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RE: Scientific Research License # **NRI License 03 010 23R-M** Annual Report and 2024 plans.

Dear NRI, NIRB, and interested parties,

Please accept this letter as our report submission for our 2024 data collection and mooring deployment operations as part of the Belcher Islands-Arctic Eider Society polynya research (sea ice work), Churchill Marine Observatory-Environmental Observatories (CMO-EO) and Year 3 of the James Bay Expedition (JBE) combined with research operations of the *RV William Kennedy* around Belcher Islands and a University field course near Churchill, Manitoba. All work in 2023 was carried out under the multiyear NRI License number, 03 010 23R-M. Of the 5 oceanographic moorings deployed (as described in last year's renewal), we were able to recover 3, with 1 lost (CMO-A) and 1 planning to be recovered this year. We believe thick sea ice last year had moved the mooring away from its original deployment location. We also deployed one annual mooring just south of the Belcher Islands and two seasonal moorings nearby the Moose and Winisk Rivers with support from Weenusk and Moose River First Nations. One of the two moorings was retrieved. Unfortunately, strong tidal currents near the Moose River submerged the other mooring upon deployment. We plan to search for it again this year with hopes for retrieval. Additionally, we collected oceanographic samples and sensor data along southern Hudson Bay and within James Bay. As data becomes available it will be housed at U. Manitoba within the Canadian Watershed Information Network (CanWIN) (http://lwbi.cc.umanitoba.ca/) as well on the SIKU platform and made publicly accessible. This year we are requesting renewal of the multiyear licence, NRI 03 010 23R-M, to: (1) undergo sea ice and open water research within the Belcher Islands, based out the community of Sanikiluaq and in collaboration with the Arctic Eider Society; (2) retrieve annual moorings to the west (deployed 2022) and south (deployed 2023) of the Belcher Islands, deploy the annual CMO-A mooring and 1-2 seasonal water moorings in estuaries along southern Hudson Bay/James Bay in collaboration with community members from Cree First Nations, and carry out distributed sampling around the Belcher Islands on the *RV William Kennedy*; (3) carry out distributed sampling around Roes Welcome Sound and

Chesterfield Inlet on the *RV William Kennedy*; and (4) carry out distributed sampling and mooring work in eastern Foxe Basin on the *RV William Kennedy*. Below we expand on these scientific research plans for 2024.

2023 Report

CMO-EO, JBE, and Belcher Islands Oceanographic Mooring Deployment and Retrieval
In August 2023, 3 of 5 oceanographic moorings were retrieved via the *RV William Kennedy* and 3 deployed (Figure 1, Table 1). All moorings had hydrophones to monitor for marine mammals. The CMO and Belcher Islands moorings had conductivity, temperature and depth (CTD) sensors to measure ocean properties, current meters to measure ocean currents and ice draft, a collection trap to measure small particles that sink in the water column, and sensors to measure algae concentrations and partial pressure of carbon dioxide (pCO_2). One of the two seasonal estuary moorings deployed was retrieved last summer. These moorings consisted of a surface float with a hydrophone and multiprobe CTD (including sensors for river colour, pH, and algae concentration).

JBE and Belcher Islands Sampling from the RV William Kennedy
To better understand the oceanography and ecology of James Bay and its connection to the marine system around the Belcher Islands, the project team conducted a 2nd scientific mission along the southwest coast of Hudson Bay, along the west side of James Bay, and around the Belcher Islands over 25 days in August 2023. Offshore and coastal samples were collected from *RV William Kennedy* and the vessel's two boats. Sample collection included water, phytoplankton, zooplankton, benthic invertebrates, benthic fish, and sediment to support research on physical and chemical oceanography (water mass tracing), biogeochemistry, inorganic carbon system, primary production, eDNA, invertebrates and fish, and sediments. The sample collection and subsequent onboard processing are described in detail in the JBE-Belcher Islands 2023 cruise report that will be posted on the associated CanWIN data repository site this March, 2024.

Data collection was conducted at 21 partial stations in Southern Hudson Bay and James Bay and 12 full stations around the Belcher Islands (Figure 2a). Full stations included collection of a CTD profile and water samples from targeted depths in the water column using the 12 five-litre Niskin bottles on the Seabird rosette sampler. Following the rosette, a series of nets were deployed. 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. Water samples brought onboard were filtered or otherwise processed in the lab for later analysis in southern labs and used for on-deck incubation experiments. 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. Water samples were also collected during transit using the ship's underway system. Using the vessel's two boats, near shore and river samples were collected in coastal areas along southern Hudson Bay and James Bay. Coastal sampling conducted from the boats included CTD profiles and collection of water using a single Niskin bottle deployed on a weighted line.

Belcher Islands – Community-Based Research
Sea ice research was carried out in collaboration with the Arctic Eider Society (AES) between

mid-March to mid-April. The sea ice study focused on the Ulutsatuuq polynya (Figure 2b), studying the impact of tidal flow on sea ice primary production. All sites were accessed via snowmobile with at least two local guides assisting researchers at all times. Data collection included CTD profiles, current measurements and sea ice and water column samples analysed for algal biomass and primary production. A member of AES was also trained in water column sampling and processing, where AES collected samples at least monthly in Sanikiluaq harbour from June through to October, then started again in late January 2024 once the ice was safe to travel on.

Arctic Field Oceanography Course in Churchill
Following data collection around the Belcher Islands, the *RV William Kennedy* transited back to Churchill, Manitoba to refuel. While there, students and instructors boarded the ship for a two-day cruise to sample river-marine gradients in physical, chemical and biological properties of the Churchill River estuary (Figure 2c). Although the course is oriented towards teaching field techniques, data from CTD casts and sample collections will be posted on CanWIN.

2024 Plans

CMO-EO and Belcher Islands Mooring Retrieval
In August 2024, we plan to retrieve the two Belcher Islands moorings and deploy oceanographic mooring CMO A (Figure 1, Table 1) aboard the *RV William Kennedy* as it transits from Churchill, MB to Hudson Strait. Furthermore, we plan to hire a community boat in July or August 2024 to deploy, and in September-October to retrieve 1-2 small seasonal moorings in either the Winisk, Albany, and/or Moose River estuaries. The decision on which river will be made through consultation with the Mushkegowuk Council and local First Nation Band Councils.

Belcher Islands – Community-Based Research
Sea ice and open water oceanographic research will be carried out in collaboration with the Arctic Eider Society (AES). The sea ice study will focus on distributed sea ice and water column sampling throughout the Belcher Islands to build a map of spring sea ice algal biomass (Figure 2b). Most of the sampling will occur from mid-March to early April when the landfast ice is stable. All sites will be accessed via snowmobile with at least two local guides assisting researchers at all times. Data collection will include CTD profiles and sea ice and water column samples analysed for algal biomass and production. During August, a similar data collection from the water column will occur using AES' new 28-ft research boat. However, focus will be made on the south end of the islands where primary production is believed to be enhanced by nutrient flow derived from James Bay waters. Additionally, bi-weekly to monthly sampling of the Sanikiluaq harbour will continue via a community-based sampling program developed with AES and the Sanikiluaq HTA.

RV William Kennedy Research
Belcher Islands Leg
The *RV William Kennedy* will leave Churchill in late July for a 14-day cruise to the Belcher Islands where two local guides will board. The scientific cruise will retrieve the 2 moorings near the Belcher Islands (Figure 1, Table 1), and distributed CTD casts and full station sampling will

occur in early August at some of the stations sampled in 2023, but also near the coast of the Sleeper Islands, which was a place of interest raised by the Sanikiluaq HTA (Figure 2a). A typical full station will include: 1) deployment of one of the ship's two boats to undertake near-shore sampling, 2) 1-2 rosette (water sampler) casts and an extra CTD cast for physical oceanography, biogeochemistry and phytoplankton sampling, 3) vertical and oblique net tows for zooplankton sampling, 5) a surface trawl for larger zooplankton and small fish, 6) bottom grab, box core, and gravity core collections for sediment sampling, and 7) a benthic trawl while leaving the station for benthic biota sampling. While transiting between stations, samples will be collected via a constantly flowing intake line from the ship bottom for physical oceanography, biogeochemistry and phytoplankton sampling. It is noted that the ship houses 13 science crew, that will consist of two local guides and 11 scientists. Provided a considerable number of these science crew are to be determined, a list of project principal investigators is included in Table 2 for the licence. At the end of the cruise, the *RV William Kennedy* will transit back to Churchill to refuel.

Roes Welcome Sound Leg

Leaving from Churchill in mid-August for a 15-day cruise, the *RV William Kennedy* will transit to Roes Welcome Sound to undergo sampling. Following previous research in the region (# NRI License 03 009 19R-M), the cruise will focus on ocean acidification, phytoplankton, kelp, and the food web. Sampling of full stations (Figure 3) will follow closely to that of the Belcher Islands *RV William Kennedy* leg with the addition of a SCUBA dive program to examine kelp diversity, biomass, and production. Contact has been made and letters sent to the Aqigiq and Arviq HTOs as well as the Sapujiyiit Society seeking approval for this portion of the *R/V William Kennedy* cruise. Sampling in the region will only proceed following approval by all.

Arctic Field Oceanography Course in Churchill

A 2-day field course is again planned to proceed with the same sites visited as was accomplished in 2023 (Figure 2c).

Eastern Foxe Basin Leg

The *RV William Kennedy* will start the cruise from Igloolik in early October for an 11-day cruise, returning to Igloolik in mid-October (Figure 4). The data collection is focused on carbon system parameters of the water column and will depend on samples derived from CTDs and rosette water samples for physical oceanography, biogeochemistry and phytoplankton sampling. We will use the *Kennedy's* rigid-hull inflatable boat to visit rivers along the route, and collect similar water samples to study freshwater mixing. Box cores to collect sediment samples, and net tows to conduct zooplankton sampling may also be conducted. Another part of the cruise will involve retrieval and possible re-deployment of a mooring deployed by the *CCGS Amundsen* in 2023 in southern Foxe Channel (NRI Licence #05 018 23R-M_A AMENDED). The re-deployed mooring will measure chemical (pH, pCO_2, dissolved oxygen) and physical (temperature, salinity) parameters near the bottom of the ocean (about 450 m depth). Letters will be sent to the Igloolik and Sanirajak HTOs seeking consultation and approval prior to commencing the cruise.

In summary, the oceanographic data collected will continue to provide invaluable insight into the base of the marine ecosystem in Hudson Bay and its surrounding seas. On behalf of the various project participants, I thank you for your support of our past investigations. We welcome any

comments or advice and will be happy to answer questions on the project if you have any. Please feel free to contact me at your convenience.

Sincerely,

C.J. Mundy (CMO-EO and Belcher Islands Chief Scientist)
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Figures and Tables:

Figure 1. Positions of moorings retrieved, deployed, and lost in James Bay and Hudson Bay during August 2023.

Table 1. 2023 mooring deployment and retrieval information.

Site	Bottom depth (m)	Latitude [deg min N]	Longitude [deg min W]	Date of deployment	Depth of top float (m)	Status
CMO-A	103	59 58.682	91 56.478	27-Jul-2022	15	Lost
CMO-B	181	61 45.616	84 18.071	25-Jul-2022	22	Retrieved
JB-H	78.1	52 25.902	79 24.534	16-Aug-2022	44	Retrieved
BI-M1	92.8	55 37.212	79 01.638	21-Aug-2022	16.4	Retrieved
BI-M2	110	56 00.498	80 18.156	22-Aug-2022	18.6	Deployed
BI-M3	171	55 42.114	79 46.968	26-Aug-2023	23.6	Deployed
Winisk River	6	55 21.498	85 00.498	12-Aug-2023	0	Deployed & retrieved
Moose River	4	51 22.914	80 22.446	15-Aug-2023	0	Deployed

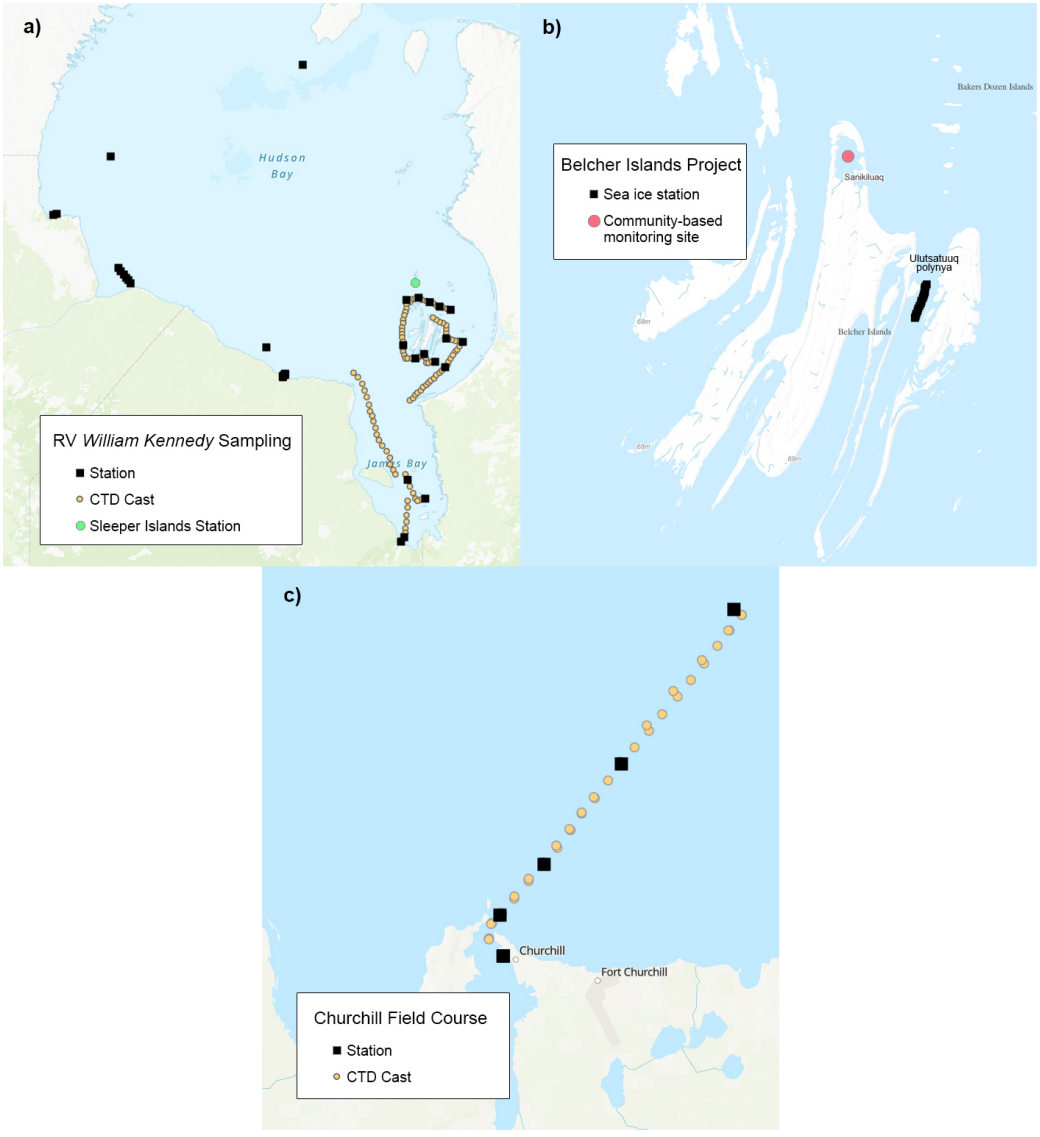

Figure 1. Locations for data collection stations and distributed CTD casts during the southern Hudson Bay, James Bay and Belcher Islands research cruises (a), community-based research within the Belcher Islands (b), and the Arctic Field course based out of Churchill (c).

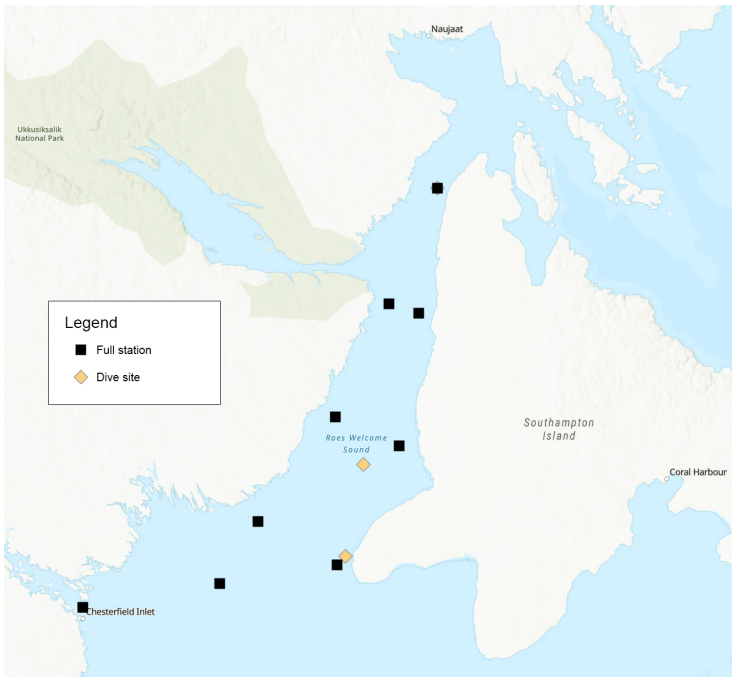

Figure 2. Research cruise planned for the 2024 Roes Welcome Sound *RV William Kennedy* leg.

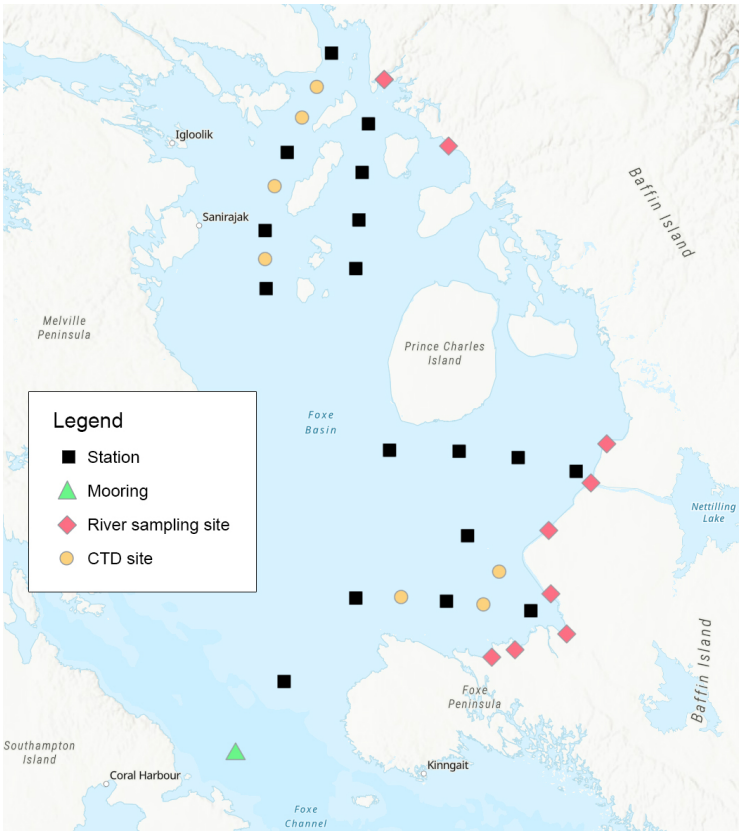

Figure 3. Research cruise planned for the 2024 eastern Foxe Basin *RV William Kennedy* leg.

Table 2. Principal Investigators during the 2024 research activities.

Participant	**Role**	**Institution/community**
C.J. Mundy	Co-Lead PI	U. Manitoba
David Yurkowski	Co-Lead PI	DFO-FWI
David Capelle	Co-Lead PI	DFO-FWI
Brent Else	Co-Lead PI	U. Calgary
Zou Zou Kuzyk	Scientist	U. Manitoba
Jens Ehn	Scientist	U. Manitoba
Tim Papakyriakou	Scientist	U. Manitoba
Andrea Niemi	Scientist	DFO-FWI
Brett Walker	Scientist	U. Ottawa
Heather Reader	Scientist	Memorial University
Lisa Miller	Scientist	DFO-IOS