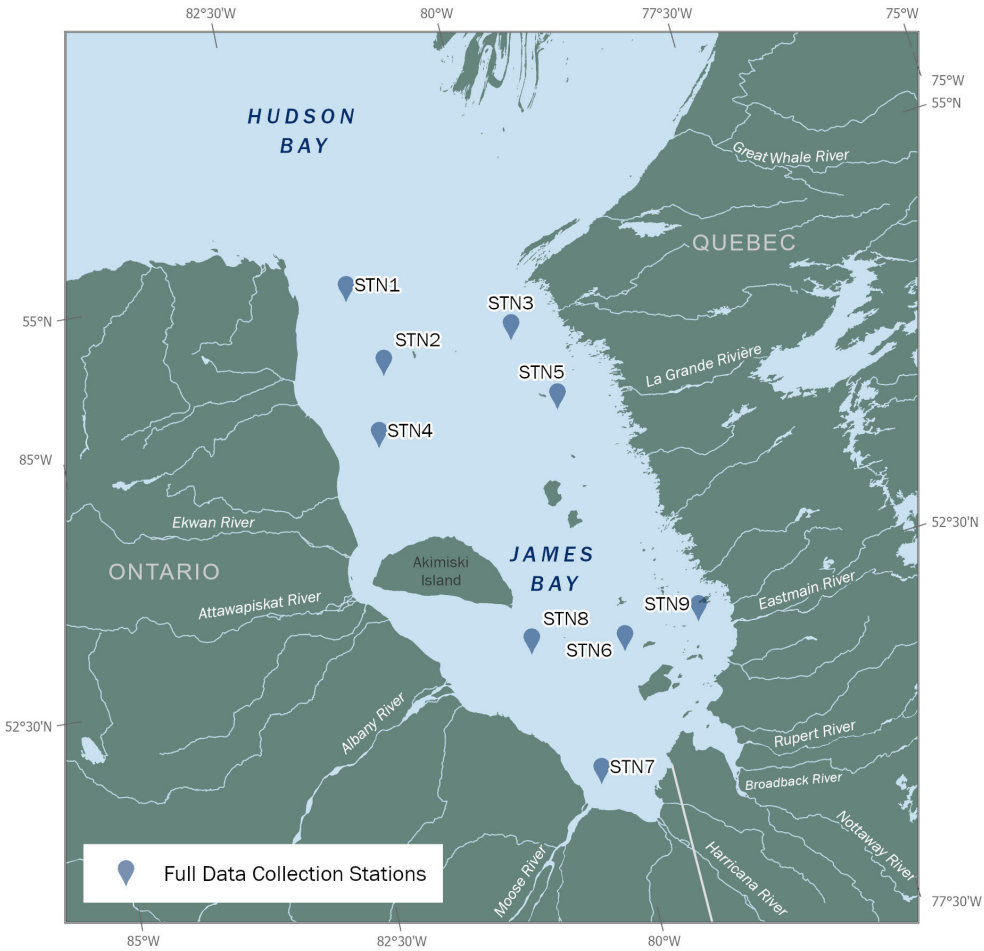

Figure 12. Location and station names for full data collection stations (i.e., "full stations") in James Bay.

Table 2. List of full stations sampled in James Bay during the 1-17 August 2021 cruise.

Station	Date	Btm depth (m)	Latitude [deg N]	Longitude [deg W]	No. rosettes
STN1	03-Aug-21	32	54.765	81.693	1
STN4	04-Aug-21	38	53.828	81.685	2
STN5	05-Aug-21	62	53.807	79.758	2
STN3	06-Aug-21	68	54.297	80.058	2
STN2	07-Aug-21	62	54.279	81.478	2
STN6	08-Aug-21	62	52.238	79.693	2
STN7	09-Aug-21	7	51.473	80.244	0
STN8	10-Aug-21	18	52.357	80.621	1
STN9	11-Aug-21	44	52.3047	78.893	1

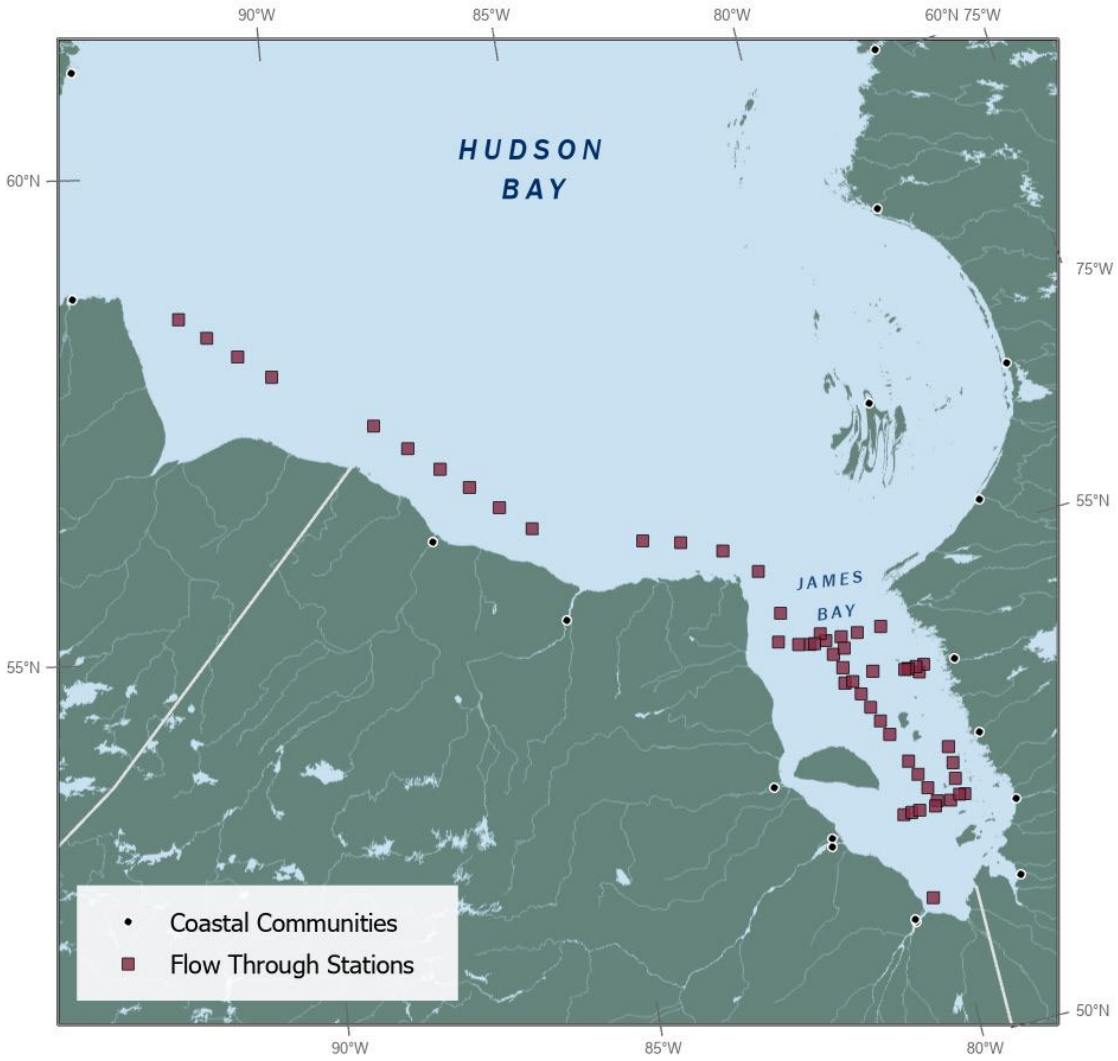

Figure 13. Map showing flow through sample sites.

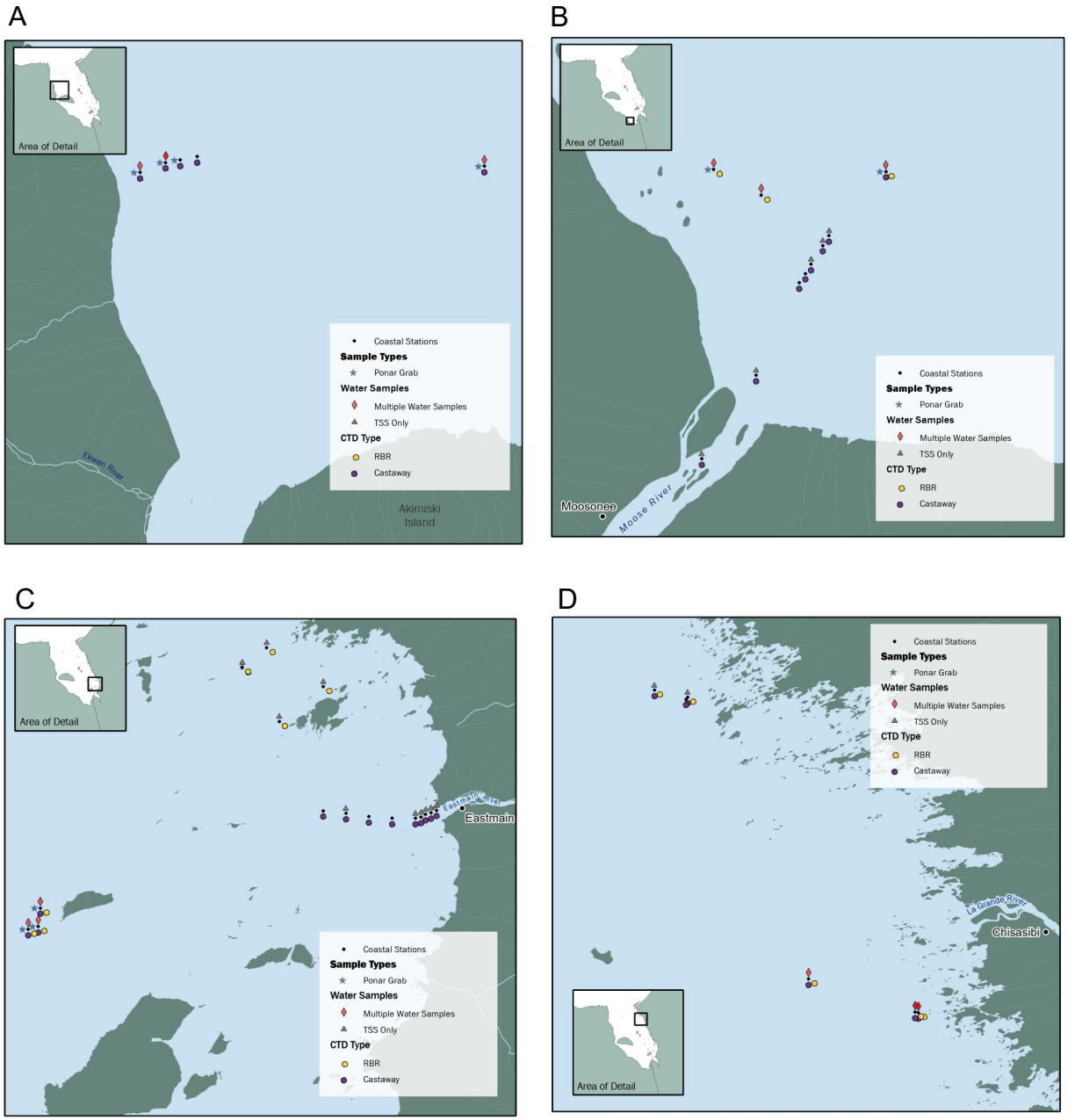

Figure 14. Map showing coastal sample sites near Ekwan River (A), Moose River (B), Eastmain River (C), and the La Grande River (D).

Table 3. List of coastal sampling sites accessed by zodiac.

Station	Depth (m)	Date and Time (EST)	Latitude [deg N]	Longitude [deg W]
STN1/Z1A	3.53	2021-08-04 10:33	53.8164	82.0471
STN4/Z1A	3.53	2021-08-04 10:33	53.8164	82.0471
STN4/Z1B	9.01	2021-08-04 12:03	53.8226	82.0009
STN4/Z1C	13.92	2021-08-04 13:45	53.8246	81.9583
STN4/Z1D	18.45	2021-08-04 15:55	53.8232	81.9103
STN4/Z1E	23.63	2021-08-04 17:15	53.8228	81.8552
STN5/Z2A	7.00	2021-08-05 14:08	53.7215	79.2257
STN5/Z2B	20.75	2021-08-05 15:37	53.7235	79.2322
STN5/Z2C	26.42	2021-08-05 7:19	53.8023	79.4476
STN3/Z3A	7.35	2021-08-06 8:54	54.2093	79.5559
STN3/Z3B	10.92	2021-08-06 10:39	54.2071	79.5603
STN3/Z3C	20.80	2021-08-06 11:11	54.2294	79.6257
STN6/Z4A	9.52	2021-08-08 14:30	52.2330	79.5617
STN6/Z4B	20.78	2021-08-08 16:10	52.2328	79.5866
STN6/Z4C	32.38	2021-08-08 17:48	52.2587	79.546
STN7/Z5A	4.80	2021-08-09 10:45	51.5367	80.3728
STN7/Z5B	6.30	2021-08-09 12:15	51.5092	80.3237
STN7/Z5C	12.76	2021-08-09 18:00	51.5041	80.169
STN9/Z6A	22.60	2021-08-11 7:17	52.5464	78.85944
STN9/Z6B	4.80	2021-08-11 9:27	52.4692	78.75167
STN9/Z6C	6.10	2021-08-11 11:02	52.4364	78.87611
STN9/Z6D	13.10	2021-08-11 12:13	52.5272	78.92889
STN7/MR1	7.10	2021-08-09 10:20	51.4669	80.2548
STN7/MR2	6.29	2021-08-09 11:10	51.4608	80.2653
STN7/MR3	5.19	2021-08-09 12:00	51.4490	80.2845
STN7/MR-CTD-12miles	4.79	2021-08-09 12:40	51.4431	80.2943
STN7/MR4	6.21	2021-08-09 14:32	51.3767	80.3817
STN7/MR5	5.96	2021-08-09 15:25	51.3246	80.47
STN7/MR-CTD-11.5	3.81	2021-08-09 12:56	51.4375	80.3042
STN9/EM1	0.73	2021-08-11 8:19	52.2494	78.5659
STN9/EM2	1.23	2021-08-11 8:57	52.2480	78.5807
STN9/EM3	1.70	2021-08-11 9:27	52.2478	78.5937
STN9/EM4	2.75	2021-08-11 10:21	52.2456	78.6058
STN9/EM5	4.55	2021-08-11 9:52	52.2462	78.6201
STN9/EM6	16.71	2021-08-11 11:39	52.2800	78.7785
STN9/CTD-EM-1	8.96	2021-08-11 11:00	52.2553	78.6744
STN9/CTD-EM-2	14.06	2021-08-11 11:15	52.2663	78.7268
STN9/CTD-EM-3	23.34	2021-08-11 12:06	52.2922	78.8290

3a. Chemical Oceanography

Cruise Participants: Lauri Corlett and Alessia Guzzi (CEOS)
Principal Investigators: Jens Ehn and Zou Zou Kuzyk (CEOS)

Objectives:

Dissolved water properties (geochemical tracers) and particulate properties measured on bottle samples provide complementary information to physical in situ measurements for improving understanding of the oceanography of James Bay including circulation, water mass distributions, mixing of freshwater from river inflow and sea-ice melt, and surface water properties that affect light penetration. Not since the 1970s have these characteristics been assessed in James Bay (Prinsenberg, 1982; Peck, 1978; El-Sabh and Koutitonsky. 1977) and it is thought that Hudson Bay surface waters have generally warmed and freshened during the 1980s and '90s (Brand et al. 2014).

Water samples were collected throughout the 2021 James Bay Expedition to be analyzed for water mass tracers (salinity, oxygen isotope ratio of seawater ($\delta^{18}O$), dissolved nutrients, dissolved organic carbon (DOC)), and suspended particulate matter quantity (total suspended solids (TSS)) and properties (organic carbon content (POC), organic nitrogen content (PON), and particulate absorption *(a_p)*). Refer to *Appendices A* and *B,* Figures 12-14, and Tables 2 and 3 for sampling locations.

The objectives of this water sampling program were to:

1. Provide an in situ dataset of water properties including salinity and water stable isotope ratios that may be applied to quantify contribution of different freshwater sources (river water, sea-ice melt). These data provide new baseline information for the James Bay region.
2. Determine how nutrients, DOC, and suspended particle properties vary both spatially and temporally, and in relation to changing light and sea ice conditions. Chlorophyll *a* data will be cross-referenced with current satellite imagery to gauge whether or not current remote sensing algorithms are suitable for high latitude waters. The data provide insight into areas of high biological productivity/phytoplankton biomass.
3. Develop a better understanding of how these variables are influenced by freshwater sources, including variations in salinity, temperature, and freshwater source.

This data will be used in conjunction with data collected from the proposed 2022 *William Kennedy* Expedition to provide a robust baseline data set spanning both inshore and offshore waters of James Bay.

Methods and Data Collection:

Sample collection occurred from July 31st to August 12th on board the MV *William Kennedy*, as well as at remote zodiac stations. A Seabird Rosette consisting of 12 five litre Niskin bottles was used to collect seawater at various depths at eight different stations—STN1-9, excluding STN7. An individual Niskin bottle was used to collect water at the zodiac stations. Six stations had an associated zodiac sample set—each set consisting of targeted sample locations in areas assumed

to have high biological productivity. Salinity gradient samples were also collected at two stations using the zodiac. These samples were taken in transect from freshwater riverine sources towards saline marine water.

Samples were collected at the surface and bottom for all Rosette stations, as well as throughout the water column at pre-determined depths. Sampling depths varied between locations based on bathymetry and can be found in *Appendices A* and *B*. Rosette samples for POC/PON, TSS and a_p were collected in bulk polyethylene containers ranging from 9 L to 20 L in volume. The containers were rinsed three times with sample water prior to collection and the water was dispensed using acid-washed tygon tubes. For salinity, $\delta^{18}O$, and other dissolved tracers, samples were collected into an acid-washed 500 mL brown Nalgene bottle. The Nalgene bottle was rinsed 3 times with sample water before collecting the sample water. The same sample collection method was used at the zodiac stations, with the exception of sites MR1-MR5 and EM1-EM6, where the sample water was collected directly from the surface using a 2.479 L bulk polyethylene container without the use of a Niskin. While in transit, water samples were collected directly from the vessel's underway flow-through system into glass jars. Flow-through samples were collected at various times, often on a three-hour rotating schedule or in conjunction with a CTD cast. Additional details pertaining to Rosette, Zodiac and Flow-through samples can be found in *Appendices A* and *B*.

Water for salinity and $\delta^{18}O$ was collected into 250mL glass bottles and 20mL glass scintillation vials, respectively. Bottles and scintillation vials were cleaned 3 times with sample water before filling. The lids were tightly closed and sealed with paraffin and then the samples were placed in the dark (salinity) or in the fridge ($\delta^{18}O$). Salinity samples will be analyzed at the Centre for Earth Observation Science (CEOS) at the University of Manitoba. ^{18}O samples will be analyzed at CEOS and University of Ottawa.

DOC and nutrients samples were filtered through a 25 mm GFF filter using an acid-washed syringe and Sweenex filter holder. The GFF filter was previously baked at 500°C. For DOC, a 0.2 µm filter was attached to the end of the Sweenex, downstream of the GFF filter, and the sample water was passed through both sets of filters and collected in amber glass vials. Nutrients samples were collected into acid-washed 15-ml falcon tubes after rinsing 3x with filtered sample. They were stored in the -20°C freezer. Each DOC vial was rinsed three times with filtered sample water and then filled to the top with the filtered water. DOC samples were placed in the fridge at 4°C until analyzing.

47mm Whatman ProWeigh® filters were used for TSS analysis on board the *William Kennedy*. Filters were pre-purchased to minimize preparation time and mitigate human error. ProWeigh® filters were rinsed three times with deionized water and dried at 105ºC prior to distribution. The filters were weighed to approximately 0.1 g and the final weight is recorded (in grams) on the side of the respective aluminum filter container, as well as a unique code identifier. Containers were stored in the laboratory until filtrations were completed in the field to ensure that the filters were kept cool and dry. 25 mm Whatman GF/F filters were used for a_p analysis. Filters for a_p analysis were not burned or rinsed with deionized water prior to use.

Water samples collected for TSS and a_p analysis were transferred from the bulk sampling container to a graduated cylinder for filtration (Figure 15). Each bulk container was equipped with a spigot for ease of transfer. The prepared 47mm Whatman ProWeigh® filters and 25 mm Whatman GF/F filters were placed on the filtration system for TSS and a_p analysis, respectively. The filtration system consisted of three 250 mL funnels for TSS filtrations and three 250 mL funnels for a_p. A GAST vacuum pump was incorporated into the filtration system to expedite the filtration process. The volumes of water filtered varied from 500-6820 mL for total suspended solids and 55-1035 mL for particulate absorption. Lower volumes were required in areas influenced by riverine run-off, which commonly had higher quantities of colour dissolved organic matter (CDOM) and suspended solids. Samples were filtered until there was visible colour on the filters, at which point the filtration valves would be closed and the pump would be turned off to avoid the collection of any airborne particles. For each sampling location, the volume of water filtered was recorded in millilitres, as well as the filter weight (in grams) and code identifier for TSS.

Following filtration, the 47mm Whatman ProWeigh® filter for TSS analysis would be removed from the filtration stand with a pair of tweezers and placed in its respective labelled aluminum container. These containers were stacked and immediately stored in the -20°C freezer until analysis down south. The 25 mm Whatman GF/F filters for a_p analysis were also removed from the filtration rack using tweezers and stored in their respective labelled container. Unlike TSS, the a_p containers were labelled on board the ship with the applicable sampling location ID and depth (in metres). The containers were plastic polyethylene capsules that were manufactured to size. The capsules were wrapped in regular, unbaked aluminum foil and stored in a Ziploc bag. The samples were immediately placed in the -80°C freezer until analysis down south.

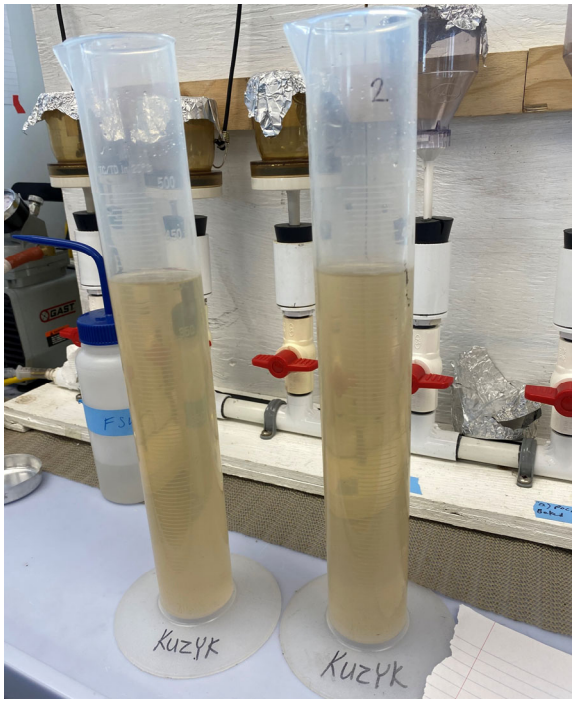

Figure 15. Water measured out into graduated cylinders before filtration to assess concentrations of TSS. Vacuum filtration rack is in the background.

3b. Biogeochemistry

Cruise Participant: Claudie Meilleur, Université de Sherbrooke
Principal Investigators: Céline Guéguen, Université de Sherbrooke

Objectives:
Optically active DOM has been used extensively as a tracer of river discharge in the estuaries and coastal waters of Hudson Bay (Guéguen et al., 2011, 2016; Granskog et al., 2007). There are no previously published observations for James Bay. The objective of this study is to contribute to understanding how James Bay influences the carbon cycle of Hudson Bay, by examining the influx and outflux of dissolved organic matter (CDOM, FDOM) from different sources (rivers, primary production etc.). Other substances that may help trace river water within James Bay including thiols and dissolved lignin phenols also were measured.

Methods and Data Collection:
CDOM/FDOM
Data collection
CDOM samples were collected using the underway system, rosette, and zodiac (see Figure 3 a, b, c for sampling locations). Depth profiles were obtained at eight sites (STN1-6, 8 and 9). Bottom and surface samples were obtained from zodiac transects for sites Z1C, Z2A, Z2B, Z3C, Z4C, Z5C, Z6A and Z6D (Figure 14, Table 2). Other zodiac sites were only sampled for surface water. CDOM samples were also collected on two salinity gradients in the Moose River area (M1-M6) and Eastmain River area (EM1-EM6). Underway samples were collected about every other CTD cast or every 3h, whenever possible, totalling 56 samples. In total, two sets of CDOM samples (duplicates to allow sample processing both at UofM and Sherbrooke) were collected from a total of 130 sites/water depths. Nitrile gloves were worn at all times while collecting and processing water samples.

Methods
CDOM samples were filtered through a 25 mm GFF filter using a syringe and Sweenex filter holder. The GFF filter was previously baked at 500°C. A 0.2 µm filter was attached to the end of the Sweenex, downstream of the GFF filter, and the sample water was passed through both sets of filters and collected in amber glass vials. Each CDOM vials were rinsed three times with filtered sample water and then filled to the top with the filtered water. Samples were placed in the fridge at 4°C until analyzing. One set of samples will be analyzed for CDOM and FDOM at Université de Sherbrooke, and the other for CDOM at the University of Manitoba.

Thiols
Thiols samples were collected from 14 sites (zodiac and underway) in 60 mL LDPE bottles. Thiols samples were filtered through a 25 mm baked GFF filter, with a 0.2 µm filter attachment, similar to the CDOM filtration set up. Each bottle was rinsed three times then filled about 50 mL full. Bottles were then placed in -80 °C freezer until analysis at the Université de Sherbrooke.

Dissolved Lignin Phenols
Dissolved lignin phenol samples were collected from the underway system at seven sites. At each site, 2L of water was collected and filtered through 47 mm GFF filter using a peristaltic pump.

The 2L bottles were rinsed three times with filtered sample water. Filtered water samples were acidified using 2.6 mL of concentrated HCl. Solid phase extraction cartridges were conditioned using 6 mL of MeOH. The samples were passed through the cartridge at a rate of about 0.5 L/hour. After 2L of sample was passed through the cartridge, the cartridge was frozen at -20°C until further processing. Washing and elution of the cartridge, as well as analysis will be performed at Université de Sherbrooke

3c. Inorganic Carbon

Cruise Participant: Yekaterina Yezhova (CEOS)
Principal Investigator: Tim Papakyriakou (CEOS)

Objectives:
The inorganic carbon system includes: dissolved inorganic carbon (DIC), total alkalinity (TA), pH, the saturation state for calcium carbonate minerals aragonite and calcite, pCO_2, particulate inorganic carbon, and through collaboration, dissolved and particulate organic carbon. In addition to CO_2, the GHGs methane (CH_4) and nitrous oxide (N_2O) will be measured. Collectively the observations will allow us to assess the CO_2 source/sink status, broader GHG footprint through consideration of CO_2, CH_4 and N_2O, the current state and susceptibility of the region to ocean acidification, and to identify the main moderating factors to the above. We expect the carbon system (specifically pH and pCO_2) and GHG footprint of the marine system to be strongly modified by river inflow to an extent dictated by the water properties of the rivers. We expect sea ice melt to also impact the region's carbon system, however the relative role of the freshwater sources (river and sea ice melt), temperature and biology remain uncertain.

Previous studies (e.g., BaySys) have shown that the waters at the confluence between James Bay and Hudson Bay are low in aragonite saturation and pH, which has been attributed to the compounding effects of greater sea ice melt and river water in this area. While the organic load of river water can increase the partial pressure of carbon dioxide (pCO_2) through microbial and photochemical processes, the low alkalinity and dissolved inorganic carbon of river water can cause a drop in pCO_2. pCO_2 is the main driver of air-sea CO_2 exchange and determines the regions' CO_2 source/sink status. The 2021 cruise of the RV *William Kennedy* presents the first opportunity to measure attributes of the carbon system in James Bay. The cruise will allow us to establish a baseline understanding of the Bay's carbon system, its role relative to other Arctic and subarctic seas as a net GHG source or sink, and better prepare us to project future states of the carbon system, including the GHG source/sink and OA.

The objectives of the cruise are to:

- Survey the concentrations of inorganic carbon across James Bay in conjunction with measurements of freshwater tracers and the region's physical, biological system;
- Sample the concentration of these carbon species in major rivers and estuaries of James Bay;
- Sample the concentration of dissolved greenhouse gases (GHG).

Methods and Data Collection:

Discrete Water Samples

Sample collection took place from August 1 – 13, 2021, from RV *William Kennedy*. Water samples were collected using a Seabird rosette equipped with 12 5 L Niskin bottles and a seabird 19+ V2 CTD. Additionally, water samples were collected from the seawater sampling line connected to the ship's water intake system that continuously sampled water from ~2 m depth. Lastly, water samples were also taken using a 5 L Niskin bottle from small boats deployed from the RV *William Kennedy* to sample near coastal and river areas.

Water samples were usually sampled in the following order: pCO_2, CH_4/N_2O, 13C-DIC, DIC/TA. First, a sampling tube was connected to the Niskin spigot or the seawater sampling line in the ship's laboratory and water was allowed to run through to clean and remove any air bubbles from the tubing. For pCO_2, CH_4/N_2O, and 13C-DIC samples, the vials were filled smoothly from the bottom, with tubing touching the bottom of the vial, and were overflowed three times their volume. For DIC, the bottle was rinsed twice with ~100 mL of sample water, then filled smoothly from the bottom, with tubing touching the bottom of the vial, and overflowed by a full volume. The glass stopper was inserted to prevent contamination. After all sampling was completed (5-15 minutes), 5 mL of the stoppered DIC sample was removed to prevent the bottles from breaking in case of freezing temperatures. The gas samples were then spiked with saturated mercuric chloride ($HgCl_2$) solution, with volumes of $HgCl_2$ used outlined in Table 4. Once the samples were spiked, the DIC stopper was greased and the sample was securely closed with electrical tape around the bottle and stopper, pCO_2 and CH_4/N_2O samples were crimped, and 13C-DIC samples were parafilmed. Information for rosette, small boat, and water intake line samples is given in Tables 5, 6, and 7, respectively. The CH_4/N_2O samples will be analyzed at UBC, DIC/TA samples will be analyzed at BIO DFO, and pCO_2 and 13C-DIC samples will be analyzed at UM.

Table 4. Volumes of saturated mercuric chloride solution used to spike gas samples

Variable	Vial type	Volume of $HgCl_2$ used (µL)
DIC/TA	500 mL borosilicate glass bottle with glass stopper	100
CH_4/N_2O	60 mL clear glass vial with rubber stopper and aluminum crimp seal	20
pCO_2	60 mL clear glass vial with rubber stopper and aluminum crimp seal	20
13C-DIC	12 mL exetainer vial	10

Table 5. Samples collected from the rosette. At each sampling depth, 1 pCO_2 vial, 1 CH_4/N_2O vial, 2 13C-DIC vials, and 1 DIC/TA bottle were collected, unless noted otherwise. Dates and times are in EDT.

Date	Time	Stn	Latitude	Longitude	Stn depth (m)	Sample depth (m)
8/3	19:21	STN1	54.7650	-81.6933	31.5	0, 10, 15, 20, 26
8/7	08:45	STN2	54.2633	-81.4695	57.8	0, 10[a], 20, 30, 40[b], 46
8/6	08:10	STN3	54.2974	-80.0579	68.0	0, 10, 20, 30, 40[b], 60
8/4	09:47	STN4	53.8283	-81.6850	38.0	0, 10, 20, 30
8/5	14:35	STN5	53.8067	-79.7579	62	0, 10, 20, 30, 40, 50
8/8	16:38	STN6	52.2389	-79.6954	61.8	0, 10, 20, 30, 40[b], 54
8/10	08:25	STN8	52.3570	-80.6212	18	0, 10
8/11	11:10	STN9	52.3048	-78.8933	43.9	0[c], 10[c], 20[c], 30[c], 40[c]

[a] No CH_4/N_2O sample
[b] DIC/TA collected in duplicate
[c] No CH_4/N_2O or pCO_2 samples

Table 6. Samples collected from small boat operations. At each sampling depth, 1 pCO_2 vial, 1 CH_4/N_2O vial, 2 13C-DIC vials, and 1 DIC/TA bottle were collected, unless noted otherwise. Dates and times are in EDT. Stn is station.

Date	Time	Stn	Latitude	Longitude	Stn depth (m)	Sample depth (m)
8/4	10:33	Z1-A	53.8164	-82.0471	3.53	0
8/4	12:03	Z1-B	53.8226	-82.0009	9.01	0
8/4	13:45	Z1-C	53.8246	-81.9583	13.92	0, 13
8/5	14:08	Z2-A	53.7215	-79.2257	7	0, 6
8/5	15:37	Z2-B	53.7235	-79.2322	20.75	0, 18
8/5	19:19	Z2-C	53.8023	-79.4476	26.42	0
8/6	08:54	Z3-A	54.2093	-79.5559	7.35	0
8/6	11:11	Z3-C	54.2294	-79.6257	20.8	0
8/8	14:30	Z4-A	52.2330	-79.5617	9.52	0
8/8	16:10	Z4-B	52.2328	-79.5866	20.78	0
8/8	17:48	Z4-C	52.2587	-79.5460	33.2	0
8/9	10:25	MR1	51.4669	-80.2548	7.1	1.5
8/9	11:08	MR2	51.4608	-80.2653	6.29	1.5
8/9	12:10	MR3	51.4490	-80.2845	5.19	0
8/9	14:33	MR4	51.3767	-80.3872	6.1	0
8/9	15:25	MR5	51.3246	-80.4701	5.96	0
8/9	10:45	Z5-A	51.5367	-80.3728	4.8	0
8/9	18:00	Z5-C	51.5041	-80.1690	12.76	0, 10
8/11	08:19	EM1	52.2490	-78.5659	0.73	0
8/11	08:57	EM2	52.2480	-78.5807	1.23	0
8/11	09:28	EM3	52.2478	-78.5937	1.70	0
8/11	10:21	EM4	52.2456	-78.6058	2.75	0
8/11	09:52	EM5	52.2462	-78.6201	4.7	0
8/11	11:38	EM6	52.2800	-78.7785	16.71	0

Date	Time	Stn	Latitude	Longitude	Stn depth (m)	Sample depth (m)
8/11	07:17	Z6-A	52.3931	-78.7722	22.6	0, 20
8/11	09:27	Z6-B	52.3572	-78.6091	4.8	0
8/11	11:02	Z6-C	52.2925	-78.6166	6.1	0
8/11	12:13	Z6-D	52.2980	-78.7137	13.1	0, 12

Table 7. Samples collected from the ship's water intake line. At each sampling depth, 1 pCO_2 vial, 1 CH_4/N_2O vial, 2 13C-DIC vials, and 1 DIC/TA bottle were collected, unless noted otherwise. Dates and times are in EDT and Stn is station.

Date	Time	Associated Stn	Latitude (N)	Longitude (W)	Stn depth (m)
8/1	13:00		58.5167	-92.0500	67
8/1	16:00		58.3088	-91.5213	64
8/1	19:00		58.0928	-90.9457	na
8/1	22:00		57.8558	-90.3221	48
8/2	07:00		57.2514	-88.4739	44.9
8/2	10:00		56.9801	-87.8804	39.6
8/2	13:00		56.7265	-87.3278	44.6
8/2	16:00		56.4928	-86.8306	41.5
8/2	19:05		55.5191	-85.6853	39.0
8/2	22:00		55.9851	-85.7965	70
8/3	07:00		55.6698	-83.8435	53.2
8/3	10:00		55.5794	-83.1717	29.7
8/3	13:00		55.4094	-82.4525	22.4
8/3	16:00		55.1269	-81.9079	29.7
8/3	23:30		54.3757	-81.8234	32.7
8/6	15:20	CTD34	54.2940	-80.0138	55.9
8/6	17:50	CTD37	54.2895	-80.4383	49
8/6	19:13	CTD39	54.2860	-80.7290	50
8/6	20:44	CTD41	54.2843	-81.0041	28
8/6	22:24	CTD43	54.2812	-81.2888	51.5
8/7	15:55	CTD51	54.1289	-80.9314	22.5
8/7	17:50	CTD53	53.9731	-80.8244	20
8/7	19:28	CTD55	53.8130	-80.7124	20.6
8/7	21:16	CTD57	53.6682	-80.6209	26
8/7	22:44	CTD59	53.5124	-80.5151	37.3
8/8	00:23	CTD61	53.3532	-80.4079	48.6
8/8	01:51	CTD63	53.1973	-80.3061	49.3
8/8	09:18	CTD71	52.5747	-79.8954	58.7
8/8	10:56	CTD73	52.4214	-79.7916	61.4
8/9	12:30[a]	STN7	51.4702	-80.2433	5.9
8/10	15:24	CTD100	52.3651	-80.3907	17.8
8/10	17:05	CTD102	52.3710	-80.1193	34.5
8/10	18:43	CTD104	52.3748	-79.8459	63.2

Date	Time	Associated Stn	Latitude (N)	Longitude (W)	Stn depth (m)
8/10	20:11	CTD106	52.3937	-79.5768	77.9
8/10	22:08	CTD108	52.4233	-79.3190	77.5
8/11	13:22	STN9	52.3047	-78.8930	43.7
8/11	19:05	CTD114	52.4307	-79.4085	78.5
8/11	20:28	CTD116	52.5975	-79.4078	44.6
8/11	21:46	CTD118	52.7601	-79.3815	58.4
8/11	23:04	CTD120	52.9300	-79.3882	65.3
8/12	10:00	STN3/CTD134	53.8054	-79.7856	61.0
8/12	14:00		53.8681	-80.3413	39.7
8/12	17:00		54.1791	-80.7398	37.7
8/13	09:30		54.3655	-81.0755	20.2
8/13	16:00		54.2782	-81.2076	48.1
8/13	19:00		54.3057	-81.4985	58.0
8/13	22:00		54.6602	-81.6798	32.5

[a] Only DIC was collected.

Underway pCO_2 Measurements:

A flow-through pCO_2 system (model CO_2-Pro FT, Pro-Oceanus, Halifax, NS) was installed on the RV *William Kennedy* (Figure 16). The sensor operates through rapid diffusion of dissolved gas from water through a semi-permeable membrane to a non-dispersive infrared (NDIR) gas analyzer. The sensor was factory calibrated (February 2020) prior to deployment using gas traceable to international standards at the NOAA ESRL GMD Central Calibration Laboratory. Declared accuracy is 0.01 ppm or ± 0.5%. Long-term stability is achieved through an automated zeroing routine that periodically removes CO_2 from the system establishing a new zero CO_2 baseline value. Seawater was continuously pumped through the system at a rate of approximately 1 L/min from a clean water intake located approximately 2 m beneath the surface. Through sensor programing the pCO_2 was sampled at ~7 min increments. The sensor operated continuously from Halifax to the study area. It provided data in support of this project between August 1 and 13. However, because of an issue with the intake, pump data are missing between August 3 and 6. Data are synchronized to UTC.

Figure 16. pCO_2 system attached to the flow-through system, which brings in seawater through the ship's hull from a depth of about 2 m below the sea surface. (Photo credit: J. Hunt)

3d. Primary Production

Cruise Participants: Elizabeth Kitching[1], Jillian Reimer[1], David Capelle[2], Alessia Guzzi[1], Lauri Corlett[1], Zou Zou Kuzyk[1], CJ Mundy[1]
Principal Investigators: CJ Mundy[1], Zou Zou Kuzyk[1], Andrea Niemi[2], Michel Gosselin[3]

[1]Centre for Earth Observation Science, University of Manitoba
[2]Department of Fisheries and Oceans Canada (DFO)
[3]Université du Québec à Rimouski (UQAR)

Objectives:
The objectives of the primary production group were to:

1. Characterize the phytoplankton community and estimate rates of net ecosystem production (NEP), gross primary production (GPP), and gross respiration (GR).
2. Quantify new versus regenerated primary production rates across James Bay.
3. Examine spatial differences and establish baseline estimates in phytoplankton production, phytoplankton taxonomic composition, and photosynthetic pigment concentrations.
4. Investigate how primary production and other variables related to primary production are influenced by freshwater sources, including variations in water salinity and temperature.
5. Examine the presence/absence of kelp and/or benthic algae.

Methods and Data Collection:
Water sampling:
Water samples, kelp samples, and conductivity, temperature and depth (CTD) profiles were collected using a Seabird rosette with 12 x 5-L Niskin bottles, a singular 5-L Niskin bottle (for work aboard small research vessels), water underway flowthrough system, DTG3 Remote Operated Vehicle (ROV), and CTD. Depths for rosette stations were chosen prior to the cruise for the majority of the water sampling variables, with the number of depths being determined upon arrival at each station. The pre-chosen depths were surface water, 10, 20, 30, 40, and bottom. If present and not captured within a listed depth, a chlorophyll a (chl *a*) maximum depth was determined via the down cast data of the rosette's CTD. The exception to the set depths was the primary production depths, which was chosen based on the photosynthetically active radiation (PAR) profiles for set light depths of 100, 55, 28, 17, 8, and 2% PAR. The Secchi disk depth, i.e., the depth at which a weighted, black-and-white disk, 30 cm in diameter, disappeared from view, which corresponds to the depth at which approximately 10% of the surface light remains, was assessed from the bow at each station (Table 7).

Water was collected at 2 m depth from the flow-through underway system in the engine room of the ship, which was continuously pumped up to the lab workspace and fed into an incubation system used for NEP, GPP, and GR estimations. These samples were collected following every other CTD deployed in a transect line or every 3 hours on days without rosette sampling stations and without CTD transects. Several stations were sampled from small research vessels, with water

being collected from the surface, or 0.5-1 m depth. *Appendix C* provides a list of samples collected.

Bulk water was collected at rosette stations and small research vessel stations using acid washed tygon tubing and polyethylene bulk water containers that were first rinsed in sample water three times before being filled with the sample. The bulk water containers came in two sizes, 9-L and 20-L bottles, and the larger bottles were used for 0 m and bottom depth, as greater volumes were needed. Water was also collected straight from the surface during some small research vessel sampling sites, without the use of a Niskin, straight into 2.5 L polyethylene, 9-L, and 20-L bottles for filtration. Collected water samples were then transferred to the lab for filtration and taxonomy. Water needed for primary production was subsampled from the bulk water containers and then moved to a dark area of the lab. The bulk water was then subsampled for specific analyses in the following order: nutrient concentration, flow cytometry, chl *a* concentration, particulate absorption (a_p), particulate organic carbon and nitrogen (POC/N) (only at bottom depth and 0 m), lugol taxonomy (only at 0 m and chla maximum), high-performance liquid chromatography (only at chla maximum and 0 m), and total suspended solids (TSS).

Four (at rosette stations, flow through stations, and Moose River (MR) and Eastmain River (EM) small vessel stations) or three (all other small vessel stations) nutrient samples were taken at each depth. Water samples were drawn through an acid washed 60-ml syringe and then a swinnex filter with a 25-mm combusted GFF was attached. The syringe, filter, and acid washed 15-ml falcon tube were rinsed 3x with filtered sample before the falcon tube was filled with 12 ml and stored in the -20°C freezer. Seven flow cytometry samples were collected using the same 60-ml syringe used for nutrient sample collection without a swinnex filter. A subsample of 4-ml was added to pre-spiked cryovial containing 20-µl or 100-µl of glutaraldehyde (6 contained 20-µl and 1 contained 100-µl). They were placed in the dark for 15 minutes before being stored in the -80°C freezer. Lugol taxonomy samples were collected at the 0 m and chl *a* maximum depths. Subsamples of 200 ml were collected at each depth and placed in amber bottles. Following this, 0.8 ml of Lugol was added, and the bottle was inverted five times gently. Each bottle was then sealed with parafilm and stored in the fridge (4°C).

Two chl *a* samples were filtered for each sampling depth onto a 25-mm GFF. The amount of water filtered varied between 80 and 600 ml depending on the colouration of the filter. The filters were then placed into unburnt tinfoil sleeves and stored in the -80°C freezer. One POC/PON sample were filtered at each sampling depth. The volume filtered varied between 200 and 1000 ml depending on the amount of particulates in the water. Subsamples were filtered on a 25-mm pre-combusted GFF and then placed in a pre-combusted tinfoil sleeve. The sleeves were then stored in the -80°C freezer. One high performance liquid chromatography for measurement of algal pigment composition was also collected from the chl *a* maximum depth. The amount filtered at each station ranged between 250 and 1000 ml depending on the colour seen upon the filter. The samples were filtered on a 47-mm pre-combusted GFF and then placed in a 2-ml cryovials. A blank filter was also collected at each station using the same procedure with 25 ml of filtered seawater instead of sample. The cryovials were then stored in the -80°C freezer.

One total suspended solids (TSS) sample was collected at each sampling depth. Approximately 500-6820 mL of water was filtered through a 7mm ProWeigh® filter until colour was visible on

the filter. The initial weight of the filter was approximated to be 0.1 g and the final weight is recorded (in grams) on the side of the respective aluminum filter container, as well as a unique code identifier. The sample was stored in this aluminum filter container in the -20°C freezer until analysis down south. One particulate absorption (a_p) sample was collected at each sampling depth using a 25 mm Whatman GF/F filter. Approximately 55-1035 ml of water was filtered, with water being filtered until colour was visible on the filter. Filters were placed in plastic polyethylene capsules, wrapped in unburned aluminum foil, and stored in the -80°C freezer until analysis down south.

Table 8. Secchi disk depths recorded to the nearest half-metre from the ship's bow.

Station number	Secchi depth (m)
4	5.5
5	4.5
3	4.5
2	7.0
6	2.5
8	2.0
MR 1	0.5
MR 2	0.5
MR 3	0.5
MR 4	0.5
MR 5	0.5
EM 1	0.5
EM 2	0.5
EM 3	0.5
EM 4	0.5
EM 5	1.0
EM 6	1.5

Incubations:

For primary production (PP) incubations for the estimation of new and regenerated primary production, 2000 ml of bulk water was sampled into 4 clear Nalgene polycarbonate bottles. Each subsample was spiked with 500-µl of Carbon-13 (^{13}C) in the form of $NaH^{13}CO_3$. Then 2 bottles are spiked with 500-µl of NH_4 in the form of $(15NH_4)_2SO_4$ and the other 2 are spiked with 500-µl of NO_3 in the form of $K^{15}NO_3$. This is done for each of the 6 light depths (100, 55, 28, 17, 8, and 2% PAR), and then the 24 bottles are turned upside down 3 times, before being placed into the incubator for 4 hours. The incubators were placed on the top deck of the ship and surface water was circulated through (Figure 17). Each set of bottles were placed in clear plastic tubes covered with a film that replicates the light received at each of the light depths. Two 500 ml t_0 bottles were taken at the surface depth (for underway flow through sampling stations) or the 2% light depth (for rosette sampling stations). The water was immediately filtered, and when there was 20 ml remaining, 500-µl of Carbon-13 (^{13}C) in the form of $NaH^{13}CO3$ was added to each, and one bottle was also then spiked with 500-µl of NH_4 and the other with 500-µl of NO_3. After the four-hour incubation, water from the light incubations was filtered onto pre-combusted (450 degrees for 5

hours) 21 or 25-mm glass fibre filters (GFF). Filters were placed into pre-combusted (450 degrees for 5 hours) aluminum foil sleeves and stored in the -80°C freezer until analysis down south.

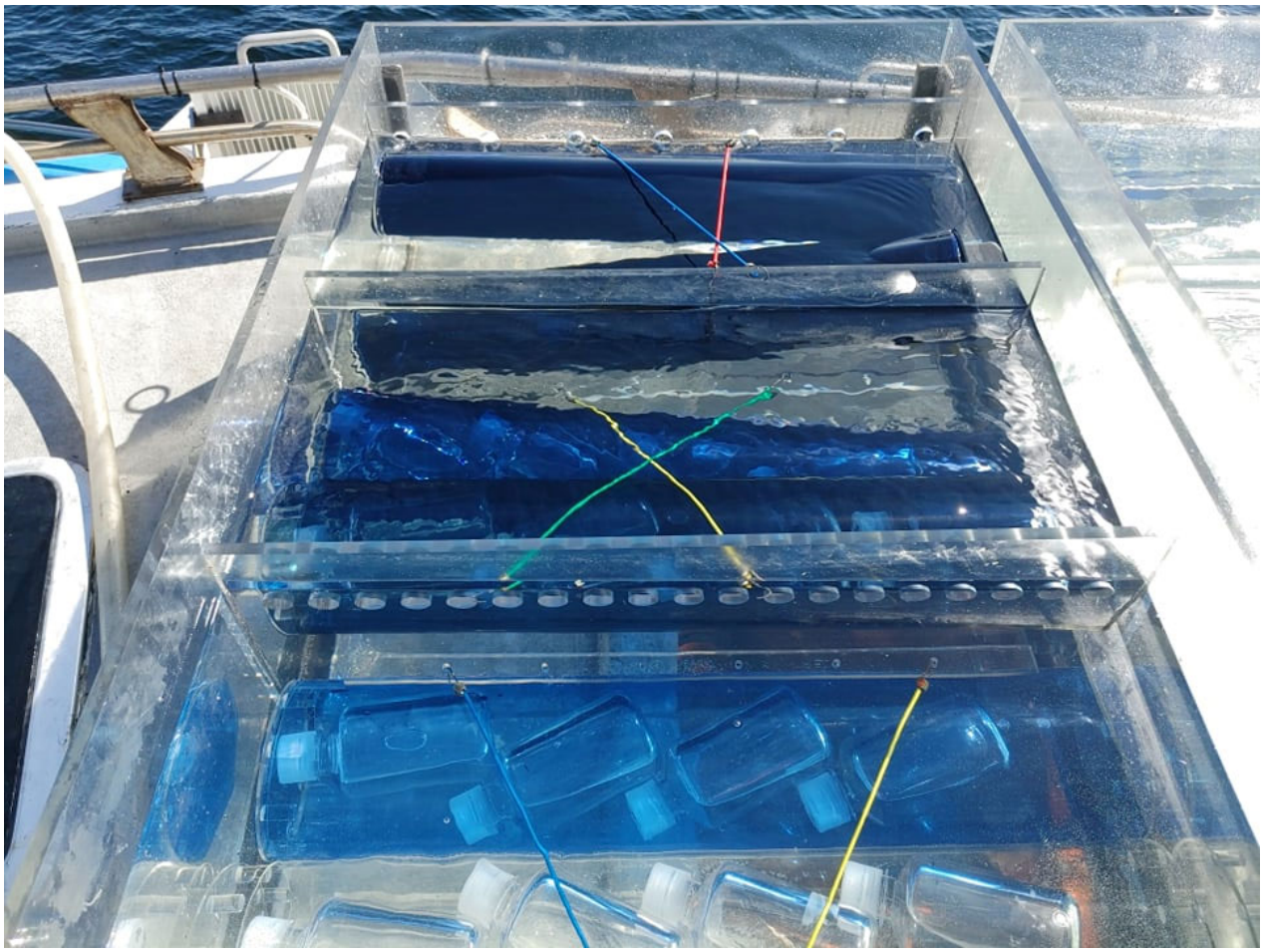

Figure 17. Incubation chambers for primary production estimates. (Photo credit: E. Kitching)

Assessments of in situ phytoplankton community abundance:
Phytoplankton community abundance was estimated using an Algae Online Analyser (bbe Moldaenke) (Figure 18). The instrument uses fluorescence at 4 wavelengths to estimate the abundance of chlorophyll concentration among four different algal groups (greens, blue-greens, diatoms, and chlorophytes). It also estimates the concentration of fluorescent yellow substance, essentially a measure of colored dissolved organic matter (CDOM), as well as turbidity. Water samples were pumped from the ships seawater intake line to the Algal Online Analyser and measured every 10 minutes over the duration of the cruise. In addition to the algal analyser, an automated incubator was installed to estimate NPP, GPP, and GR along the cruise track. The incubator consists of two spherical chambers which are filled with seawater from the ship's water intake line once every hour. Once filled, a stirring pump mixes the water inside the chamber while an oxygen probe measures dissolved oxygen and temperature. The incubators are housed inside coolers, one of which is illuminated by an LED light. The change in oxygen concentration over the course of the incubation is a function of primary production and respiration in the light chamber, while the change in oxygen in the dark chamber is a function of respiration only.

Together, these can be used to estimate the rates of primary production and respiration in the near-surface (~2 m) water column along the cruise track at hourly intervals (Yezhova et al. 2021).

Figure 18. Algal Online Analyzer and automated incubator set up on the flow through system where it discharges in the lab. (Photo credit: D. Capelle)

ROV data collection:
A DTG3 Remote Operated Vehicle (ROV) equipped with at 270º range view camera was deployed from the stern deck of the ship and from the zodiac (Figure 19). Perpendicular coastline transects were recorded of the ocean floor to explore for kelp around nearshore environments (within approximately 20 km from shore). Various bottom depths were recorded at approximately 2 meters off the ocean floor for approximately 2 minutes. In total, 6 zodiac stations with 19 ROV bottom depth recordings and three additional deployments from the RV *William Kennedy* were completed. None of the 22 recordings revealed the presence of kelp. However, the benthic footage may be useful for identifying benthic species (see section 3f *Invertebrates and Fish*).

Figure 19. Remote Operated Vehicle (ROV). (Photo credit: J. Reimer)

3e. eDNA

Cruise Participants: Kimberly Howland (DFO); support provided by Lauri Corlett, Maude Durand
Principal Investigators: Kimberly Howland (DFO)

Objectives:
Biodiversity and the presence of invasive species in James Bay emerged as research priorities among discussions of the members of the Cree Marine Research Needs Working Group. Parks Canada and Eeyou Marine Region representatives both mentioned that community members have reported seeing unfamiliar species and are generally very curious about what species are present in James Bay. The objectives of this sampling program were:

1) To characterize patterns of biodiversity and distributions of key fish and invertebrate species along the Hudson Bay- James Bay coast based on eDNA metabarcoding.
2) Evaluate the level of correspondence between eDNA and specimen-based measures of biodiversity and community structure
3) Evaluate relationships between environmental variables and eDNA-based species composition
4) Screening for potential invasive/non-indigenous species of concern in Hudson Bay-James Bay

Methods and Data Collection:
Water sample collection:
Water samples for eDNA analysis were collected from July 31 to August 15, 2021 using three different methods, each of which is more fully described in section 3 (also see Appendix D for eDNA sample list with collection methods and sample details):

1) Directly from the ship's flow-through underway system which collected water at a 2 m depth and pumped it into the lab space on a continuous basis.
2) Bulk water samples from rosettes deployed off the ship offshore at each of the full sampling stations (Appendix A).
3) Water taken directly from Niskin bottles (5L) deployed from the zodiac at nearshore transect stations associated with each full sampling station (Appendix B). These transects were mainly located near areas with freshwater inflow and made up 3 sites each ranging from <10m to approximately 30m.

In most cases eDNA water samples were taken concurrent with primary productivity and biogeochemistry sampling/measures to allow for later exploration of relationships between eDNA-based biodiversity and environmental conditions in different areas along the Hudson Bay-James Bay coastline (Appendix A-D). The only exception was eDNA samples collected from the flow through system at 3 sites toward the end of the voyage (FT22-24 on August 14-15; Appendix D), when other groups had ceased sampling. For these samples information on temperature and salinity at time of sampling was obtained from a thermosalinograph installed in the engine room.

Samples from the flow through system were taken in duplicate along the west side of Hudson Bay, between Churchill and STN1 (FT1-FT11), at regular intervals (approximately every 2nd flow through station) throughout the transit to James Bay; an additional 3 sets of duplicate samples

(FT22-24) were taken along the same return route to obtain better coverage of areas where there were gaps on the outbound trip, for a total of 16 surface samples covering this portion of the coastline. In addition 2 sets of paired flow through samples were collected at CTD sites 57 and 71.

For each of the full stations in James Bay, two surface samples (usually flow through) and two bottom samples (bulk rosette) were taken at approximately the same time period while the ship was at anchor offshore. Exceptions were STN7 where the Rosette was not deployed so no offshore eDNA samples were collected, and STN8 where there was no corresponding zodiac station so an extra set of offshore surface samples (from the rosette) was collected to increase sample size for this full station.

An additional six nearshore samples were collected by Niskin Bottle at each of the corresponding zodiac transect sites; in most cases these consisted of 3 sets of paired surface and bottom samples at each of three sites along a given transect with the exception of transect Z1 (associated with full STN4) where only surface samples were taken at each of 5 sites. Also, in cases where sites were extremely shallow (i.e., <6m) only a surface sample was taken (Z6B, Z6C near Moose Factory).

In total 89 samples were collected, of which 34 were offshore (from the ship) and 35 were nearshore (from the zodiac) at full stations in James Bay, with an additional 20 samples collected from the flow through system, mainly along the west side of Hudson Bay.

All water samples for eDNA were collected in sterile stand-up Whirlpac bags which were handled using a new pair of sterile gloves each time a new sample was collected and carefully sealed to avoid contaminating the inside of the bag. Full samples were propped up inside a clean plastic container for extra stability during transport and later filtering. Whenever possible, samples were filtered shortly after collection. If this was not possible, they were temporarily placed in the refrigerator (on the ship) or in a cooler (on the zodiac) until they could be filtered, taking care to ensure that the top of the bags did not come in contact with any surfaces.

Filtration:

To limit the risk of cross-contamination during filtering in the field, individual bagged sampling kits (one/sample) containing a sterilized filter housing with filters, gloves, syringes and tweezers were prepared ahead of time. As an extra precaution each bagged and sealed sampling kit was exposed to UV for 30 minutes. The majority of samples were hand filtered using a syringe (BD 60 mL, Kranklin Lakes, NJ, USA) equipped with a filter housing (MilliporeSigma Swinnex) containing a 0.7 µm glass microfiber filter (Whatman GF/F, 25 mm), although in some cases, samples collected on the ship were filtered using a peristaltic pump equipped with sterilized tubing instead of a syringe. A total of 1L was filtered per sample Field negative controls (1 L distilled water) were filtered for approximately every 10 samples. Filters containing eDNA were immediately preserved at -80°C in 2 mL cryovials containing 700 µl of Longmire's lysis preservation buffer (Wegleitner et al., 2015) and shipped south in coolers with ice packs for later lab analyses.

3f. Invertebrates and Fish

Cruise Participants: David Capelle, Kimberly Howland (DFO); support with benthic invertebrate field processing/sorting also provided by Lauri Corlett, Maude Durand, Alessia Guzzi, Janine Hunt, Zou Zou Kuzyk and Jill Reimer

Principal Investigators: Andrea Niemi (Zooplankton, Icthyoplankton, Benthic fish); Philippe Archambault (Laval University)/Kimberly Howland (DFO) (Benthic Invertebrates, nearshore Zooplankton and Invasive Species)

Objectives:
The objectives of the Niemi group were to characterize the biodiversity and distribution of zooplankton and fish communities in James Bay and assess taxon-specific fatty acids and stable isotopes signatures of key forage species.

The objectives of Howland/Archambault include characterizing baseline biodiversity and distributions of benthic invertebrates, assessing fatty acid and isotopic signatures of key benthic invertebrates, and mapping the distributions of invasive/non-indigenous species along the James Bay Coast.

Methods and Data Collection:
Invertebrates and fish were collected at each of the full sampling stations using a combination of sampling gears deployed from the ship (Appendix A) and at parallel transect sites from a zodiac (excluding Station 8 where there zodiac sampling could not be done due to high winds and substantial distance from shore; Appendix B) to target offshore and nearshore organisms, respectively, as outlined below.

Zooplankton and fish in the water column:
Vertical Tows:
At each full sampling station, from the ship, a series of nets were used to collect pelagic and benthic zooplankton and fish samples from the water column. Similar methods with smaller nets were used from the zodiac to collect zooplankton in parallel nearshore areas of each of the full sampling sites – these nearshore areas of particular interest from an invasive species perspective since most ship-mediated invasive species originate from nearshore environments in various ports around the globe. A Hydrobios WP2 conical net was deployed from the ship to collect integrated samples for taxonomic analyses of zooplankton (150 µm mesh). A single tow was conducted at each full station, integrating the entire water column. A flow meter (General Oceanics) attached to the net was used to determine filtration volume. The net was lowered at 1 m/s to within 10 m or in some cases within 2 m from the bottom and then recovered at 0.5 m/s. Once at the surface the outside of the net was rinsed with a saltwater hose prior to bringing the net onboard. Icthyoplankton was removed and frozen, and the remainder of the sample was preserved (10% (v/v) buffered formaldehyde in filtered sea water) and stored at room temperature.

A 0.5 m diameter, 80 µm mesh conical net (Aquatic Instruments) was deployed from the zodiac to collect a single depth-integrated sample of zooplankton from the water column at the deepest nearshore site (ranging from 20.8 -33.38 m) along each zodiac sampling transect. The net was equipped with an RBR Solo depth sensor to verify depth and weighted to ensure it remained

vertical in the water column during deployment in cases where there was wind/current. The net was lowered by hand either directly over the side of the boat or through a davit pulley system (depending on which zodiac was used) at approximately 1 m/s to within 1-2 meters of the bottom and brought back to the surface at a speed of approximately 0.5-1 m/s. Filtration volumes will be calculated based on net size and total depth of each tow. A portable garden sprayer with water from the same sampling location was used to spray down the outside of the net and ensure all organisms were rinsed down and concentrated in the codend. Samples were removed and preserved in 95% ethanol to allow for morphological identification, but with the option of using genetic barcoding as a means of confirming species identifications where there is uncertainty. This is particularly important with respect to confirming any potential non-indigenous or invasive species. All samples (N=5 nearshore vertical tows; see Appendix B for site details) were drained and ethanol was replaced after 24 hours to ensure adequate preservation. A second set of vertical tow samples were also collected from the ship with the WP2 150 µm mesh net at several sites (N=6 from STNs1, 3, 4, 5, 6, 9) and similarly preserved in 95% ethanol. Both sets of samples will be sorted and analysed for abundance and species composition at labs in Winnipeg (DFO) and/or the Atlantic Reference Center (St. Andrews).

Oblique Tows:

A bongo net (2 nets, 500 µm mesh; Figure 20) deployed from the ship was towed obliquely for a total of 15 minutes at each full station. The Bongo net is used primarily to collect high biomass samples for food web analyses and the study of larger zooplankton and fish larvae. Nets were deployed at approximately 2 knots speed-over-ground with a vertical line out of 2 m/s to within 10 of the bottom. Line out was estimated using a combination of a line counter on the winch and physical markings on the line. Once near bottom, the net was retrieved at a winch speed of 0.5 m/s. The procedure was repeated until the net had been towed for 15 minutes. Prior to bringing onboard, the outside of the nets were rinsed with a gentle saltwater spray. Flow meter numbers were recorded for both nets. Samples were sorted by hand into target groups of zooplankton and frozen at -80°C for later food web analysis. For the WP2 and Bongo net deployments, an RBR Duet temperature and depth sensor was attached to verify net deployment depth. If the net was not deployed as expected, the samples were discarded and the deployment was repeated.

From the zodiac, a single 0.5 m diameter, 250 µm mesh conical net (Aquatic Instruments) was towed obliquely for 3 minutes to target large, faster swimming plankton from the water column in the general area of the deepest nearshore site along each sampling transect. The net was weighted and equipped with an RBR Solo depth sensor to track tow depth and a flow meter (General Oceanics) to track filtration volume. The net was deployed by hand to within ~2 meters of the bottom (using a line of ~2 times the depth) and retrieved at 1-2 m/second at 1-2 knots speed-over-ground. This process was repeated for 3 minutes. A portable garden sprayer was used to rinse organisms down into the net codend. Samples were then removed and all (N=5 nearshore oblique tows; see Appendix B for site details) were preserved in 95% ethanol which was drained and replaced after 24 hours. These will be sorted and analysed by the Howland group, together with nearshore samples, for abundance and species composition at labs in Winnipeg (DFO) and/or the Atlantic Reference Center (St. Andrews).

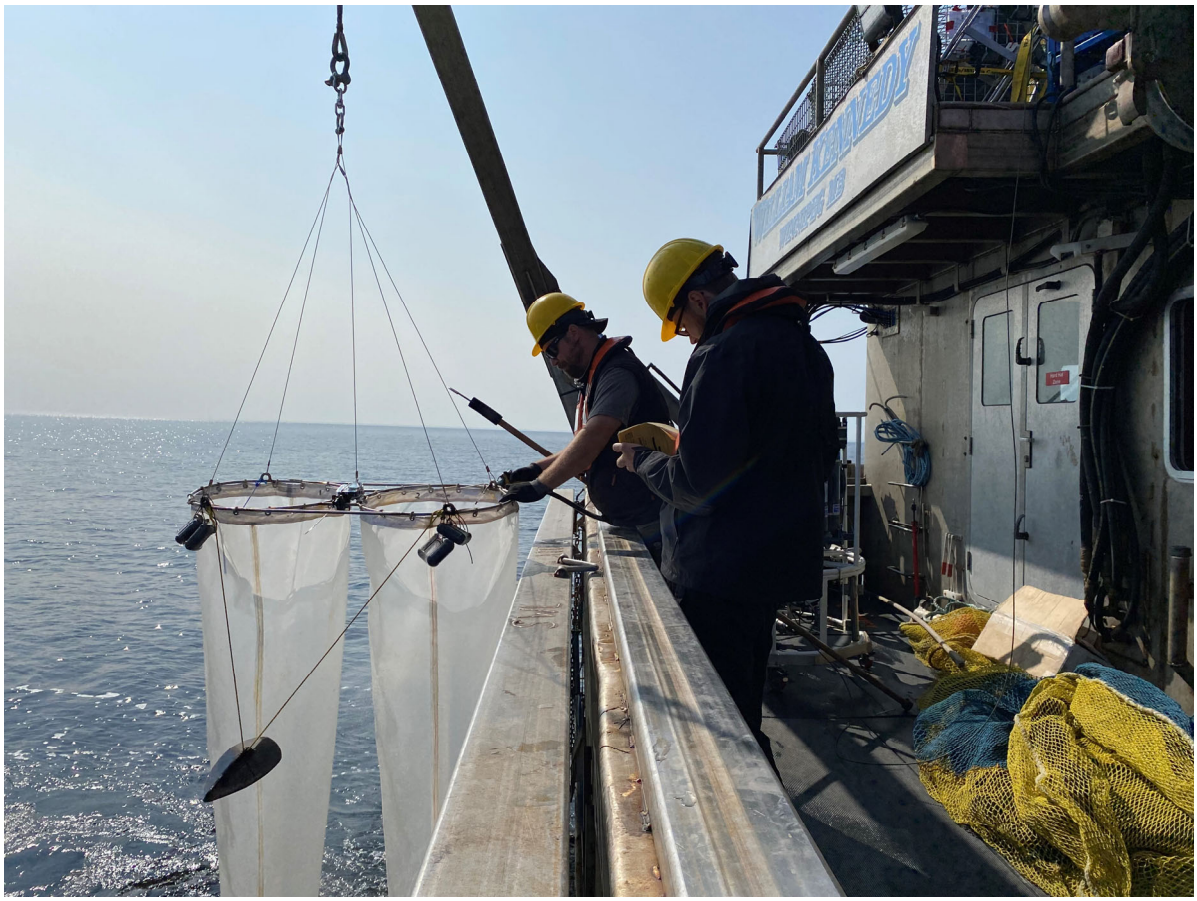

Figure 20. Readying the net for a zooplankton tow.

Benthic invertebrates and fish:
Epifauna:
Two types of trawls were deployed from the ship to assess fish and epifauna (benthic beam and benthic sled). A benthic beam trawl (Figures 21-23), the main trawl type used at most full stations, was lowered to the bottom and towed at ~2 knots for 15 minutes. The beam trawl was not properly assembled for the first three stations (4, 5, and 3). As a result, the trawl did not collect benthic samples, likely due to the net not actually dragging along the bottom, but rather floating several inches above. Station 3 was re-sampled with the beam trawl assembled for proper benthic sampling, however it was still noted that the deployment tended to mainly capture more mobile benthic species from the water column just above the bottom and may provide good representation of epifaunal invertebrates on, or attached to, the seafloor itself. The beam trawl is a proven method for capturing benthic epifauna, successful in many programs; the issues indicated here are not a function of the gear but rather the deployment.

To diversify the sampling approaches and attempt to obtain additional benthic fauna, for the last 3 stations (3 (during beam trawl re-sample visit), 8, 9) a smaller benthic sled was used in parallel with the beam trawl. The benthic sled, designed to target invertebrate epifauna, was made up of a rigid stainless steel rectangular frame (1 m × 0.5 m) with two 1.2 m long skids attached to the bottom. The mouth of a conical net (similar to the beam trawl) was connected to the rectangular frame (main

body 1.8 m long with a mesh size of 10 mm, the codend was 1.2 m long with a mesh size of 6 mm) and the codend tied prior to each deployment. A chain was attached at the bottom of the net mouth to help maintain contact with the bottom and weights (30 kg in total) were attached to the skids to ensure the frame sank in the correct orientation and remained on the seafloor during trawling. Time, depth and coordinates were collected at the beginning and end of each tow, along with warp length and towing speed. Similar to the beam trawl, the sled was towed for 15 minutes (after making contact with the seafloor), but at a slower speed of approximately 0.6-1 knots using a bridle and attached line with a warp length of 2-3 times the estimated depth. An RBR Solo data logger was attached to the sled frame to record depth throughout each tow.

Upon completing each trawl (benthic beam and benthic sled), the catch was placed in fish totes for sorting and documentation (Figure 23). A photograph was taken to document the volume of the catch and any types of macro algae (if present). Invertebrates and fish were separated in sorting trays (Figures 24, 25). All invertebrates were sorted by taxa, photographed and preserved. Larger hard-bodied organisms, and where possible, up to 10 individuals per species of other remaining taxa were frozen for future confirmation of identity, abundance, biomass and food web analyses (to be completed at labs in Winnipeg and Laval). Remaining smaller and soft-bodied organisms were preserved in 95% ethanol to retain shape and characteristics for identification and determination of abundance and biomass (to be completed at Winnipeg/Laval). Preservation of specimens by freezing and in ethanol will also allow for genetic barcoding as a possible means of confirming species identifications where there is uncertainty. To avoid damaging organisms attached to substrates (e.g., rocks, shells), individual specimens were often preserved with them. For all samples preserved in ethanol, the fluids were drained and replaced after 24 hours to ensure adequate preservation. Fish from the benthic trawl and sled were grouped by family and weighed, then the length of each fish was recorded before freezing. At DFO Winnipeg, the taxonomy of frozen samples will be verified as possible and tissue samples will be sub-sampled for foodweb analyses (stable isotopes and fatty acids).

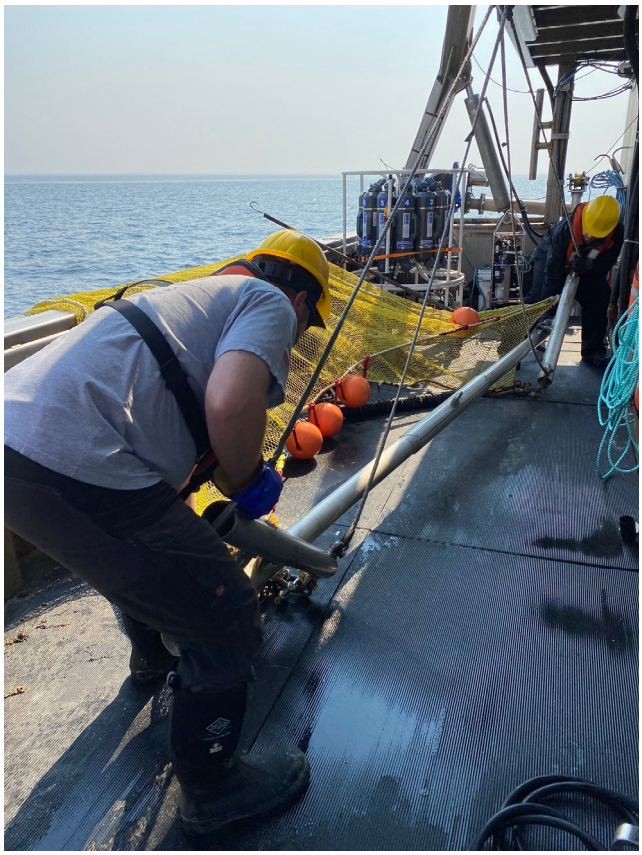

Figure 21. Benthic beam trawl being prepared for deployment.

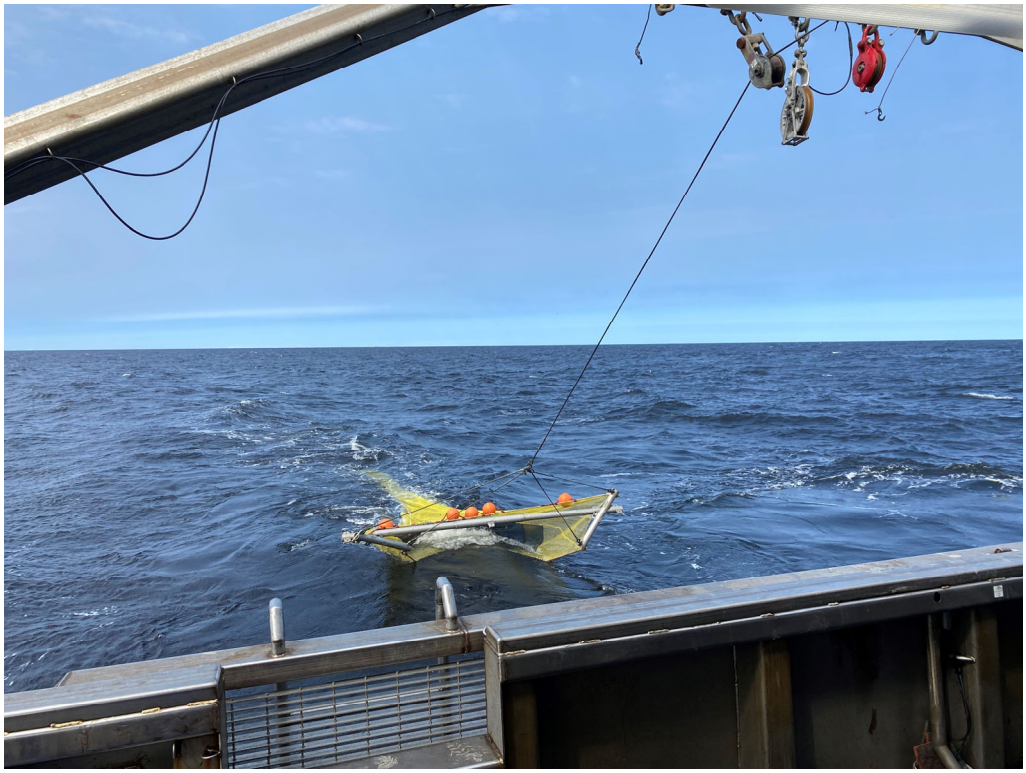

Figure 22. Benthic beam trawl being deployed over the stern.

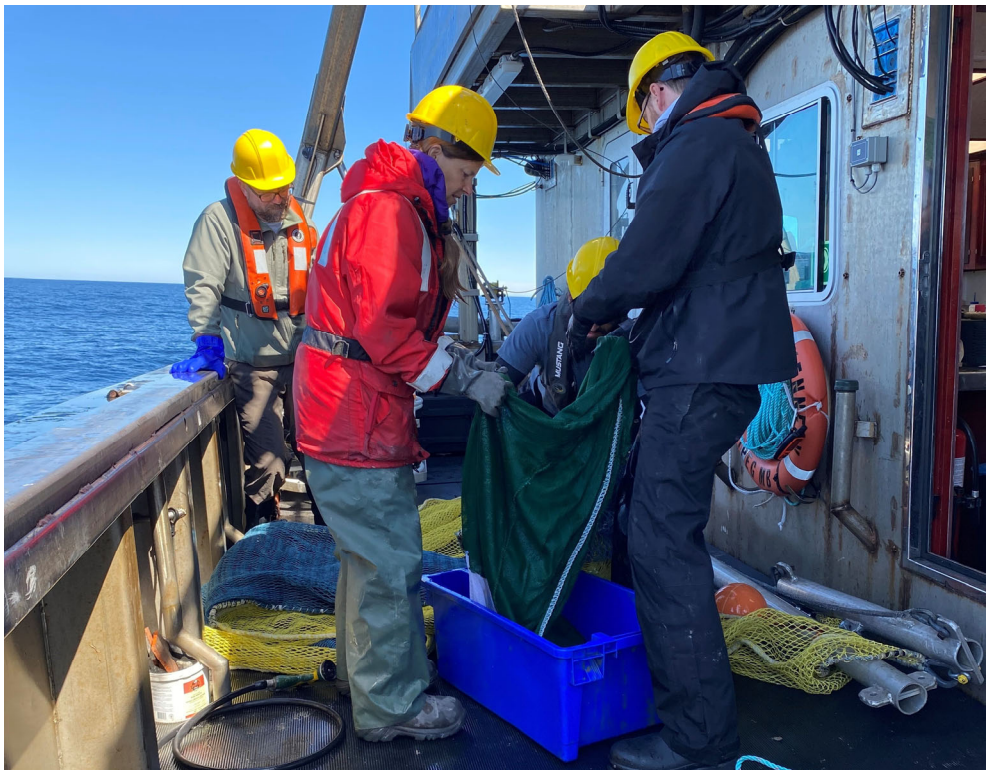

Figure 23. Rinsing out the catch from the benthic beam trawl.

Figure 24. The catch being sieved.

Figure 25. Sorting and documenting the catch from station 3.

Infauna:
Infaunal benthic invertebrates were extracted from sediments collected with a large Van Veen grab (OSIL 0.1m^2, ~12L capacity) and box corer (Gomex) deployed from the ship at all full sampling sites where suitable substrate (soft bottom) was available (1-2 replicate samples per gear type/station; see section 7 for sediment sampling details). Benthic infauna were also extracted from sediments collected with a petit Ponar grab (Wildco, 2.4L capacity) at suitable nearshore zodiac transect sites (1-2 replicate samples/transect site; see section 7 and Appendix B for details). Upon completing each grab, the sediment sample was placed in a fish tub and photographed to document the general type and volume of sediment (ship) or recorded in field notes (zodiac). Samples were then gently rinsed through stacked sieves (4 mm on on top of a 500 µm sieve) with a larger (4 mm) sieve on top to remove any rocks, larger debris and larger organisms, and a smaller (500 um) sieve on the bottom to retain remaining organisms (of >500 µm) while allowing most of the finer sediments to be rinsed through and removed from the sample. Similar to the epifauna, any larger hard-bodied organisms, and where possible, up to 10 individuals per species of other remaining taxa of reasonable size were frozen for future confirmation of identity, abundance, biomass and food web analyses (to be completed at labs in Winnipeg and Laval). All remaining organisms and any remaining sediment was rinsed into a sample jar and preserved with 95% ethanol for later identification and determinations of species density and biomass (to be completed at Winnipeg/Laval). Cases of partial samples or box core samples from which a smaller push core was taken (see section 3g for a list of the latter), will only be used to determine presence or absence since accurate estimates of density are not feasible.

Table 9. Ethanol preserved benthic invertebrate samples (see Appendix A and B for station details)

Station	Petit Ponar	Van Veen	Box Core	Beam Trawl	Benthic Sled
STN2 (ship)	-	1	1	1	not deployed
STN3 (ship)	-	1	2	2	1
STN4 (ship)	-	1	1	1	not deployed
STN5 (ship)	-	1	1	1	not deployed
STN6 (ship)	-	1	1	2	not deployed
STN7 (ship)	-	not deployed	1	1	not deployed
STN8 (ship)	-	2*	not deployed	frozen only	2**
STN9 (ship)	-	1	1	1	1
Z1A (zodiac)	1	-	-	-	-
Z1B (zodiac)	1	-	-	-	-
Z1C (zodiac)	1	-	-	-	-
Z1D (zodiac)	1	-	-	-	-
Z1E (zodiac)	1	-	-	-	-
Z2A (zodiac)	hard bottom	-	-	-	-
Z2B (zodiac)	1	-	-	-	-
Z2C (zodiac)	1	-	-	-	-
Z3A (zodiac)	hard bottom	-	-	-	-
Z3B (zodiac)	hard bottom				
Z3C (zodiac)	1				
Z4A (zodiac)	1	-	-	-	-
Z4B (zodiac)	1	-	-	-	-
Z4C (zodiac)	1	-	-	-	-
Z5A (zodiac)	1	-	-	-	-
Z5B (zodiac)	not deployed				
Z5C (zodiac)	1	-	-	-	-
Z6A (zodiac)	1	-	-	-	-
Z6B (zodiac)	1	-	-	-	-
Z6C (zodiac)	no sample kept	-	-	-	-
Z6D (zodiac)	not deployed	-	-	-	-

*replicate 1 – no mud; rocks with attached epifauna kept for presence absence only
**replicate 1 – only towed for 11 minutes

3g. Sediments

Cruise Participants: Alessia Guzzi, Zou Zou Kuzyk
Principal Investigators: Zou Zou Kuzyk, Audrey Limoges

Objectives:
There are few previous data concerning bottom sediments in James Bay. Studies were conducted in the Eastmain estuary prior to river diversion (d'Anglejan, 1982). Sediment cores were collected and analyzed in Hudson Bay including just outside the entrance to Hudson Bay (cf., Kuzyk et al. 2008). These first surface sediment samples and cores from James Bay will provide much needed data on sediment properties such as particle size distribution and organic carbon content. Profiles of radioisotopes will be assessed for the possibility of using them to constrain sedimentation rates. First surveys for possible proxies also will be conducted.

1. Characterize surface sediment properties across James Bay including particle size distribution, organic matter content and composition
2. Determine profiles of radioisotopes (210Pb, 137Cs) in sediment cores and where possible estimate modern sedimentation rates and burial rates of organic carbon
3. Quantify dinoflagellate cysts in relation to environmental properties to develop basis for applying these as paleo proxies in James Bay.

Methods and Data Collection:
The Van Veen grab (OSIL 0.1 m^2, ~12L) was deployed from the ship at each station, followed by the Gomex box corer, provided the bottom substrate was not rocky. The Gomex was not deployed if the grab sampler recovered only rocks (Table 10). At each station with soft sediment, a surface sample representing approximately the top 1 cm of the sediment was collected with a steel spatula, often by accessing the sediment through the top door flaps of the grab (Figure 26). Surface sediment samples were homogenized, subdivided, and placed in the fridge. A subsample of surface sediment was set aside in a fridge for Dr. Audrey Limoges to use for dinoflagellate cyst quantification.

If there was good recovery of sediment in the box corer, a push coring tube was inserted slowly, away from the edges, and pushed down until refusal. The box was then lifted off the push core tube, leaving the tube in place in the muddy sediment. A plug was inserted into the bottom of the tube, capturing a core of sediment inside the tube and overlying water (Figure 27). The tube containing the sediment (i.e., a 9 cm diameter core) was then carefully excavated by hand from the surrounding mud. It was capped and held securely in an upright position until we were ready to extrude the sediment. At that time, the core tube was placed on the extruder (stand). The cap was removed from the top and the overlying water was siphoned off the surface of the mud. Then the core was extruded and sectioned (Figure 28). The sectioning occurred at intervals of 1 cm for the upper 10 cm of the core and at intervals of 2 cm for the remainder of the core. Sediment core sections were placed in whirlpak bags and frozen at -20°C.

From the zodiac, a petit Ponar grab (OSIL 0.1 m^2, ~12L) was used to collect surface sediment samples near river mouths and in estuarine areas. Many nearshore sediments particularly in the area of the Eastmain River and La Grande River were coarse-grained (rock) and no samples were recovered in the grab sampler. In total, 24 surface sediments were obtained including 14 from the

zodiac sites (see *Appendix B* for locations). Five sediment cores (of various lengths) were obtained and sectioned with total lengths as follows (lengths in brackets): STN4 (26 cm), STN5 (24 cm), STN6 (42 cm), STN7/Moose River Anchorage (12 cm), and STN9 (26 cm) (Table 10).

Table 10. List of sediment samples collected from the grab sampler or surface of the box core

Station	ID	Date and Time (UTC)	Latitude [deg N]	Longitude [deg W]	Bottom depth (m)	Description	Sample type	Core length (cm)
STN4	BOX1	2021-08-04 18:21:00 PM	53.816	81.699	na	slumped, poor recovery	surface sample	
STN4	BOX2	2021-08-04 19:02:00 PM	53.812	81.702	38	okay	core	26
STN4	BOX3	2021-08-04 19:23:00 PM	53.815	81.703	37	okay but shorter	surface sample	
STN5	PON	2021-08-05 22:45:00 PM	53.805	79.790	71	full	surface sample	
STN5	BOX1	2021-08-05 22:54:00 PM	53.803	79.791	70	good	core	24
STN3	PON1	2021-08-06 14:30:00 PM	54.296	80.059	68	no recovery	none	
STN3	PON2	2021-08-06 14:53:00 PM	54.291	80.062	67	full	surface sample	
STN3	BOX1	2021-08-06 15:01:00 PM	54.290	80.063	67	poor recovery	surface sample	
STN3	BOX2	2021-08-06 15:13:00 PM	54.291	80.062	67	poor recovery	surface sample	
STN2	PON1	2021-08-07 14:32:00 PM	54.279	81.475	61	no recovery	none	
STN2	PON2	2021-08-07 14:49:00 PM	54.279	81.468	58	full	surface sample	
STN2	BOX1	2021-08-07 14:57:00 PM	54.279	81.466	60	no recovery	none	
STN2	BOX2	2021-08-07 15:18:00 PM	54.280	81.478	61	no recovery	none	
STN2	BOX3	2021-08-07 15:28:00 PM	54.280	81.475	60	no recovery	none	
STN6	PON1	2021-08-08 22:38:00 PM	52.242	79.699	62	no recovery	none	
STN6	PON2	2021-08-08 22:42:00 PM	52.244	79.700	62	okay	surface sample	
STN6	BC1	2021-08-08 22:50:00 PM	52.246	79.702	62	no recovery	none	
STN6	BC2	2021-08-08 22:53:00 PM	52.248	79.703	62	no recovery	none	
STN6	BC3	2021-08-08 23:02:00 PM	52.249	79.705	62	no recovery	none	
STN6	BC4	2021-08-08 23:17:00 PM	52.253	79.710	61	good	core	42

Station	ID	Date and Time (UTC)	Latitude [deg N]	Longitude [deg W]	Bottom depth (m)	Description	Sample type	Core length (cm)
STN7	BC1	2021 Aug 09 01:29	51.473	80.244	7	okay	core	12
STN8	PON1	2021-08-10 14:41:00 PM	52.361	80.626	18	rocks	none	
STN8	PON2	2021-08-10 14:45:00 PM	52.360	80.627	18	rocks	none	
STN9	PON1	2021-08-11 16:40:00 PM	52.305	78.893	44	full	surface sample	
STN9	BOX	2021-08-11 17:12:00 PM	52.305	78.893	44	good	core	26

Figure 26. Inspecting a sediment grab sample. (Photo credit: M. Durand)

Figure 27. Sediment core showing undisturbed surface and overlying water. (Photo credit: Z. Kuzyk)

Figure 28. Extruding and sectioning a sediment core. (Photo credit: M. Durand)

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Appendix A: Ship Log

Station	Code	No	Date	Time (UTC)			Location In		Location Out		Bot Depth	Notes
				Surf	Bot	Out	Lat (N)	Long (W)	Lat (N)	Long (W)	(m)	
STN1	ROS	1	2021-08-03	23:21	23:32	23:40	54.765	81.69333	54.775	81.69167	31.5	bottle 7 didn't close
	CTD	1	2021-08-04	4:52	4:57	4:59	54.27693	81.86253	54.2782	81.8629	33.5	
	CTD	2	2021-08-04	5:54	5:57	5:59	54.18753	81.83417	54.18837	81.83398	37.5	touched bottom, raised up
	CTD	3	2021-08-04	6:42	6:45	6:47	54.10853	81.80058	54.1043	81.80087	40.3	touched bottom, raised up (CTD time 23:42 Aug 23)
	CTD	4	2021-08-04	7:32	7:35	7:37	54.02473	81.7733	54.0248	81.77317	38	touched bottom, raised up
	CTD	5	2021-08-04	8:19	8:23	8:25	53.94427	81.74082			41.6	touched bottom, raised up
	CTD	6	2021-08-04	9:06	9:09	9:12	53.86358	81.70857			39.1	touched bottom, raised up
	CTD	7	2021-08-04	13:25	13:28	13:30	53.82267	81.71397	53.82423	81.68748	37.4	
STN4	ROS	2	2021-08-04	13:47	13:52	14:01	53.82833	81.685	53.83282	81.6828	38	
STN4	WP2-1		2021-08-04	14:30	14:33	14:35	53.841	81.67793	53.8424	81.67707	38.5	
STN4	WP2-2		2021-08-04	15:04	15:06	15:07	53.83232	81.68553	53.83322	81.68538	37.7	PAR cal const. did not include e+009 (magnitude was off byx10^9
STN4	ROS	3	2021-08-04	15:48	15:54	16:06	53.82373	81.68883	53.82863	81.688	38.6	PAR cal coef. Changed
STN4	BON-1		2021-08-04	16:24	16:29	16:39	53.82483	81.69022	53.81742	81.69288	36.8	
STN4	BON-2		2021-08-04	17:02	17:05	17:19	53.81822	81.69497	53.81015	81.70102	36.7	
STN4	VV		2021-08-04	18:12	18:13	18:15					37	
STN4	BOX1		2021-08-04	18:21	18:22	18:24	53.81583	81.69918	53.81593	81.69917		
STN4	BOX2		2021-08-04	19:02		19:08	53.81205	81.70175	53.8154	81.70198	37.6	
STN4	BOX3		2021-08-04	19:23	19:23	19:24	53.81483	81.70255	53.81473	81.70265	37.4	
STN4	BHT1		2021-08-04	20:13	20:16	20:38	53.81492	81.70515	53.8232	82.52618	37.6	forgot RBR

Station	Code	No	Date	Time (UTC)			Location In		Location Out		Bot Depth	Notes
				Surf	Bot	Out	Lat (N)	Long (W)	Lat (N)	Long (W)	(m)	
STN4	BHT2		2021-08-04	21:04	21:10	21:25	53.83053	81.785	53.84015	81.67345	39.3	180 m line out, 1.5 kn S06, lat out at off bottom
	bad CTD cast		2021-08-05									
	CTD	8	2021-08-05	0:20	0:22	0:23	53.82395	81.92278	53.82318	81.92287	15.4	
	CTD	9	2021-08-05	0:56	0:59	1:00	53.82535	81.82997	53.82415	81.83008	24.7	
	CTD	10	2021-08-05	2:37	2:40	2:42	53.82413	81.55257	53.82237	81.54917	30.4	
	CTD	11	2021-08-05	3:30	3:32	3:34	53.82345	81.41638	53.82293	81.4156	34.3	
	CTD	12	2021-08-05	4:20	4:23	4:26	53.82213	81.27648	53.82148	81.27815	31.6	
	CTD	13	2021-08-05	5:15	5:18	5:21	53.82035	81.13203	53.81973	81.13377	30.8	
	CTD	14	2021-08-05	6:17	6:20	6:23	53.81733	80.98442	53.81582	80.98612	39.7	
	CTD	15	2021-08-05	7:09	7:12	7:15	53.81448	80.85012	53.81337	80.76527	34.5	
	CTD	16	2021-08-05	8:03	8:06	8:08	53.81377	80.70913	53.81277	80.70978	20.6	
	CTD	17	2021-08-05	8:59	9:01	9:04	53.81358	80.56945	53.8117	80.56975	24.7	
	CTD	18	2021-08-05	9:51	9:55	9:57	53.81252	80.42852	53.81117	80.42888	32.5	
	CTD	19	2021-08-05	10:41	10:45	10:47	53.81117	80.28593	53.80997	80.28443	44.9	
	CTD	20	2021-08-05	11:29	11:33	11:35	53.81157	80.14225	53.81005	80.14147	53.8	
	CTD	21	2021-08-05	12:17	12:21	12:23	53.80873	80.0057	53.81535	80.00547	66.4	
	CTD	22	2021-08-05	13:05	13:08	13:10	53.80788	79.86565	53.80685	79.86547	31	
STN5	CTD	23	2021-08-05	13:39	13:41	13:44	53.807	79.77982	53.80613	79.78047	59.1	
	CTD	24	2021-08-05	14:08	14:11	14:13	53.80697	79.72555	53.80625	79.72572	58	
	CTD	25	2021-08-05	14:57	15:00	15:01	53.80895	79.5857	53.80785	79.58552	44	
	CTD	26	2021-08-05	15:44	15:46	15:48	53.81202	79.44753	53.81108	79.44697	31	
STN5	ROS	4	2021-08-05	18:35	18:42	19:00	53.80668	79.75787	53.80727	79.78287	62	
STN5	WP2-1		2021-08-05	19:13	19:18	19:22	53.80778	79.7854	53.8081	79.78598	62.6	
STN5	ROS	5	2021-08-05	19:48	20:00	20:12	53.80727	79.78165	53.8084	79.78428	60	
STN5	WP2-2	2	2021-08-05	20:31	20:33	20:35	53.80895	79.7854	53.80902	79.7856	65	
STN5	BON-1	1	2021-08-05	20:48		21:05	53.80792	79.7821	53.80432	79.76863	62	

Station	Code	No	Date	Time (UTC)			Location In		Location Out		Bot Depth	Notes
				Surf	Bot	Out	Lat (N)	Long (W)	Lat (N)	Long (W)	(m)	
STN5	BON-2	2	2021-08-05	21:39		21:54	53.80933	79.7866	53.8069	79.77697	62	didn't get to target depth, try again
STN5	BON-3	3	2021-08-05	22:22		22:36	53.80307	79.77517	53.80538	79.78802	65	
STN5	VV		2021-08-05	22:45	22:47	22:48	53.80463	79.79043	53.8042	79.79052	71	
STN5	BOX		2021-08-05	22:54	22:55	22:56	53.80345	79.79065	53.80307	79.79067	69.5	
STN5	BHT		2021-08-05	23:33	23:35	23:50	53.80418	79.77797	53.80705	79.76612	64.8	
	CTD	27	2021-08-06	3:28	3:30	3:32	53.88898	79.82703	53.88922	79.82812	60	
	CTD	28	2021-08-06	4:10	4:12	4:13	53.96747	79.87282	53.96775	79.8738	47	
	CTD	29	2021-08-06	4:51	4:54	4:58	54.04547	79.91998	54.04623	79.92302	67.6	
	CTD	30	2021-08-06	5:34	5:38	5:41	54.12155	79.95925	54.12183	79.96102	66.6	
	CTD	31	2021-08-06	6:25	6:28	6:31	54.20155	80.00883	54.20177	80.00953	57.4	
STN3	CTD	32	2021-08-06	7:19	7:23	7:28	54.29407	80.05795	54.29365	80.05785	65.5	
STN3	M3		2021-08-06				54.2944	80.05905	54.29438	80.05905	67.8	mooring deployment
STN3	ROS	6	2021-08-06	12:10	12:18	12:30	54.29737	80.05792	54.29155	80.05862	68	
STN3	WP2-1		2021-08-06	12:38	12:40	12:42	54.28988	80.0592	54.28893	80.0594	67	target depth 58 m
STN3	WP2-2		2021-08-06	12:57	12:59	13:01	54.29287	80.05845	54.29018	80.05878	66.5	target 60 m
STN3	ROS	7	2021-08-06	13:28	13:34	13:48	54.29315	80.058	54.28752	80.06088	66	
STN3	BON-1		2021-08-06	13:59	na	14:15	54.28993	80.05905	54.29898	80.05835	65.7	12 min, 67m, 1.4kn; 15 min, 59 m, 1.5 kn
STN3	VV-1		2021-08-06	14:30	14:35	14:36	54.29587	80.0587	54.29482	80.05958	67.5	didn't catch anything
STN3	VV-2		2021-08-06	14:53	14:55	14:56	54.29105	80.0618	54.29077	80.0619	67	
STN3	BOX-1		2021-08-06	15:01	15:02	15:05	54.2901	80.06257	54.28967	80.06303	67	not good for core, sfc sample only (bottom too hard)
STN3	BOX-2		2021-08-06	15:13	15:15	15:17	54.29117	80.06187	54.29057	80.06262	67	
STN3	BHT		2021-08-06	15:42	15:45	16:00	54.29088	80.05317	54.293	80.0394	63	***out location for BHT is always off bottom
	CTD	33	2021-08-06	17:48	17:50	17:52	54.29278	79.87002	54.29185	79.87127	49	
	CTD	34	2021-08-06	19:05	19:08	19:10	54.29395	80.01375	54.29352	80.01422	55.9	
	CTD	35	2021-08-06	19:53	19:56	19:58	54.29218	80.15542	54.29315	80.15592	48	

Station	Code	No	Date	Time (UTC)			Location In		Location Out		Bot Depth	Notes
				Surf	Bot	Out	Lat (N)	Long (W)	Lat (N)	Long (W)	(m)	
	CTD	36	2021-08-06	20:40	20:45	20:48	54.29233	80.29613	54.29117	80.29742	62	
	CTD	37	2021-08-06	21:30	21:34	21:36	54.28952	80.43833	54.2881	80.43883	49	
	CTD	38	2021-08-06	22:23	22:26	22:27	54.28693	80.5916	54.28563	80.592	52	
	CTD	39	2021-08-06	23:08	23:10	23:12	54.28603	80.72903	54.28533	80.729	50	
	CTD	40	2021-08-06	23:51	23:54	23:55	54.28612	80.8607	54.28648	80.86115	46	
	CTD	41	2021-08-07	0:37	0:40	0:40	54.2843	81.00413	54.28412	81.0039	28	
	CTD	42	2021-08-07	1:29	1:32	1:33	54.28115	81.14602	54.2805	81.14558	44	
	CTD	43	2021-08-07	2:19	2:22	2:23	54.28122	81.28882	54.28123	81.28767	51.5	
	CTD	44	2021-08-07	3:26	3:30	na	54.27732	81.4843			59	
STN2	M2		2021-08-07	3:53	na	na	54.27705	81.47915			60.2	Mooring Deployment
	CTD	45	2021-08-07	4:30	4:33	4:36	54.27408	81.57645	54.2739	81.57572	54.3	
	CTD	46	2021-08-07	5:18	5:21	5:23	54.27188	81.71722	54.27173	81.71705	42.9	
	CTD	47	2021-08-07	6:05	6:09	6:10	54.2736	81.86353	54.27347	81.86352	32	
	CTD	48	2021-08-07	6:55	6:57	6:59	54.27062	82.01917	54.27018	82.0191	17.4	
STN2	ROS	8	2021-08-07	11:52	11:58	12:12	54.27875	81.47822	54.27035	81.47548	62	
	WP2-1		2021-08-07	12:19	12:20	12:22	54.26935	81.47503	54.26852	81.47468	61.5	
	WP2-2		2021-08-07	12:32	12:34	12:35	54.26685	81.4715	54.2661	81.47107	59.3	
	ROS	9	2021-08-07								57.8	
STN2	CTD	49	2021-08-07	13:11	13:14	13:16	54.25658	81.46277	54.2556	81.46152	57.4	
STN2	BON		2021-08-07	13:32	13:34	13:49	54.25483	81.4558	54.26112	81.46008	57.8	0.6 kn SOG, rows 97-101 are same BON cast with OUT location being bottom
STN2	VV-1		2021-08-07	14:32	14:33	14:35	54.27938	81.47488	54.27943	81.51808	60.7	no mud
STN2	VV-2		2021-08-07	14:49	14:51	14:51			54.27862	81.46753	57.5	
STN2	BOX-1		2021-08-07	14:57	14:58	14:59	54.27853			81.46628	60	no mud, try again
STN2	BOX-2		2021-08-07	15:18	15:19	15:20	54.27925	81.47777	54.27953	81.47717	61.2	no mud, try again
STN2	BOX-3		2021-08-07	15:28	15:29	15:31	54.27955	81.47503	54.27952	81.47443	60.3	no mud, no core

Station	Code	No	Date	Time (UTC)			Location In		Location Out		Bot Depth	Notes
				Surf	Bot	Out	Lat (N)	Long (W)	Lat (N)	Long (W)	(m)	
STN2	ROV1		2021-08-07	15:34			54.27942	81.47345			60	SOG=1.4-1.8
STN2	BHT		2021-08-07	16:16	16:20	16:36	54.27777	81.45595	54.27702	81.44065	57	tried with new chain set-up; 57,57.8,55.6
	CTD	50	2021-08-07	19:03	19:06	19:07	54.22045	81.03355	54.20663	80.9872	24	
	CTD	51	2021-08-07	19:50	19:53	19:54	54.12887	80.93142	54.1289	80.93138	22.5	
	CTD	52	2021-08-07	20:35	20:38	20:39	54.05043	80.87965	54.05023	80.88028	22	
	CTD	53	2021-08-07	21:41	21:45	21:46	53.97307	80.82438	53.97333	80.82583	20	
	CTD	54	2021-08-07	22:28	22:30	22:32	53.89592	80.77487	53.89627	80.77607	18.6	
	CTD	55	2021-08-07	23:21	23:24	23:25	53.81302	80.71243	53.81355	80.71373	20.6	
	CTD	56	2021-08-08	0:06	0:09	0:09	53.74453	80.67	53.74445	80.67032	20.2	
	ROV2		2021-08-08			0:29			53.74637	80.66887	20	ROV of bottom
	CTD	57	2021-08-08	1:08	1:11	1:13	53.66822	80.62088	53.66778	80.62193	26	
	CTD	58	2021-08-08	1:57	2:02	2:03	53.58252	80.55993	53.58263	80.55942	37.9	
	CTD	59	2021-08-08	2:39	2:42	2:43	53.51243	80.5151	53.5125	80.51467	37.3	
M4	CTD	60	2021-08-08	3:23	3:26	3:28	53.42852	80.46008	53.42722	80.46017	50.5	at M4 location
	M4		2021-08-08	3:35			53.42612	80.4601			49.8	M4 mooring deployment
	CTD	61	2021-08-08	4:14	4:18	4:21	53.35323	80.40788	53.35208	80.4075	48.6	
	CTD	62	2021-08-08	4:59	5:02	5:04	53.27413	80.35917	53.27338	80.35842	39	
	CTD	63	2021-08-08	5:43	5:48	5:49	53.19725	80.30607	53.19703	80.30585	49.3	
	CTD	64	2021-08-08	6:32	6:35	6:37	53.11863	80.25687	53.11883	80.25725	44.7	
	CTD	65	2021-08-08	7:22	7:28	7:31	53.04078	80.20422	53.04295	80.20478	52.2	small fish at sfc
	CTD	66	2021-08-08	8:23	8:28	8:30	52.96333	80.15287	52.96752	80.15295	58.8	strong current, small fish again
	CTD	67	2021-08-08	9:29	9:33	9:37	52.885	80.10188	52.88682	80.10346	60.7	yellow colour becoming stronger
	CTD	68	2021-08-08	10:30	10:33	10:35	52.80742	80.05395	52.80925	80.0564	65	
	CTD	69	2021-08-08	11:24	11:28	11:30	52.73223	80.00112	52.7339	80.0025	61.8	clear, sunny, light wind
	CTD	70	2021-08-08	12:19	12:23	12:24	52.65487	79.95305	52.65537	79.95363	58.7	no waves
	CTD	71	2021-08-08	13:10	13:15	13:17	52.57473	79.89538	52.57475	79.89545	58.7	water colour brown

Station	Code	No	Date	Time (UTC)			Location In		Location Out		Bot Depth	Notes
				Surf	Bot	Out	Lat (N)	Long (W)	Lat (N)	Long (W)	(m)	
	CTD	72	2021-08-08	14:01	14:04	14:06	52.4954	79.8462	52.49547	79.84623	61.2	dark+air, good PAR profile
	CTD	73	2021-08-08	14:47	14:50	14:52	52.4214	79.79155	52.42175	79.79165	61.4	secchi 3.5 m (done just after by Jens)
	CTD	74	2021-08-08	15:36		15:55	52.34237	79.74858	52.34188	79.74977	62	left on from last CTD, slick seen, download data
	M5-2		2021-08-08	17:17			52.23845	79.69355			61.9	ADCP mooring deployment
STN6	CTD	75	2021-08-08	18:17	18:23	18:25	52.2402	79.69438	52.23955	79.69445	62.3	
STN6	ROS	10	2021-08-08	18:37	18:44	18:57	52.23795	79.69307	52.23497	79.69357	62	
STN6	WP2		2021-08-08	19:07			52.23368	79.694			62	bad cast, had to turn boat 180 degrees
STN6	WP2-1		2021-08-08	19:14	19:16	19:18	52.23358	79.69382	52.23298	79.69382	61	
STN6	WP2-2		2021-08-08			19:32			52.2371	79.69037	62	out location recorded late
STN6	BON-1		2021-08-08	19:58		20:14	52.24227	79.69153	52.25443	79.69527	63.7	depth sensior not attached
STN6	ROS11		2021-08-08	20:38	20:45	20:59	52.23888	79.6954	52.23933	79.69747	61.8	
STN6	BON-2		2021-08-08	21:12		21:28	52.23447	79.68965	52.22517	79.67583	61.6	didn't get to target depth, try again
STN6	BON-3		2021-08-08	21:38		21:56	52.2302	79.68142	52.23875	79.70042	61.4	reached 61 m!
STN6	VV-1		2021-08-08	22:38	22:39	22:40	52.24233	79.69933	52.24292	79.69957	61.8	no mud
STN6	VV-2		2021-08-08	22:42	22:43	22:44	52.24353	79.69998	52.24405	79.70042	61.8	mud!
STN6	BOX-1		2021-08-08	22:50	22:51	22:53	52.24578	79.70187	52.24625	79.70239	61.8	fell over, did not trip - hard bottom?
STN6	BOX-2		2021-08-08	22:53	22:54	22:56	52.24667	79.7027	52.24685	79.7029	61.8	"
STN6	BOX-3		2021-08-08	23:02	23:03	23:04	52.24915	79.70493	52.24977	79.70548	61.6	"
STN6	BOX-4		2021-08-08	23:17	23:18	23:19	52.25348	79.70973	52.25397	79.71047	61.4	
STN6	BHT-1		2021-08-08	23:56	23:59	0:15	52.26155	79.6851	52.26412	79.67293	61.4	200 m line out, clay bottom, z=61.4-66.6, speed = 1.8-2.0 knts
STN6	M5-1		2021-08-09	2:05			52.27193	79.70132			63.2	main M5 mooring deployment
STN6	BHT-2		2021-08-09	2:22	2:25	2:40	52.26808	79.6851	52.26253	79.7316	61.6	time,speed,z; 3min,2.1,60.9;6min,2.0,60.5;9min ,1.9,na;12min,1.6,na; 15min,1.6,59.2/ on bottom

Station	Code	No	Date	Time (UTC)			Location In		Location Out		Bot Depth	Notes
				Surf	Bot	Out	Lat (N)	Long (W)	Lat (N)	Long (W)	(m)	
												location was 52°15.989'N,79°43.092'W
	CTD	76	2021-08-09	3:45	3:48	3:49	52.19805	79.77822	52.19865	79.7787	46.6	
	CTD	77	2021-08-09	4:31	4:34	4:36	52.1188	79.8271	52.11837	79.82702	33.5	
	CTD	78	2021-08-09	5:15	5:17	5:19	52.04403	79.87083	52.04328	79.8891	20.5	
	CTD	79	2021-08-09	5:55	5:59	6:01	51.96788	79.94247	51.96688	79.94463	23.5	
	CTD	80	2021-08-09	6:45	6:48	6:50	51.88948	79.98923	51.88973	79.98915	24.7	
	CTD	81	2021-08-09	7:32	7:35	7:37	51.81317	80.04383	51.81323	79.04382	28	
	CTD	82	2021-08-09	8:19	8:23	8:25	51.73607	80.09668	51.73675	80.09663	13	
	CTD	83	2021-08-09	9:09	9:13	9:15	51.66013	80.14877	51.66175	80.13357	16	
	CTD	84	2021-08-09	10:02	10:05	10:06	51.58097	80.19767	51.5822	80.19885	12.4	turbid, touched bottom
	CTD	85	2021-08-09	10:53	10:56	10:57	51.5013	80.23243	51.50253	80.23358	7.9	
STN7	CTD	86	2021-08-09	11:18	11:22	11:23	51.47015	80.24332	51.47147	80.24373	5.9	anchorage site, touched bottom on purpose
STN7	WP2-1		2021-08-10	1:03	1:03	1:04	51.4732	80.24423	51.47323	80.24418	6.4	at anchor
STN7	BON		2021-08-10	1:16			51.47323	80.24422	51	80	6.4	no currect to take out net; bad cast
STN7	BOX		2021-08-10	1:29	1:30	1:30	51.47303	80.244	51.47303	80.24402	7	small recovery
STN7	BHT		2021-08-10	2:26	2:27	2:41	51.49572	80.23363	51.50478	80.23135	7.6	
	CTD	87	2021-08-10	3:42	3:45	3:46	51.58332	80.2033	51.5828	80.2051	12.6	
	CTD	88	2021-08-10	4:31	4:33	4:34	51.66052	80.23782	51.65928	80.23938	16.7	
	CTD	89	2021-08-10	5:24	5:27	5:29	51.73948	80.2791	51.73768	80.27137	19	
	CTD	90	2021-08-10	6:18	6:21	6:23	51.81852	80.32297	51.81742	80.32337	19.6	
	CTD	91	2021-08-10	7:09	7:12	7:14	51.89735	80.36672	51.89667	80.36775	20.6	
	CTD	92	2021-08-10	7:57	8:00	8:01	51.976	80.40997	51.97552	80.41053	19.9	
	CTD	93	2021-08-10	8:43	8:45	8:46	52.05622	80.45273	52.05625	80.45345	16	
	CTD	94	2021-08-10	9:27	9:30	9:32	52.13408	80.49395	52.13385	80.4934	13.2	
	CTD	95	2021-08-10	10:12			52.21823	80.53875	52.21903	80.5385	18.1	
	CTD	96	2021-08-10	10:54	10:57	10:58	52.29992	80.58165	52.30053	80.57985	19	

Station	Code	No	Date	Time (UTC)			Location In		Location Out		Bot Depth	Notes
				Surf	Bot	Out	Lat (N)	Long (W)	Lat (N)	Long (W)	(m)	
STN8	CTD	97	2021-08-10	11:35	11:39	11:41	52.36838	80.61285	52.36893	80.60925	18.1	
STN8	CTD	98	2021-08-10	12:37	12:40	12:41	52.35838	80.63078	52.35667	80.628	17.8	
STN8	ROS	12	2021-08-10	12:52	13:03	13:11	52.35697	80.62115	52.35627	80.61285	18	
STN8	WP2-1		2021-08-10	13:34			52.35227	80.59997			18.1	
STN8	WP2-2		2021-08-10	13:44	13:45	13:46	52.35047	80.59583	52.3506	80.59525	17.8	
STN8	BON-1		2021-08-10	13:55		14:10	52.35017	80.59385			17	aborted - just testing depth
STN8	BON-2		2021-08-10	14:12		14:27	52.35565	80.60633	52.36032	80.62032	18.2	
STN8	VV-1		2021-08-10	14:41			52.36075	80.62638			17.9	failed, small rocks+water, sample kept for small fauna attached to rocks
STN8	VV-2		2021-08-10	14:45	14:46	14:46	52.35967	80.62698	52.35938	80.62713	18.1	
STN8	BHT		2021-08-10	15:05	15:07	15:22	52.35833	80.61753	52.35843	80.60418	18.5	SOG approx. 1.6 kn
STN8	BS-1		2021-08-10	16:32			52.35017	80.60812	52.35063	80.60722	18.9	was on bottom for 4 min, but ship was still, 0.6 knt Sog
STN8	BS-2		2021-08-10	17:17	17:19	17:36	52.35195	80.59438	52.3524	80.58945	19.2	added weight to sled, 50 m line put out
	CTD	99	2021-08-10	18:21	18:25	18:26	52.36097	80.53127	52.36057	80.53245	19	
	CTD	100	2021-08-10	19:19	19:22	19:24	52.36512	80.3907	52.3609	80.39128	17.8	CTD#100 !!
	CTD	101	2021-08-10	20:08	20:12	20:12	52.3683	80.25577	52.36792	80.25752	12.4	plus-minus 1 m depth variations
	CTD	102	2021-08-10	20:59	21:02	21:04	52.37163	80.11932	52.37138	80.12033	34.5	
	CTD	103	2021-08-10	21:48	21:52	21:54	52.37435	79.9836	52.37692	79.98372	49.3	
	CTD	104	2021-08-10	22:35	22:39	22:40	52.3748	79.84587	52.37603	79.84447	63.2	touched bottom
	CTD	105	2021-08-10	23:20	23:21	23:25	52.37935	79.70998	52.3809	79.71005	49.8	touched bottom
	CTD	106	2021-08-11	0:06	0:11	0:12	52.39365	79.57678	52.395	79.57752	77.9	c-star dark, deep hole
	CTD	135	2021-08-11	0:48	0:53	0:55	52.41487	79.48937	52.41585	79.49088	85	c-star dark, deep hole
	CTD	107	2021-08-11	1:13	1:20	1:22	52.42478	79.45247	52.42565	79.45495	78	
	CTD	108	2021-08-11	2:04	2:07	2:08	52.42332	79.319	52.4249	79.31915	77.5	
	CTD	109	2021-08-11	2:54	2:58	2:59	52.41097	79.18218	52.4116	79.18318	57.7	
	CTD	110	2021-08-11	3:44	3:49	3:51	52.38482	79.05087	52.38638	79.05097	50.1	

Station	Code	No	Date	Time (UTC)			Location In		Location Out		Bot Depth	Notes
				Surf	Bot	Out	Lat (N)	Long (W)	Lat (N)	Long (W)	(m)	
	CTD	111	2021-08-11	4:35	4:39	4:41	52.33543	78.9413	52.33602	78.94072	55	
STN9	CTD	112	2021-08-11	5:02	5:06	5:11	52.30372	78.89062			38.2	
STN9	CTD	113	2021-08-11	9:51	9:54	9:56	52.3048	78.89337	52.30478	78.89338	45	hit bottom, (CTD#140 in SBE 19Plus)
STN9	ROS	13	2021-08-11	15:10		15:35	52.30478	78.89327			43.6	
STN9	WP2-1		2021-08-11	16:19	16:21	16:24	52.30473	78.8931			43.6	
STN9	WP2-2		2021-08-11	16:29	16:31	16:33	52.30477	78.8931			43.7	
STN9	VV		2021-08-11	16:40	16:41	16:42	52.30477	78.89305			43.7	
STN9	BOX		2021-08-11	17:12	17:13	17:14	52.3047	78.89302			43.7	
STN9	BON		2021-08-11	18:28	18:29	18:45	52.30533	78.89362	52.3112	78.90498	38.6	2.9 SOG
STN9	BHT		2021-08-11	19:11	19:16	19:31	52.3091	78.90132	52.31402	78.90943	37.7	2.1 SOG, 160 m warp out, 3 min 47.7 m, 1.6 SOG
STN9	BS		2021-08-11	19:56	20:04	20:19	52.31527	78.91287	52.32213	78.92192	51.6	3.1SOG, 160 m warp, (up to 9 min)+180 for last 6 min
	CTD	114	2021-08-11	22:58	23:03	23:05	52.43072	79.40852	52.43298	79.41613	78.5	3 m secchi depth
	CTD	115	2021-08-11	23:42	23:46	23:47	52.51305	79.40497	52.51538	79.40428	57.4	
	CTD	116	2021-08-12	0:20	0:27	0:28	52.59745	79.40783	52.6014	79.40602	44.6	
	CTD	117	2021-08-12	0:59	1:03	1:05	52.67928	79.39668	52.6824	79.39698	59.1	
	CTD	118	2021-08-12	1:39	1:43	1:44	52.76005	79.38145	52.76332	79.38148	58.4	a lot of shoals just before
	CTD	119	2021-08-12	2:15	2:19	2:22	52.83945	79.38392	52.84248	79.38402	77	
	CTD	120	2021-08-12	2:58	3:02	3:04	52.92995	79.38815	52.93193	79.3868	65.3	
	CTD	121	2021-08-12	3:42	3:46	3:47	53.01103	79.40587	53.01148	79.4041	48.8	
	CTD	122	2021-08-12	4:28	4:32	4:34	53.09422	79.41817	53.09392	79.41758	46.4	
	CTD	123	2021-08-12	5:25	5:29	5:31	53.17268	79.37775	53.17223	79.37767	40.1	
	CTD	124	2021-08-12	6:18	6:22	6:24	53.25603	79.38612	53.25588	79.38515	37.9	
	CTD	125	2021-08-12	7:09	7:13	7:15	53.31628	79.48392	53.31537	79.48388	30.3	
	CTD	126	2021-08-12	8:00	8:04	8:07	53.40432	79.4984	53.40613	79.4993	45.3	
	CTD	127	2021-08-12	8:47	8:51	8:54	53.49257	79.51263	53.49498	79.51495	59	c-star dark

Station	Code	No	Date	Time (UTC)			Location In		Location Out		Bot Depth	Notes
				Surf	Bot	Out	Lat (N)	Long (W)	Lat (N)	Long (W)	(m)	
	CTD	128	2021-08-12	9:29	9:32	9:34	53.574	79.52502	53.57628	79.52607	43.9	
	CTD	129	2021-08-12	10:11	10:14	10:16	53.65728	79.54375	53.65982	79.54528	50.5	
	CTD	130	2021-08-12	10:54	10:58	10:59	53.7431	79.55518	53.74517	79.5556	40.4	
	CTD	131	2021-08-12	11:50	11:51	11:52	53.80927	79.44653	53.81162	79.445	31.5	same as CTD26
	CTD	132	2021-08-12	12:37	12:40		53.80673	79.58798	53.80883	79.58953	44	same as CTD25
	CTD	133	2021-08-12	13:22	13:27	13:28	53.80543	79.72782	53.80707	79.7277	59.4	same as CTD24
STN3	CTD	134	2021-08-12	13:45	13:49	13:51	53.80538	79.78557	53.80743	79.78635	61	same as CTD23, STN3, 3.5 secchi
STN3	BHT		2021-08-12	14:04	14:10	14:25	53.80427	79.80592	53.80227	79.82262	68.2	
STN3	BS		2021-08-12	15:03	15:06	15:18	53.80342	79.8195	53.80588	79.81735	47	130 m warp, 0.8 knts
	CMOA		2021-08-16	23:54			59.97815	91.940033			107	mooring deployed
	CTD	136	2021-08-17	0:06	0:09	0:12	59.97993	91.94022	59.9811	91.940133 33	102	CTD cast at CMO-A deployment site
	CMOB		2021-08-25	23:37			61.7613	84.30152			180	mooring deployed
	CTD	137	2021-08-25	23:40	23:48	23:50	61.761266	84.29813	61.7612	84.2935	175	CTD cast at CMO-B deployment site (cast done after deployment)

NOTES: CTD = conductivity temperature and depth sonde, BS = bottom sled trawl, BHT = beam trawl, WP2 = vertical zooplankton net, VV = Van Veen Sediment Grab, BOX = box corer, CMO-A and CMO-B = CMO moorings deployed in Hudson Bay.

Appendix B: Zodiac Log

Date	Station	Associated Ship Stn.	Time (EST)	Longitude	Latitude	Bottom Depth (m)	COLLECTED						
							CTD Type	Bulk Water Sample Depths (m)	Gases Water Samples	ROV	Petite ponar grab Sediments/Benthos	eDNA (surface, bottom)	Plankton Nets (80µm, 250 µm)
21-08-04	Z1-A	STN4	10:33	-82.0471	53.8164	3.53	CA	0	**X**	**X**	**X/X**	**X**[1]	
21-08-04	Z1-B	STN4	12:03	-82.0009	53.8226	9.01	CA	0	**X**	**X**	**X/X**	**X**[1]	
21-08-04	Z1-C	STN4	13:45	-81.9583	53.8246	13.92	CA	0, 13	**X**	**X**	**/X**	**X**[1]	
21-08-04	Z1-D	STN4	15:55	-81.9103	53.8232	18.45	CA	na		**X**	**X/X**	**X**[1]	
21-08-04	Z1-E	STN4	17:15	-81.8552	53.8228	23.63	CA	na		**X**	**/X**	**X**[1]	**X**
21-08-05	Z2-A	STN5	14:08	-79.2257	53.7215	7.00	CA, RBR	0, 6	**X**	**X**	**Hard bottom**	**X**	
21-08-05	Z2-B	STN5	15:37	-79.2322	53.7235	20.75	CA, RBR	0, 18	**X**	**X**	**/X**	**X**	
21-08-05	Z2-C	STN5	19:19	-79.4476	53.8023	26.42	CA, RBR	0	**X**	**X**	**X/X**	**X**	**X**
21-08-06	Z3-A	STN3	08:54	-79.5559	54.2093	7.35	CA, RBR	0	**X**	**X**	**Hard bottom**	**X**	
21-08-06	Z3-B	STN3	10:39	-79.5603	54.2071	10.92	CA	na		**X**	**Hard bottom**	**X**	
21-08-06	Z3-C	STN3	11:11	-79.6257	54.2294	20.8	CA, RBR	0, 18	**X (only 0m)**	**X**	**X/X**	**X**	**X**
21-08-08	Z4-A	STN6	14:30	-79.5617	52.233	9.52	CA, RBR	0	**X**	**X**	**X/X**	**X**	
21-08-08	Z4-B	STN6	16:10	-79.5866	52.2328	20.78	CA, RBR	0	**X**	**X**	**X/X**	**X**	
21-08-08	Z4-C	STN6	17:48	-79.546	52.2587	32.38	CA, RBR	0, 30	**X**	**X**	**X/X**	**X**	**X**
21-08-09	Z5-A	STN7	10:45	-80.3728	51.5367	4.8	RBR	0	**X**	**X**	**X/X**	**X**[1]	
21-08-09	Z5-B	STN7	12:15	-80.3237	51.5092	6.3	RBR	na		**X**	**No sample taken**	**X**	
21-08-09	Z5-C	STN7	17:59	-80.169	51.5041	12.76	CA, RBR	0, 10	**X**		**X/X**	**X**	
21-08-11	Z6-A	STN9	07:17	-78.77223	52.39312	22.6	CA, RBR	0, 20	**X**	**X**	**X/X**	**X**	**X**
21-08-11	Z6-B	STN9	09:27	-78.6091	52.35715	4.8	RBR	0	**X**	**X**	**X/X**	**X**[1]	
21-08-11	Z6-C	STN9	11:02	-78.61657	52.29252	6.1	RBR	0	**X**	**X**	**X/**	**X**[1]	
21-08-11	Z6-D	STN9	12:13	-78.71373	52.29797	13.1	RBR	0, 12	**X**			**X**	
21-08-09	MR1	STN7	10:20	-80.2548	51.4669	7.1	CA, SB	0	**X**				
21-08-09	MR2	STN7	11:10	-80.2653	51.4608	6.29	CA, SB	0	**X**				
21-08-09	MR3	STN7	12:00	-80.2845	51.449	5.19	CA, SB	0	**X**				
21-08-09	MR-CTD-12miles	STN7	12:40	-80.2943	51.4431	4.79	CA, SB	na					
21-08-09	MR4	STN7	14:32	-80.3817	51.3767	6.21	CA, SB	0	**X**				
21-08-09	MR5	STN7	15:25	-80.4701	51.3246	5.96	CA, SB	0	**X**				
21-08-09	MR-CTD-11.5	STN7	12:56	-80.3042	51.4375	3.81	CA, SB	na					
21-08-11	EM1	STN9	08:19	-78.5659	52.2494	0.73	CA, SB	0	**X**				
21-08-11	EM2	STN9	08:57	-78.5807	52.248	1.23	CA, SB	0	**X**				
21-08-11	EM3	STN9	09:27	-78.5937	52.2478	1.7	CA, SB	0	**X**				
21-08-11	EM4	STN9	10:21	-78.6058	52.2456	2.75	CA, SB	0	**X**				
21-08-11	EM5	STN9		-78.6201	52.2462	4.55	CA, SB	0	**X**				
21-08-11	EM6	STN9	11:39	-78.7785	52.28	16.71	CA, SB	0	**X**				
21-08-11	CTD-EM-1	STN9	11:00	-78.6744	52.2553	8.96	CA, SB	na					
21-08-11	CTD-EM-2	STN9	11:15	-78.7268	52.2663	14.06	CA, SB	na					
21-08-11	CTD-EM-3	STN9	12:06	-78.829	52.2922	23.34	CA, SB	na					

NOTES: CTD Type indicates which type of CTD was used at each site. Where CA = Castaway, RBR = RBR, and SB = Seabird 19plus, [1]Surface sample only, **X** Indicates when a sample was collected or an activity was conducted

Appendix C: Primary Production Sampling Log

STN	Type [1]	Date (yy-mm-dd)	Time (EST)	Cast	Bot Depth (m)	Depth (m)	Latitude (N)	Longitude (W)	Nut	Flow Cytometry	Chl *a*	POC/N/S	Lugol Tax	PP	HPLC	ROV	TSS	AP
FT 1	FT	01-Aug-21	13:00	N/A	67.0	2	58°31.000	92°03.000	Y	Y	Y	N	Y	Y	Y	N	N	N
FT 2	FT	01-Aug-21	16:00	N/A	64.0	2	58°18.530	91°31.280	Y	Y	Y	Y	N	N	N	N	Y	N
FT 3	FT	01-Aug-21	19:00	N/A	N/A	2	58°05.568	90°56.743	Y	Y	Y	Y	N	N	N	N	Y	Y
FT 4	FT	01-Aug-21	22:00	N/A	48.0	2	57°51.350	90°19.324	Y	Y	Y	Y	N	N	N	N	Y	N
FT 5	FT	02-Aug-21	07:00	N/A	44.9	2	57°15.081	88°28.433	Y	Y	Y	Y	Y	Y	Y	N	Y	Y
FT 6	FT	02-Aug-21	10:00	N/A	39.6	2	56°58.803	87°52.822	Y	Y	Y	Y	N	N	N	N	Y	Y
FT 7	FT	02-Aug-21	13:00	N/A	44.6	2	56°43.590	87°19.670	Y	Y	Y	Y	Y	Y	Y	N	Y	Y
FT 8	FT	02-Aug-21	16:00	N/A	41.5	2	56°29.570	86°49.835	Y	Y	Y	Y	N	N	N	N	Y	Y
FT 9	FT	02-Aug-21	19:00	N/A	39.0	2	55°31.147	85°41.115	Y	Y	Y	Y	N	N	N	N	Y	Y
FT 10	FT	02-Aug-21	22:00	N/A	70.0	2	55°59.107	85°47.791	Y	Y	Y	Y	N	N	N	N	Y	Y
FT 11	FT	03-Aug-21	07:00	N/A	53.2	2	55°40.187	83°50.607	Y	Y	Y	Y	Y	Y	Y	N	Y	Y
FT 12	FT	03-Aug-21	10:00	N/A	29.7	2	55°34.765	83°10.303	Y	Y	Y	Y	N	N	N	N	Y	Y
FT 13	FT	03-Aug-21	13:00	N/A	22.4	2	55°24.564	82°27.149	Y	Y	Y	Y	Y	Y	Y	N	Y	Y
FT 14	FT	03-Aug-21	16:00	N/A	29.7	2	55°07.615	81°54.474	Y	Y	Y	Y	N	N	N	N	Y	Y
1	ROS	03-Aug-21	19:21	1	31.5	1.6, 10 15, 20, 26	54°45.900	81°41.600	Y	Y	Y	Y	Y	N	Y	N	Y	Y
FT 15	FT	03-Aug-21	23:30	N/A	32.7	2	54°22.543	81°49.401	Y	Y	Y	Y	N	N	N	N	Y	Y
4	ROS	04-Aug-21	09:47	1	38.0	1.2, 10, 20, 32	53°49.700	81°41.100	Y	Y	Y	Y	Y	N	Y	N	Y	Y
4	ROS	04-Aug-21	11:48	2	38.6	1.5, 3, 7, 10, 14, 22	53°49.424	81°41.330	N	N	N	N	N	Y	N	N	N	N
Z1-A	SB	04-Aug-21	10:33	1, 2	4.0	0.5, 4	53°48.590	82°02.500	Y	N	N	Y	N	N	N	Y	Y	Y
Z1-B	SB	04-Aug-21	12:03	1, 2	9.0	0.5, 9	53°49.210	82°00.300	Y	N	N	Y	N	N	N	Y	Y	Y
Z1-C	SB	04-Aug-21	13:45	1, 2	13.0	0.5, 13	53°49.290	81°57.300	Y	N	N	Y	N	N	N	Y	Y	Y
Z1-D	SB	04-Aug-21	15:55	1, 2	20.0	0.5, 20	53°49.600	81°54.370	Y	N	N	N	N	N	N	Y	N	N
Z1-E	SB	04-Aug-21	17:15	1, 2	25.0	0.5, 25	53°49.220	81°51.190	Y	N	N	N	N	N	N	Y	N	N
CTD 24	FT	05-Aug-21	08:08	N/A	58.0	2	53°48.418	79°45.533	Y	N	N	N	N	N	N	N	Y	Y
5	ROS	05-Aug-21	14:38	1	62.0	1.4., 10, 20, 30, 40, 50	53°48.401	79°45.472	Y	Y	Y	Y	Y	N	Y	N	Y	Y
5	ROS	05-Aug-21	15:48	2	60.0	1.3, 3, 5, 7, 10, 16	53°48.436	79°46.899	N	N	N	N	N	Y	N	N	N	N
Z2 - A	SB	05-Aug-21	14:08	1, 2	7.0	0.5, 7	53°43.170	79°13.330	Y	N	N	Y	N	N	N	Y	Y	Y
Z2-B	SB	05-Aug-21	15:37	1, 2	20.7	0.5, 20	53°43.250	79°13.560	Y	N	N	Y	N	N	N	Y	Y	Y
Z2-B2	SB	05-Aug-21	17:15	1, 2	15.0	0.5, 15	53°43.000	79°13.600	Y	N	N	Y	N	N	N	Y	Y	Y
Z2 - C	SB	05-Aug-21	19:19	1, 2	26.4	0.5, 26	53°48.800	79°26.510	Y	N	N	Y	N	N	N	Y	Y	Y
3	ROS	06-Aug-21	08:10	1	68.0	1.9, 10, 20, 30, 40, 60	54°17.842	80°03.475	Y	Y	Y	Y	Y	N	Y	N	Y	Y
3	ROS	06-Aug-21	09:28	2	66.0	1.5, 3, 6, 8, 12, 19	54°17.589	80°03.480	N	N	N	N	N	Y	N	N	N	N
CTD 37	FT	06-Aug-21	17:50	N/A	49.0	2	54°17.371	80°26.300	Y	Y	Y	N	N	N	N	N	N	N
CTD 39	FT	06-Aug-21	19:13	N/A	50.0	2	54°17.162	80°43.742	Y	Y	Y	N	N	N	N	N	N	N

STN	Type [1]	Date (yy-mm-dd)	Time (EST)	Cast	Bot Depth (m)	Depth (m)	Latitude (N)	Longitude (W)	Nut	Flow Cytometry	Chl *a*	POC/N/S	Lugol Tax	PP	HPLC	ROV	TSS	AP
CTD 41	FT	06-Aug-21	20:44	N/A	28.0	2	54°17.058	81°00.248	Y	Y	Y	N	N	N	N	N	N	N
CTD 43	FT	06-Aug-21	22:24	N/A	51.5	2	54°16.873	81°17.329	Y	Y	Y	N	N	N	N	N	N	N
Z3 - A	SB	06-Aug-21	8:54	1, 2	7.4	0.5, 7	54°12.330	79°33.210	Y	N	N	Y	N	N	N	Y	Y	Y
Z3 - B	SB	06-Aug-21	10:39	1, 2	10.0	0.5, 10	54°12.260	79°33.370	Y	N	N	N	N	N	N	Y	N	N
Z3 - C	SB	06-Aug-21	11:11	1, 2	20.8	0.5, 20	54°13.460	79°37.330	Y	N	N	N	N	N	N	Y	Y	Y
2	ROS	07-Aug-21	07:52	1	62.0	1.8, 4, 8, 12, 17, 26	54°16.725	81°28.693	N	N	N	N	N	Y	N	N	N	N
2	ROS	07-Aug-21	08:45	2	57.8	1.5, 10, 20, 30, 40, 46	54°15.800	81°28.170	Y	Y	Y	Y	Y	N	Y	Y	Y	Y
CTD 51	FT	07-Aug-21	15:55	N/A	22.5	2	54°07.732	80°55.885	Y	Y	Y	N	N	N	N	N	N	N
CTD 53	FT	07-Aug-21	17:50	N/A	20.0	2	53°58.384	80°49.463	Y	Y	Y	Y	N	N	N	N	Y	N
CTD 55	FT	07-Aug-21	19:28	N/A	20.6	2	53°48.781	80°42.746	Y	Y	Y	N	N	N	N	Y	Y	Y
CTD 57	FT	07-Aug-21	21:16	N/A	26.0	2	53°40.093	80°37.253	Y	Y	Y	Y	N	N	N	N	Y	Y
CTD 59	FT	07-Aug-21	22:44	N/A	37.3	2	53°30.746	80°30.906	Y	Y	Y	N	N	N	N	N	N	N
CTD 67	FT	08-Aug-21	05:30	N/A	60.7	2	52°53.100	80°06.113	Y	N	N	Y	N	N	N	N	Y	Y
CTD 71	FT	08-Aug-21	09:18	N/A	58.7	2	52°34.484	79°53.723	Y	Y	Y	Y	N	N	N	N	Y	Y
CTD 73	FT	08-Aug-21	10:56	N/A	61.4	2	52°25.284	79°47.493	Y	Y	Y	Y	N	N	N	N	Y	Y
6	ROS	08-Aug-21	14:37	1	62.0	1.5, 2, 4, 6, 8, 12	52°14.277	79°41.584	N	N	N	N	N	Y	N	N	N	N
6	ROS	08-Aug-21	16:38	2	61.8	1.5, 10, 20, 30, 40, 54	52°14.333	79°41.724	Y	Y	Y	Y	Y	N	Y	N	Y	Y
Z4 - A	SB	08-Aug-21	14:30	1, 2	9.5	0.5, 9	52°13.588	79°33.421	Y	N	N	Y	N	N	N	Y	Y	Y
Z4 - B	SB	08-Aug-21	16:10	1, 2	20.8	0.5, 20	52°13.581	79°35.118	Y	N	N	Y	N	N	N	Y	Y	Y
Z4 - C	SB	08-Aug-21	17:48	1, 2	33.2	0.5, 33	52°15.313	79°32.456	Y	N	N	Y	N	N	N	Y	Y	Y
MR 1	SB	09-Aug-21	10:34, 10:41, 10:46	2, 3, 4	7.1	1.5	51°28.084	80°15.173	Y	Y	Y	Y	Y	Y	Y	N	Y	Y
MR 2	SB	09-Aug-21	11:17, 11:23, 11:28	2, 3, 4	6.3	1.5	51°27.389	80°15.558	Y	Y	Y	Y	Y	Y	Y	N	Y	Y
MR 3	SB	09-Aug-21	12:23, 12:29	2, 3	5.2	0.5	51°26.564	80°17.420	Y	Y	Y	Y	Y	Y	Y	N	Y	Y
MR 4	SB	09-Aug-21	14:39, 14:40, 14:43	2, 3, 4	6.1	0.5	51°22.361	80°23.139	Y	Y	Y	Y	Y	Y	Y	N	Y	Y
MR 5	SB	09-Aug-21	15:25	1	6.0	0.5	51°19.286	80°28.124	Y	Y	Y	Y	Y	Y	Y	N	Y	Y
Z5 - A	SB	09-Aug-21	10:45	1, 2	4.8	0.5, 4	51°32.121	80°22.221	Y	N	N	Y	N	N	N	Y	Y	Y
Z5 - B	SB	09-Aug-21	12:15	1,2	6.3	0.5, 6	51°30.331	80°19.253	Y	N	N	N	N	N	N	N	N	N
Z5 - C	SB	09-Aug-21	18:00	1, 2	12.8	0.5, 12	51°30.148	80°10.084	Y	N	N	Y	N	N	N	N	Y	Y

STN	Type [1]	Date (yy-mm-dd)	Time (EST)	Cast	Bot Depth (m)	Depth (m)	Latitude (N)	Longitude (W)	Nut	Flow Cytometry	Chl *a*	POC/N/S	Lugol Tax	PP	HPLC	ROV	TSS	AP
8	ROS	10-Aug-21	08:52	1	18.0	1, 2, 3, 5, 7, 10	52°21.418	80°37.269	Y	Y	Y	Y	Y	Y	Y	N	Y	Y
CTD 100	FT	10-Aug-21	15:24	N/A	17.8	2	52°21.907	80°23.442	Y	Y	Y	Y	N	N	N	N	Y	Y
CTD 102	FT	10-Aug-21	17:05	N/A	34.5	2	52°21.258	80°07.155	Y	Y	Y	N	N	N	N	N	N	N
CTD 104	FT	10-Aug-21	18:43	N/A	63.2	2	52°21.488	79°50.572	Y	Y	Y	Y	N	N	N	N	Y	Y
CTD 106	FT	10-Aug-21	20:11	N/A	77.9	2	52°21.619	79°34.607	Y	Y	Y	N	N	N	N	N	N	N
CTD 108	FT	10-Aug-21	22:08	N/A	77.5	2	52°25.399	79°19.140	Y	Y	Y	N	N	N	N	N	N	N
EM 1	SB	11-Aug-21	08:19	1	0.7	0.5	52°14.564	78°33.572	Y	Y	Y	Y	Y	Y	Y	N	Y	Y
EM 2	SB	11-Aug-21	08:57	1	1.2	0.5	52°14.528	78°34.505	Y	Y	Y	Y	Y	Y	Y	N	Y	Y
EM 3	SB	11-Aug-21	09:28	1	1.7	0.5	52°14.521	78°35.373	Y	Y	Y	Y	Y	Y	Y	N	Y	Y
EM 4	SB	11-Aug-21	10:21	1	2.8	0.5	52°14.442	78°36.209	Y	Y	Y	Y	Y	Y	Y	N	Y	Y
EM 5	SB	11-Aug-21	09:52	1	4.6	0.5	52°14.463	78°37.124	Y	Y	Y	Y	Y	Y	Y	N	Y	Y
EM 6	SB	11-Aug-21	11:38	1	16.7	0.5	52°16.480	78°46.426	Y	Y	Y	Y	Y	Y	Y	N	Y	Y
9	ROS	11-Aug-21	11:10	1	43.9	1, 10, 20, 30, 40	52°18.289	78°53.600	Y	Y	Y	N	N	N	N	N	N	N
CTD 114	FT	11-Aug-21	19:05	N/A	78.5	2	52°25.843	79°24.511	Y	Y	Y	N	N	N	N	N	Y	Y
CTD 116	FT	11-Aug-21	20:28	N/A	44.6	2	52°35.847	79°24.470	Y	Y	Y	N	N	N	N	N	Y	Y
CTD 118	FT	11-Aug-21	21:46	N/A	58.4	2	52°45.603	79°22.887	Y	Y	Y	N	N	N	N	N	Y	Y
CTD 120	FT	11-Aug-21	23:04	N/A	65.3	2	52°55.797	79°23.289	Y	Y	Y	N	N	N	N	N	Y	Y
Z6 - A	SB	11-Aug-21	07:17	1, 2	22.6	0.5, 20	52°23.352	78°46.199	Y	N	N	N	N	N	N	N	Y	Y
Z6 - B	SB	11-Aug-21	09:27	1, 2	4.8	0.5, 4	52°21.259	78°36.328	Y	N	N	N	N	N	N	N	Y	Y
Z6 - C	SB	11-Aug-21	11:02	1, 2	6.1	0.5, 6	52°17.330	78°36.598	Y	N	N	N	N	N	N	N	Y	Y
Z6 - D	SB	11-Aug-21	12:13	1, 2	13.1	0.5, 12	52°17.878	78°42.824	Y	N	N	N	N	N	N	N	Y	Y
CTD 130	FT	12-Aug-21	06:54	N/A	40.4	2	53°44.586	79°33.311	N	N	N	Y	N	N	N	N	N	N
CTD 131	FT	12-Aug-21	07:50	N/A	31.5	2	53°48.556	79°26.792	N	N	N	Y	N	N	N	N	N	N
CTD 133	FT	12-Aug-21	09:22	N/A	59.4	2	53°48.326	79°43.669	N	N	N	N	N	N	N	N	N	N
CTD 134	FT	12-Aug-21	10:00	N/A	61.0	2	53°48.323	79°47.134	Y	Y	Y	Y	Y	Y	Y	N	N	N
FT 16	FT	12-Aug-21	14:00	N/A	39.7	2	53°52.085	80°20.480	Y	Y	Y	Y	Y	Y	Y	N	N	N

STN	Type [1]	Date (yy-mm-dd)	Time (EST)	Cast	Bot Depth (m)	Depth (m)	Latitude (N)	Longitude (W)	Nut	Flow Cytometry	Chl *a*	POC/N/S	Lugol Tax	PP	HPLC	ROV	TSS	AP
FT 17	FT	12-Aug-21	17:00	N/A	37.7	2	54°10.747	80°44.389	Y	Y	Y	N	N	N	N	N	N	N
FT 18	FT	13-Aug-21	09:30	N/A	20.2	2	54°21.931	81°04.531	Y	Y	Y	Y	Y	Y	Y	Y	N	N
FT 19	FT	13-Aug-21	16:00	N/A	48.1	2	54°16.693	81°12.453	Y	Y	Y	N	N	N	N	N	N	N
FT 20	FT	13-Aug-21	19:00	N/A	58.0	2	54°18.340	81°29.907	Y	Y	Y	N	N	N	N	N	N	N
FT 21	FT	13-Aug-21	22:00	N/A	32.5	2	54°39.614	81°40.786	Y	Y	Y	N	N	N	N	N	N	N

[1]FT= Flow through system sample, ROS = rosette sample, SB = Sample Bottle

Appendix D: eDNA Sampling Log

eDNA ID	Station-Rep	Water column	Sample method[1]	Cast No	Bot depth (m)	Sample depth (m)	Latitude (dd)	Longitude (dd)	Collect Date	Collect time (EST)	Filter time (EST)	Notes
1	FT01-1	surface	FT		67	2	58.513183	-92.038867	8/1/2021	13:05	14:30	
2	FT01-2	surface	FT		67	2	58.501183	-92.008417	8/1/2021	13:23	15:10	
3	FT03-1	surface	FT		not taken	2	58.079367	-90.908633	8/1/2021	19:10	19:50	
4	FT03-2	surface	FT		not taken	2	58.068567	-90.87625	8/1/2021	19:20	20:20	
B1			BLANK						8/1/2021	20:40	20:40	distilled water blank
5	FT05-1	surface	FT		44.9	2	57.2073	-88.373433	8/2/2021	7:20	7:40	
6	FT05-2	surface	FT		44.9	2	57.2073	-88.373433	8/2/2021	7:25	7:04	
7	FT09-1	surface	FT		39	2	56.25	-86.333333	8/2/2021	19:15	20:15	coordinates from captain log as there was error in flow through log
8	FT09-2	surface	FT		39	2	56.25	-86.333333	8/2/2021	19:25	20:15	coordinates from captain log as there was error in flow through log
B2			BLANK						8/2/2021	20:45	20:45	distilled water blank
9	FT11-1	surface	FT		53.2	2	55.669783	-83.84345	8/3/2021	7:20	8:30	
10	FT11-2	surface	FT		53.2	2	55.669783	-83.84345	8/3/2021	7:25	9:00	
11	STN1-1	surface	FT		31.5	2	54.765	-81.6933333	8/3/2021	20:00	22:30	
12	STN1-2	surface	FT		31.5	2	54.765	-81.6933333	8/3/2021	20:05	22:30	
13	STN1-3	bottom	ROS	1	31.5	26	54.765	-81.6933333	8/3/2021	19:21	21:30	
14	STN1-4	bottom	ROS	1	31.5	26	54.765	-81.6933333	8/3/2021	19:21	21:30	
B3			BLANK						8/3/2021	21:45	21:45	distilled water blank
15	STN4-1	surface	FT		38	2	53.822667	-81.713967	8/4/2021	13:56	17:46	
16	STN4-2	surface	FT		38	2	53.822667	-81.713967	8/4/2021	13:57	18:08	
17	STN4-3	bottom	ROS	1	38	32	53.8283333	-81.685	8/4/2021	9:47	12:50	
18	STN4-4	bottom	ROS	1	38	32	53.8283333	-81.685	8/4/2021	9:47	13:11	
19	Z1-A	surface	SB		3.53	1.5	53.8164	-82.0471	8/4/2021	11:00	15:30	
20	Z1-B	surface	SB		9.01	1.5	53.8226	-82.0009	8/4/2021	12:30	12:45	2 filters used
21	Z1-C	surface	SB		13.92	1.5	53.8246	-81.9583	8/4/2021	14:00	15:00	
22	Z1-D	surface	SB		18.45	1.5	53.8232	-81.9103	8/4/2021	16:15	16:30	
23	Z1-E	surface	SB		23.63	1.5	53.8228	-81.8552	8/4/2021	17:36	20:30	
B4			BLANK						8/4/2021	22:00	22:00	distilled water blank
24	STN5-1	surface	FT		62	2	53.806683	-79.757867	8/5/2021	14:26	14:56	
25	STN5-2	surface	FT		62	2	53.806683	-79.757867	8/5/2021	14:29	15:18	
26	STN5-3	bottom	ROS	1	62	50	53.806683	-79.757867	8/5/2021	14:38	16:28	
27	STN5-4	bottom	ROS	1	62	50	53.806683	-79.757867	8/5/2021	14:38	16:28	
28	Z2-A	surface	SB		7	1.5	53.7215	-79.2257	8/5/2021	14:31	14:40	
29	Z2-A	bottom	SB		7	6	53.7215	-79.2257	8/5/2021	14:55	18:10	
30	Z2-B	surface	SB		20.75	1.5	53.7235	-79.2322	8/5/2021	16:00	16:15	

eDNA ID	Station-Rep	Water column	Sample method[1]	Cast No	Bot depth (m)	Sample depth (m)	Latitude (dd)	Longitude (dd)	Collect Date	Collect time (EST)	Filter time (EST)	Notes
31	Z2-B	bottom	SB		20.75	18	53.7235	-79.2322	8/5/2021	16:51	16:55	
32	Z2-C	surface	SB		26.42	1.5	53.8023	-79.4476	8/5/2021	19:35	22:00	*sample may be mixed up with #33
33	Z2-C	bottom	SB		26.42	26	53.8023	-79.4476	8/5/2021	19:55	22:15	*sample may be mixed up with #32
B5			BLANK						8/5/2021	22:30	22:30	distilled water blank
34	STN3-1	surface	FT		68	2	54.297367	-80.057917	8/6/2021	9:04	11:15	
35	STN3-2	surface	FT		68	2	54.297367	-80.057917	8/6/2021	9:05	11:39	
36	STN3-3	bottom	ROS	1	68	60	54.297367	-80.057917	8/6/2021	8:10	11:57	
37	STN3-4	bottom	ROS	1	68	60	54.297367	-80.057917	8/6/2021	8:10	12:14	
38	Z3-A	surface	SB		7.35	1.5	54.2093	-79.5559	8/6/2021	9:50	10:14	
39	Z3-A	bottom	SB		7.35	7	54.2093	-79.5559	8/6/2021	9:21	9:30	
40	Z3-B	surface	SB		10.92	1.5	54.2071	-79.5603	8/6/2021	10:45	11:00	
41	Z3-B	bottom	SB		10.92	10	54.2071	-79.5603	8/6/2021	10:30	16:30	
42	Z3-C	surface	SB		20.8	1.5	54.2294	-79.6257	8/6/2021	11:39	16:00	
43	Z3-C	bottom	SB		20.8	18	54.2294	-79.6257	8/6/2021	12:00	16:00	
93	STN2-1	surface	FT		62	2	54.263333	-81.4695	8/7/2021	9:11	9:52	
94	STN2-2	surface	FT		62	2	54.263333	-81.4695	8/7/2021	9:25	10:14	
95	STN2-3	bottom	ROS	2	57.8	46	54.263333	-81.4695	8/7/2021	8:45	11:22	
96	STN2-4	bottom	ROS	2	57.8	46	54.263333	-81.4695	8/7/2021	8:45	11:39	
97	CTD57-1	surface	FT		26	2	53.668217	-80.620883	8/7/2021	21:25	21:30	
98	CTD57-2	surface	FT		26	2	53.668217	-80.620883	8/7/2021	21:27	21:45	
B5			BLANK						8/7/2021	22:00	22:00	distilled water blank
44	CTD71-1	surface	FT		58.7	2	52.574733	-79.895383	8/8/2021	8:10	9:10	
45	CTD71-2	surface	FT		58.7	2	52.574733	-79.895383	8/8/2021	8:15	9:30	
46	STN6-1	surface	FT		62	2	52.23795	-79.693067	8/8/2021	14:21	15:05	
47	STN6-2	surface	FT		62	2	52.23795	-79.693067	8/8/2021	14:24	15:24	
48	STN6-3	bottom	ROS	2	61.8	54	52.00555	-79.0120667	8/8/2021	16:38	17:57	
49	STN6-4	bottom	ROS	2	61.8	54	52.00555	-79.0120667	8/8/2021	16:38	18:15	
B6			BLANK						8/8/2021	15:00	15:15	distilled water blank
50	Z4-A	surface	SB		9.52	1.5	52.233	-79.5617	8/8/2021	15:00	15:15	
51	Z4-A	bottom	SB		9.52	9	52.233	-79.5617	8/8/2021	15:35	16:30	
52	Z4-B	surface	SB		20.78	1.5	52.2328	-79.5866	8/8/2021	16:35	17:00	
53	Z4-B	bottom	SB		20.78	20	52.2328	-79.5866	8/8/2021	17:00	17:05	
54	Z4-C	surface	SB		32.38	0	52.2587	-79.546	8/8/2021	18:00	1:10	
55	Z4-C	bottom	SB		32.38	30	52.2587	-79.546	8/8/2021	18:40	18:55	
56	Z5-A	surface	SB		4.8	0	51.5367	-80.3728	8/9/2021	11:05	11:45	

eDNA ID	Station-Rep	Water column	Sample method[1]	Cast No	Bot depth (m)	Sample depth (m)	Latitude (dd)	Longitude (dd)	Collect Date	Collect time (EST)	Filter time (EST)	Notes
57	Z5-B	surface	SB		6.3	0	51.5092	-80.3237	8/9/2021	12:30	15:00	
58	Z5-B	bottom	SB		6.3	6	51.5092	-80.3237	8/9/2021	12:35	15:30	
59	Z5-C	surface	SB		12.76	0	51.5041	-80.169	8/9/2021	18:30	19:00	
60	Z5-C	bottom	SB		12.76	10	51.5041	-80.169	8/9/2021	19:00	19:15	
68	STN8-1	bottom	ROS		18	10	52.361517	-80.62575	8/10/2021	8:52	13:36	Extra eDNA samples taken at ship as no zodiac work at this site
69	STN8-2	bottom	ROS		18	10	52.361517	-80.62575	8/10/2021	8:52	13:54	Extra eDNA samples taken at ship as no zodiac work at this site
66	STN8-3	surface	FT		18	2	52.361517	-80.62575	8/10/2021	10:40	12:08	Extra eDNA samples taken at ship as no zodiac work at this site
67	STN8-4	surface	FT		18	2	52.361517	-80.62575	8/10/2021	10:40	13:07	Extra eDNA samples taken at ship as no zodiac work at this site
70	STN8-5	surface	ROS		18	1	52.361517	-80.62575	8/10/2021	8:52	14:20	Extra eDNA samples taken at ship as no zodiac work at this site
71	STN8-6	surface	ROS		18	1	52.361517	-80.62575	8/10/2021	8:52	14:43	Extra eDNA samples taken at ship as no zodiac work at this site
72	STN9-1	bottom	ROS		43.9	40	52.0048167	-78.8933333	8/11/2021	11:10	12:20	
73	STN9-2	bottom	ROS		43.9	40	52.0048167	-78.8933333	8/11/2021	11:10	12:30	
74	STN9-3	surface	ROS		43.9	1	52.0048167	-78.8933333	8/11/2021	11:10	13:05	
75	STN9-4	surface	ROS		43.9	1	52.0048167	-78.8933333	8/11/2021	11:10	13:19	
61	Z6-A	surface	SB		22.6	0	52.39312	-78.77223	8/11/2021	7:38	9:40	
62	Z6-A	bottom	SB		22.6	20	52.39312	-78.77223	8/11/2021	8:02	11:30	
63	Z6-B	surface	SB		4.8	0	52.35715	-78.6091	8/11/2021	9:35	12:30	
64	Z6-C	surface	SB		6.1	0	52.29252	-78.61657	8/11/2021	11:16	14:30	
B7			BLANK						8/11/2021	15:02	15:02	distilled water blank
65	Z6-D	surface	SB		13.1	0	52.29797	-78.71373	8/11/2021	12:20	15:35	
76	Z6-D	bottom	SB		13.1	12	52.29797	-78.71373	8/11/2021	12:45	15:50	
77	FT22-1	surface	FT		not recorded	2	55.704933	-83.272783	8/14/2021	10:25	10:35	
78	FT22-2	surface	FT		not recorded	2	55.704933	-83.272783	8/14/2021	10:30	10:55	
79	FT23-1	surface	FT		not recorded	2	56.398017	-85.796667	8/14/2021	22:45	22:55	
80	FT23-2	surface	FT		not recorded	2	56.398017	-85.796667	8/14/2021	22:50	23:00	
81	FT24-1	surface	FT		not recorded	2	57.064417	-88.197583	8/15/2021	10:25	10:30	
82	FT24-2	surface	FT		not recorded	2	57.064417	-88.197583	8/15/2021	10:27	10:45	
B8			BLANK						8/15/2021	15:00	15:00	distilled water blank

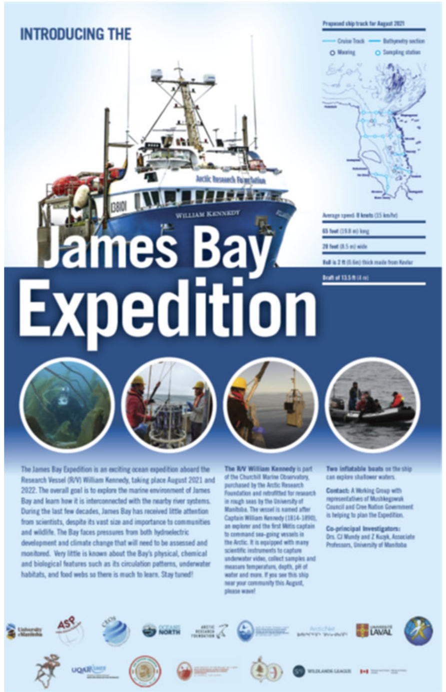
[1]FT= Flow through system sample, ROS = rosette sample, SB=Sample Bottle

Appendix E: Communications Materials

James Bay Expedition, Pre-Expedition Communications
Presentations to Communities and Regional Partners:
West James Bay – Mushkegowuk Communities
April 8, 2021: presentation to Chief and Council, Moose Cree First Nation (arranged by Ron Spencer and John Turner)

East James Bay – Eeyou Marine Region
March 1, 2021: presentation to the Eeyou Marine Region Wildlife Board (arranged by Angela Coxon, Wildlife Management Director, Eeyou Marine Region Wildlife Board)
April 16, 2021: presentation to Chief and Council, Cree Nation of Chisasibi (arranged by Fawn Iserhoff, Corporate Secretary, Jennie Knopp presented on our behalf)
May 31, 2021: presentation to Chief and Council, Cree Nation of Eastmain (arranged by Doris Gilpin, Corporate Secretary)
June 2, 2021: presentation to Chief and Council, Cree Nation of Wemindji (arranged by Karen Mistacheesick, Corporate Secretary)
June 14, 2021: presentation to Chief and Council, Cree Nation of Waskaganish (arranged by Alyssa Blackned, Corporate Secretary)
July 14, 2021: presentation to Chief and Council, Cree Nation of Whapmagoostui
July 29, 2021: radio announcement

Posters distribution list:
All communities above as well as Sanikiluaq NU, Fort Albany First Nation, Attawapiskat First Nation, Kashechewan First Nation, Weenusk First Nation (Peawanuck)


INTRODUCING THE
James Bay Expedition
Proposed ship track for August 2021
Cruise Track
Bathymetry section
Mooring
Sampling station
Average speed: 8 knots (15 km/hr)
65 feet (19.8 m) long
28 feet (8.5 m) wide
Hull is 2 ft (0.6m) thick made from Kevlar
Draft of 13.5 ft (4 m)
WILLIAM KENNEDY
Arctic Research Foundation
The James Bay Expedition is an exciting ocean expedition aboard the Research Vessel (R/V) William Kennedy, taking place August 2021 and 2022. The overall goal is to explore the marine environment of James Bay and learn how it is interconnected with the nearby river systems. During the last few decades, James Bay has received little attention from scientists, despite its vast size and importance to communities and wildlife. The Bay faces pressures from both hydroelectric development and climate change that will need to be assessed and monitored. Very little is known about the Bay's physical, chemical and biological features such as its circulation patterns, underwater habitats, and food webs so there is much to learn. Stay tuned!
The R/V William Kennedy is part of the Churchill Marine Observatory, purchased by the Arctic Research Foundation and retrofitted for research in rough seas by the University of Manitoba. The vessel is named after Captain William Kennedy (1814-1890), an explorer and the first Métis captain to command sea-going vessels in the Arctic. It is equipped with many scientific instruments to capture underwater video, collect samples and measure temperature, depth, pH of water and more. If you see this ship near your community this August, please wave!
Two inflatable boats on the ship can explore shallower waters.
Contact: A Working Group with representatives of Mushkegowuk Council and Cree Nation Government is helping to plan the Expedition.
Co-principal Investigators: Drs. CJ Mundy and Z Kuzyk, Associate Professors, University of Manitoba