Fisheries and Oceans Canada | Pêches et Océans Canada

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Field Report:
Canadian Ranger Ocean Watch 2020

Program Dates: 1 -10 February 2020

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Background

The objective of the Canadian Ranger Ocean Watch (CROW) is to establish sustainable environmental monitoring in the Northwest Passage by residents, through a collaboration in which Department of National Defense (DND)-Canadian Rangers are trained by Fisheries and Oceans Canada (DFO) scientists and technicians to collect climate-related data during patrols. The data are then available to the communities and public for education, policy and governance, and scientific use.

CROW encourages discussions with the participating communities about the community's priorities and concerns relating to the marine environment. DFO's Institute of Ocean Sciences operates several programs from ships every summer in the arctic. CROW offers an opportunity to collect wintertime data and to talk to people on the ground about ocean research in their regions.

CROW recognizes that northern residents possess unmatched skills of travel and traditional knowledge of their local environment and the need to involve natural scientists in the interpretation and application of traditional knowledge. The Rangers' keen operational knowledge and observations coupled with science's larger-picture studies gives new perspective to local conditions. In many instances, traditional knowledge has helped shape and augment DFO research in the Arctic Archipelago. DFO appreciates the capabilities of the Canadian Rangers in carrying out valuable environmental monitoring in demanding winter conditions. The ability to collect a time series over years is extremely valuable and enhances studies conducted during the summer months from ships.

Overview of the Canadian Ranger Ocean Watch (CROW) activities for 2020

Normally, CROW involves participation by DFO and the Canadian Rangers during the February to May timeframe. Plans were made for training and sampling in the Kitikmeot region (Cambridge Bay and Kugluktuk), in February with additional sampling in April and May. A second field trip was planned for training in Paulatuk for the first week of April. Due to the health precautions made necessary by the COVID-19 pandemic, these activities were restricted after mid-March. Training and sampling was only done in Cambridge Bay and Kugluktuk in early February. Long term time series were enhanced in February, but data in Darnley Bay for climate modelling was not collected. Also, the Rangers in Kugluktuk were not able to collect winter ocean data across Dolphin and Union strait due to NWS patrols being cancelled due to COVID-19.

Trip Summary

As part of their annual training for CROW, science advisors from DFO travelled to Cambridge Bay and Kugluktuk in early February 2020. Training typically includes an indoor session going over the equipment in the kit, data collection protocol, downloading data from instruments to computer, discussion of station locations, current sea-ice conditions and areas of marine-interest. After indoor dry training, Rangers go out on the ice with advisors for a hands-on practical outdoor session at a suitable site on the

ocean. The sites for the outdoor practical sessions also collected data to include in long term oceanographic monitoring. Participating Rangers had experience with all parts of the operation.

There was at least one sea-ice training day per community. Rangers from Cambridge Bay performed two day-trips. The first was a transect across Dease Strait and the second day was a transect near Unahitak Island. Rangers from Kugluktuk performed a day trip in the bay and near the mouth of the Coppermine River. The plan was for them to use their training to collect data later during their NWS patrols across Dolphin and Union Strait. A later training trip to Paulatuk in April was cancelled due to COVID-19 precautions.

The ocean measurements collected by the Rangers contribute to long term studies near northern communities. Data collected during these trips provides unmatched winter observations into Arctic ocean properties.

Method and Measurements

The primary instrument for measuring seawater properties is a CTD which gets its name from the three primary properties it measures (conductivity, temperature and depth). Conductivity is used to derive the salinity of the sea water. At each station, an 8” hole in the ice was made using a Strikemaster power head and auger with extension flights. An RBR Concerto CTD was lowered through the hole to 3 meters off the seafloor, raised to the surface and re-lowered for a second and third casts. The CTDs were equipped to measure:

- Depth (through pressure)
- Temperature
- Salinity (through conductivity)
- Dissolved Oxygen (provides information about sea-life, and water circulation)
- Fluorescence (gives an indication of the concentration of chlorophyll-a, which indicates how much algae is present in the water column)

The data were downloaded from the CTD to Panasonic Toughbook computers running free RUSKIN software from RBR after the day trips. The data give a picture of how these ocean properties change every 20 cm from the surface to the sea-floor. Data were converted into a format that the free display software “Ocean Data View” can read. Ocean Data View is a simple tool for generating profiles an 2 dimensional sections of the water column. The data are also being posted to the public Ocean Networks Canada website and are available from DFO.

Starting in 2019, data is available on the internet through the SIKU website (www.siku.org) hosted by the Arctic Eider Society. The website display uses the Google Earth engine to display data and comments from arctic communities in a geographically referenced display. The site allows observational comments as well as CTD data and links to sea ice and weather records.

Ryan Angohiatok and Tommy Ekpakohak deploying CTD offshore of Finlayson islands

Additional measurements were taken at each station that provide information about the sea-ice and how isolated (protected) it is from the atmosphere. These measurements include:

- Total thickness of the sea-ice
- Thickness of the sea-ice above the water line (freeboard)
- Thickness of the snow covering the ice
- Air temperature
- The temperature between the snow and sea ice

Baba Pedersen recording notes for CTD station

If time allowed, transects were made away from the station, measuring the snow thickness at five meter intervals for 250 meters. The data collected on the snow depth transects is being supplied to the Canadian Ice Service to help ground-truth satellite imagery.

Oceanetic model 908 thermistor ice buoys were deployed at 2 locations in Dease Strait. The buoys measure temperature at 4 depths below the surface of the ice as well

as beneath the snow and the air temperature to an accuracy of +/- 0.01 C. The data from these buoys is sent hourly via Iridium satellite to Ocean Networks Canada for display on the internet (dmas.uvic.ca –Ocean Networks Canada Oceans 2.0). Ice temperature profiles are useful in looking at events during ice accumulation and break up.

At one station in Dease Strait, a folding plankton net, made of 100um mesh, was deployed. The net has a 0.5m mouth diameter when deployed and can be collapsed to pass through an 8" (20cm) diameter hole in the ice. Samples collected will be used to determine what overwintering zooplankton species are present. An attempt was made to use a GoPro underwater camera, but conditions were too cold at sites in Dease Strait and at Unahitak in 2020.

The data collection process is explained fully in the manual:

Ranger science manual ver9 2019.pdf

Program

Cambridge Bay

Training

The stored gear was recovered and serviced and a brief "dry land" training session was arranged with the Rangers on 1 February. R/MCpl Charlie Egotak and R/Cpl Ryan Angohiatok met with Mike Dempsey and Kristina Brown at the CHARS triplex. Dry training typically includes an indoor session going over the equipment in the kit, data collection protocol, downloading data from instruments to computer, discussion of station locations, current sea-ice conditions and areas of marine-interest. During this time, the DFO consult with the Rangers concerning local knowledge, weather, safety and logistics for the upcoming ice work. It is important to incorporate observations on sea ice and weather from the Rangers into the science plan and data at this point. On 3 February, two Rangers and two DFO personnel rode out onto the sea ice south east of Cambridge Bay into Dease Strait south of Cape Colburn. Training and sampling was done at 5 sites. Sampling included snow and ice measurements, air and ice surface temperature measurements and CTD (conductivity/salinity-temperature-pressure/depth) profiling. Additionally, a satellite telemetered ice buoy was deployed to measure ice and air temperatures. A vertical net tow for zooplankton was also made at this station. Due to ridging, stations DS20-05 and DS20-05 were not accessible. A new station DS20-06 was conducted to the west of the ridging. On 4 February, the two Rangers and two DFO personnel headed south west from Cambridge Bay to the Finlayson Islands (Unahitak), to conduct more training and sampling. 4 sites were visited for CTD profiling and ice and snow measurements.

Ryan Angohiatok and Tommy Ekpakohak conducting CTD cast

This transect has been done 8 times previously since 2011. The winter data is used to help with monitoring work done in summer by DFO, University of Calgary, University of Manitoba and the Canadian High Arctic Research Station (CHARS).

Rangers receiving training and conducting the sampling were :

R/Cpl Ryan Angohiatok
R/Cpl Tommy Ekpakhoak

In addition to the 2 day trips with the Rangers, Mike Dempsey and Kristina Brown conducted CTD stations within Cambridge bay. These stations had been used previously on several other CROW trips and provide observations on the circulation within the bay. Normally, up to 4 sites are added to monitor the circulation within the bay, but in 2020, only 2 deep stations were done due to cold weather. These deep water stations are profiled to monitor the dissolved oxygen levels in the deeper parts of Cambridge bay. These deep holes do not flush thoroughly every year and can have very low oxygen concentrations due to decaying organic material and run off from community's sewage lagoons.

Kugluktuk

Training

On 5 February, the CROW gear was taken out of storage and serviced. The following day, a meeting was made with R/Sgt Roger Hitkolok and R/MCpl Baba Pedersen to discuss CROW training over the next couple of days. In 2020, DFO introduced a plan for Community Based Monitoring (CBM) in the Kugluktuk and Coppermine River area. The plan was to do CROW training with the patrol the next day and then CBM training with 2 Rangers (contracted through HTO) later. They said that in the summer, river water flows west along the shore and eastward inside the Nichols Islands before flowing into Coronation Gulf between Five and Seven Mile islands. Two additional stations were included into the training to support the CBM sampling. CBM1 was added north of Five Mile island a little further west than originally planned. CBM2 was located between KUG3 and Seven Mile Island.

Joe Novoligak and Roger Hitkolok conducting snow depth survey

The next day, the weather was -29℃ , wind chill -42℃. The rangers met at R/MCpl Baba Pedersen's workshop at 0900, went through setup with Ruskin and downloading data, and left for the ice around 1100. There were many teething problems at the first station. The auger head became extremely flooded and would not start. A hole was made with a chisel and snow and ice measurements were carried on until the auger was working again. The 3 regular (KUG1-3) CROW stations were done as well as the 2 additional CBM stations that day

On 8 February, Erik Hitkolok and Richard Akana went out with DFO researchers to train for ongoing CBM work with the HTO. An 8' x 8' Clam ice fishing tent was erected over a 10" augered hole. Through this hole, CTD profiles and water sampling were

carried out. Training received through CROW was very useful in doing the work for studying the outflow of the Coppermine River into the ocean around Kugluktuk. Hopefully this contract work will continue through 2021.

Randy Hinanik, David Enogaloak and Floyd Kaitak conducting CTD station

Rangers receiving training and conducting the sampling were :

R/Sgt Roger Hitkolok
R/MCpl Baba Pedersen
R/MCpl Floyd Kaitak
R/MCpl David Enogaloak
R/MCpl Eric Hitkolok
R/Cpl Randy Hinanik
Rgr Joe Novoligak
Rgr OJ Bernhardt

Outreach

Mike Dempsey and Kristina Brown met with Amanda Dumond, the HTO manager. The HTO has been made aware and been supportive of CROW activities since 2013. In 2020, DFO put a contract in place with the HTO to conduct water sampling in the Coppermine River/Kugluktuk area. The plan was to contract 2 people trained through CROW to do CTD profiling and water sampling at 6 locations at

intervals of 2-4 months for the next 2 years. This work will enhance and continue with studies already done by DFO looking at the interaction of the Coppermine River with the marine environment and possible influences on sea going fish populations.

NWS patrols

It was planned that the Kugluktuk patrol would take the CROW gear out on one, possibly two, NWS patrols across the sea ice. Unfortunately, COVID-19 restrictions came into place a few weeks later and no further CROW activity was carried out.

Paulatuk

Plans were made for DFO advisors to visit Paulatuk in the first week of April 2020. Unfortunately, due to COVID-19 precautions, travel to the north was suspended in Mid-March. Attempts were made to arrange for the Rangers to carry on with sampling in the ANMPA. This was not possible as COVID-19 precautions precluded Ranger operations in general and the CROW provision of service specifically.

Conclusion and Notes on Future Programs

CROW is a rare opportunity to collect oceanographic data in the Canadian Arctic Archipelago during winter months. Although there are several locations in the archipelago where moored instruments collect data, there are few places where we have a time series of CTD profile data. Due to weather, sea-ice conditions and time constraints, the ability of being able to collect data on a single trip can be quite variable and that having a kit stay in each community for at least two trips per winter would be ideal. DFO greatly appreciates the opportunity of working with the Rangers in collecting ocean and ice data and highly values the cooperation of 1 CRPG in making time in the Rangers' NWS patrols and training schedules available for CROW. The Rangers skills fit well with ocean data collection methods.

For the past several years, CROW has focused on collecting data in a few locations to build time series that may show changes or stability in ocean water over time. Most stations sampled are relatively close to shore (< 10 km) and data collected reflects local conditions more than larger patterns. An attempt has also been made to monitor larger patterns by conducting transects across Dease and Dolphin & Union straits. The ocean between Victoria Strait in the east and Dolphin & Union Strait in the west is sometimes referred to collectively as the Kitikmeot Sea. This body of water is dominated by the large amount of freshwater input from rivers largely, from the Mainland. CROW adds seasonality to summer studies such as Kitikmeot Sea Science Study (K3S).

On a more local scale, CROW adds data to Char research in Nunavut and NWT rivers. We have been monitoring the deep 83 m hole in Cambridge Bay (CBay1), since 2011. Concern over the fate of material from the community's sewage lagoons and freshwater creek and their effect on oxygen levels suggest that this location is necessary for long term monitoring. Since water below 40 m depth in this hole does not regularly circulate, organic material collecting here could use up all the oxygen in water

during decomposition. In 2016, a complete flushing event or top to bottom mixing occurred resulting in uniform high oxygen, salinity and near-freezing temperature from surface to bottom. The waters deeper than 40m have gotten progressively lower in oxygen since then. It appears that the deep water flushes every 5-6 years. Continued monitoring should give a picture of the time scales for flushing and changes over time. The population of Cambridge Bay is increasing and the demand on the sewage lagoons increases yearly. This monitoring will assist with local marine studies being carried out at the Canadian High Arctic Research Station in Cambridge Bay.

The Kitikmeot Sea Science Study (K3S) has been looking at the oceanography south of the Finlayson Islands since 2016. Summer work from the R/V Martin Bergmann and year round subsurface moorings have helped to define the processes involved in the biological hotspot. The bathymetry of the pass between Unahitak and Qikitarjuaq Islands causes tidal mixing in the area. Nutrient rich water from deep waters mixes with sunshine near the surface to benefit plankton blooms. Phytoplankton (plants) feed zooplankton which supports small fish (arctic cod) that support higher animals such as birds, seals and whales. The “winter holes tidal gardens” concept is that the same tidal currents that bring nutrients to the surface also bring warmer water which causes the sea ice melt earlier in the spring, which also benefits biological production. CROW supports K3S by adding winter CTD profiles to enhance the picture of mixing monitored by the subsurface moored instrumentation and the summer CTD profiles from the R/V Martin Bergmann.

Also in support of K3S, CROW provides a wintertime CTD transect of Dease Strait south of Cape Colburne. The string of 5 CTD stations gives a section across the water of Dease Strait. In summer, this water is strongly layered. The surface is influenced by warmth, sunlight and oxygen near the surface. The bottom waters remain relatively cold and cut off from the surface. In winter, fall storms mix the surface waters and then by April they often become completely mixed to 100 m depth. When CROW takes place in February or March, the water column is in transition and the mixing is still in process. In the middle of Dease Strait, an ice buoy was deployed and a full depth zooplankton net sample made. The ice buoy recorded temperatures until break up in July.

Normally there is some sea ice ridging occurring N-S and E-W south of Cambridge Bay. The ridging forms early in the ice season when winds can still push the ice around before it forms as solid in the strait. In February 2020, the ridging was stronger and more westerly than in recent years. Soon after the transect was made, open water was observed for the first time in some years directly off Cape Colburne. Despite the normally safe nature of the land fast strait ice, changing conditions may make dangerous leads possible. The open lead was likely a feature of the different ice ridging that was observed across the Strait and near Unahitak.

In Kugluktuk, additional stations were included to support a new Community Based Monitoring (CBM) project. Stations were added farther offshore. Additional “river” stations will be added later. The CROW stations monitor the influence of the river in winter. For the CBM project, water samples were taken at a long term CROW station. These samples are part of a study looking at the influence of the river water in Coronation Gulf and the implications for sea run Char.

Conditions encountered in February this year were more severe than trips done later in the season in past years. This year, there were more equipment problems and care was made to ensure the safety of all involved. Rangers were invaluable for working in cold conditions on the sea ice. Without their assistance, these ocean observations would be more difficult and dangerous.

If COVID-19 pandemic conditions continue in 2021, CROW next year may have to change form or be postponed. If DFO scientists are still not permitted to travel to Nunavut and NWT in the spring of 2021, the program may have to be run remotely including all training. Although no remote training can replace in person training, a lot can be done with zoom or skype type communication.

Data Availability

DFO has a mandate to make data available to local communities and to do site visits where data are being collected. During CROW, attempts are made to share with the Rangers, in the schools and to the HTOs information about oceanographic monitoring and research. CROW data has been hosted on the Arctic Eider Society's SIKU (meaning "sea ice") website (siku.org) starting in late 2019. Profiles will be available as well as pictures and the capacity to post comments and observations from the community to allow easy public access to the data. The Oceans Network Canada website (http://www.oceannetworks.ca/) also hosts ice buoy data from CROW. Education and outreach is important to Oceans Network Canada.

Acknowledgements

We thank DND, 1 Canadian Ranger Patrol Group and the Rangers and the communities of Kugluktuk, Cambridge Bay, and Paulatuk for their interest, support and participation in the CROW program. Data collected during CROW provides rare winter oceanographic observations in the Kitikmeot region that would not be otherwise possible.

Associated Researchers

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Appendix

Station Locations

Table 1. List of Stations: CTD cast and Snow depth transect performed at all stations.

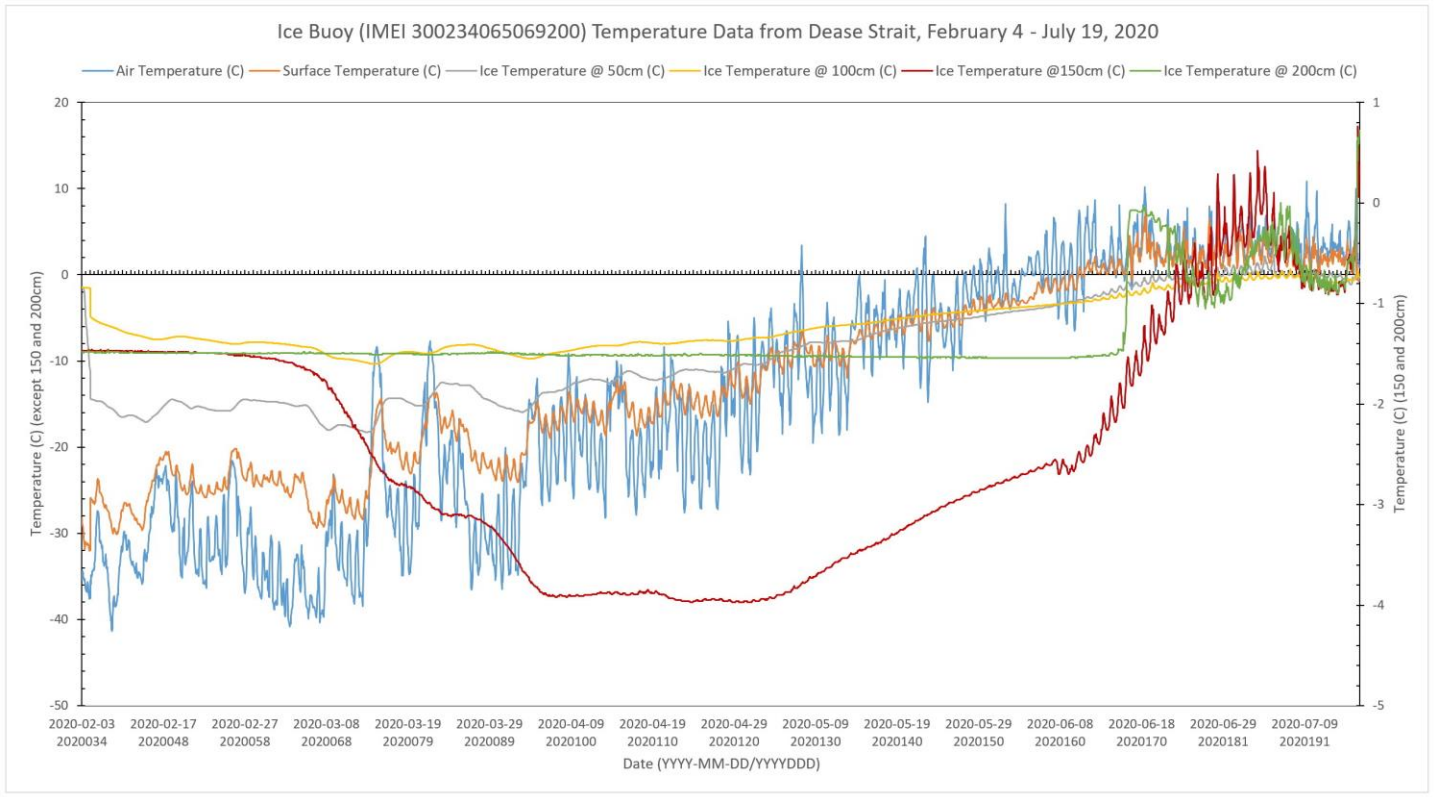
Patrol Group	*Station Name*	*Area*	*Date*	*Latitude (N)*		*Longitude (W)*		*Ice Thickness (cm)*	*Other sampling*
Cambridge Bay	CBay1	Cambridge bay	2-Feb-2020	69	6.248	105	4.495	135	
Cambridge Bay	West Arm	Cambridge bay	2-Feb-2020	69	6.065	105	8.461	99	
Cambridge Bay	DS20-01	Dease Strait	3-Feb-2020	68	56.205	105	13.991	117	
Cambridge Bay	DS20-03	Dease Strait	3-Feb-2020	68	53.338	105	20.740	120	Ice buoy, Zooplankton net
Cambridge Bay	DS20-06	Dease Strait	3-Feb-2020	68	53.108	105	27.855	113	
Cambridge Bay	DS20-02	Dease Strait	3-Feb-2020	68	54.812	105	16.934	117	
Cambridge Bay	AZFP	Dease Strait	4-Feb-2020	69	1.313	105	44.155	105	
Cambridge Bay	UN10	Unahitak	4-Feb-2020	69	1.017	105	45.838	104	
Cambridge Bay	UN20	Unahitak	4-Feb-2020	68	59.961	105	48.983	84	
Cambridge Bay	UN30	Unahitak	4-Feb-2020	68	58.875	105	54.454	109	
Kugluktuk	KUG1	Coronation Gulf	7-Feb-2020	67	51.464	115	8.174	137	
Kugluktuk	KUG2	Coronation Gulf	7-Feb-2020	67	52.412	115	1.090	140	
Kuluktuk	CBM1	Coronation Gulf	7-Feb-2020	67	55.723	115	3.447	121	
Kugluktuk	CBM2	Coronation Gulf	7-Feb-2020	67	53.555	114	52.215	120	

Kugluktuk	KUG3	Coronation Gulf	7-Feb-2020	67	50.663	114	54.118	115	
Kugluktuk	KUG2 Bottle	Coronation Gulf	9-Feb-2020	67	52.419	115	1.063	130	Water sampling at 3 depths

Note on station naming. Most stations have a simple naming such as "Kug 1" where the sea-ice is relatively flat and stations can be reached every year. In Dease and Dolphin & Union straits, sea-ice ridging is not uniform year to year. Because of this, the station location is often offset to avoid difficult ice. In order to define stations by year, a convention of naming the station such as "DS20-02" is used. Station relocation due to ridging is usually less than a few hundred metres.

Figure 1. Ice Buoy Temperature Data

Ice Buoy s/n 019 location : 68° 53.338' 105° 20.740' W (station DS 20-03)
Deployed : 3 February, 2020
IMEI ID : 300234065069200



Maps of Station locations

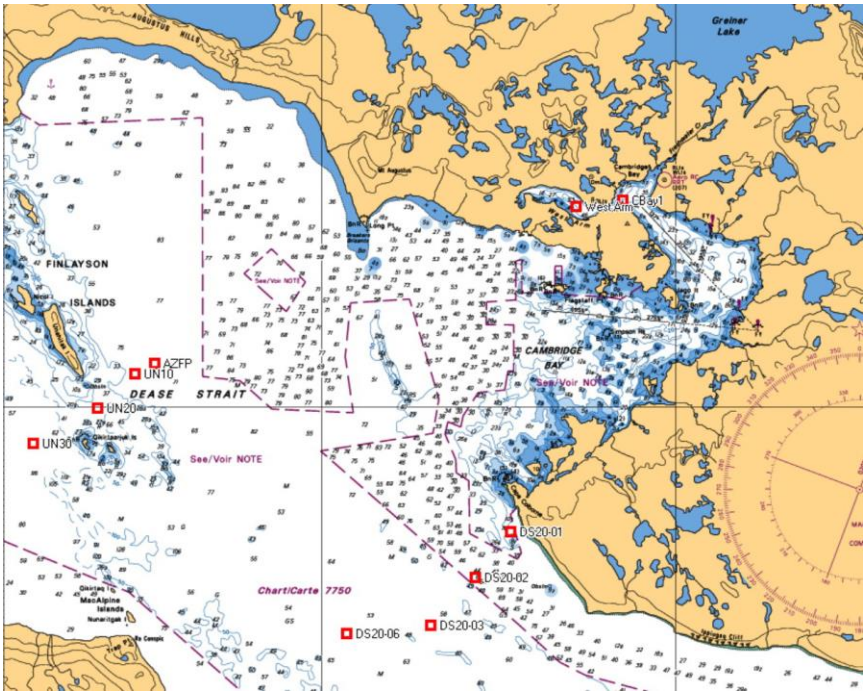


Figure 2. CROW 2020 – Cambridge Bay stations

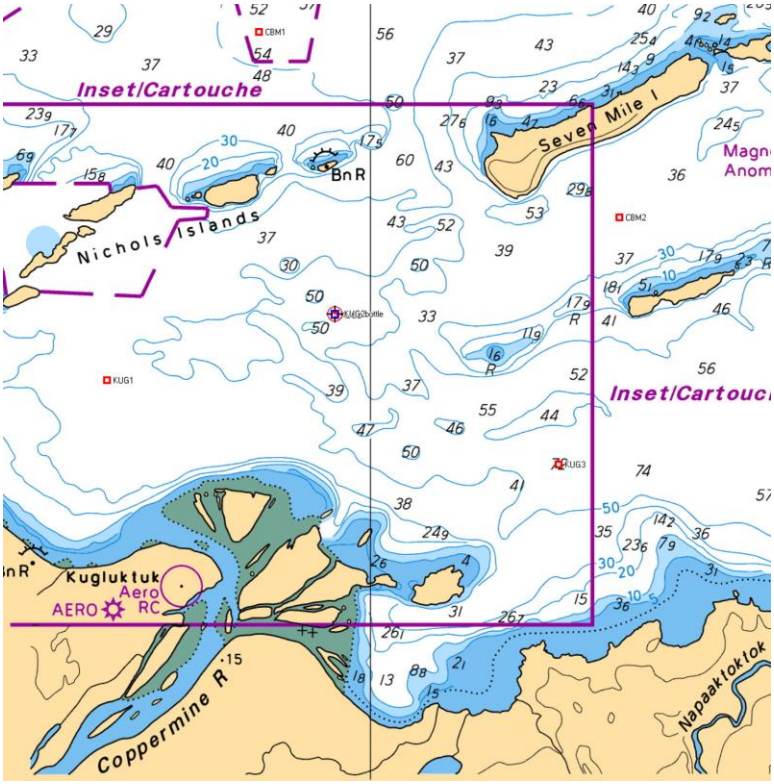


Figure 3. CROW 2020 – Kugluktuk stations

Data Figures

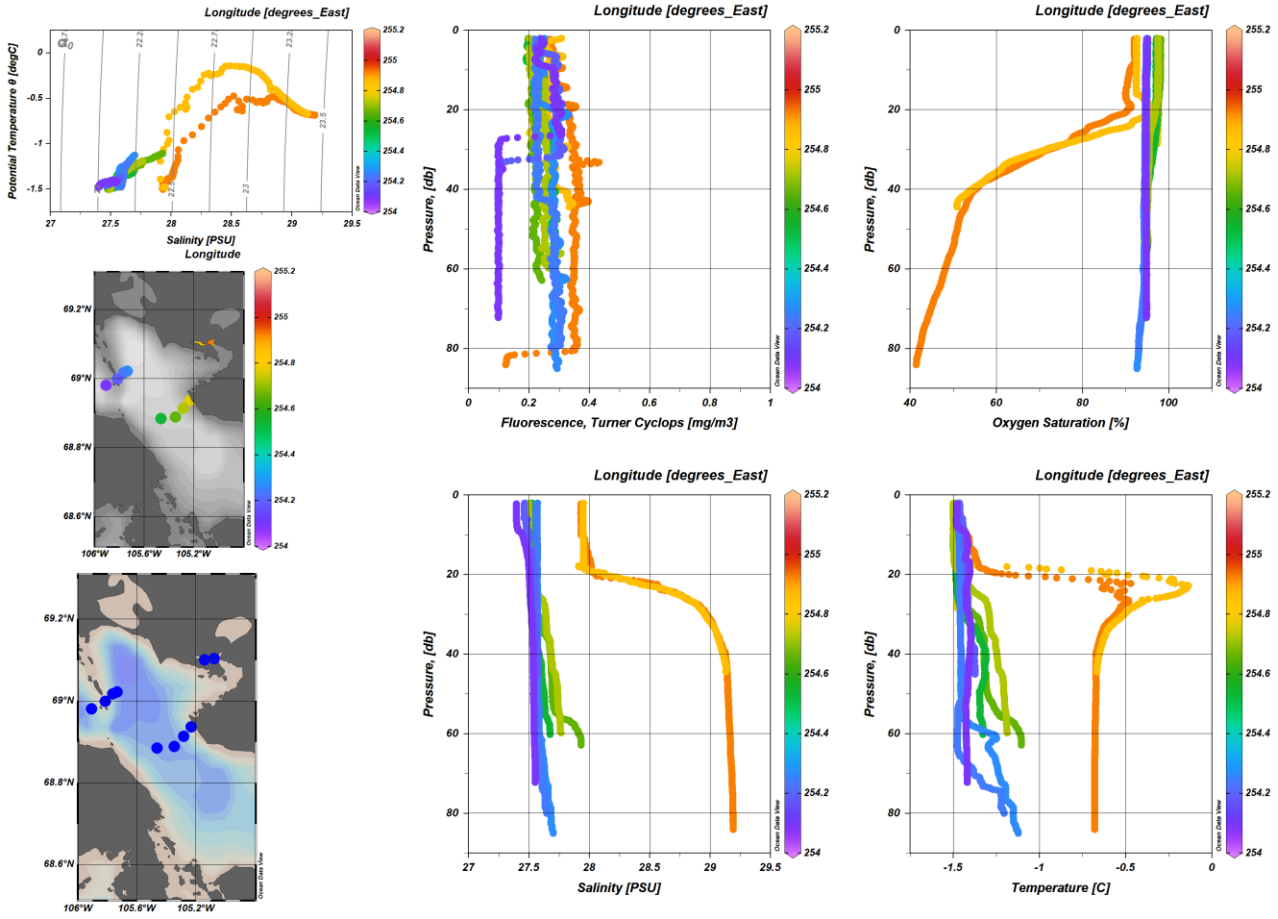


Figure 4. 2020 Cambridge Bay stations by longitude

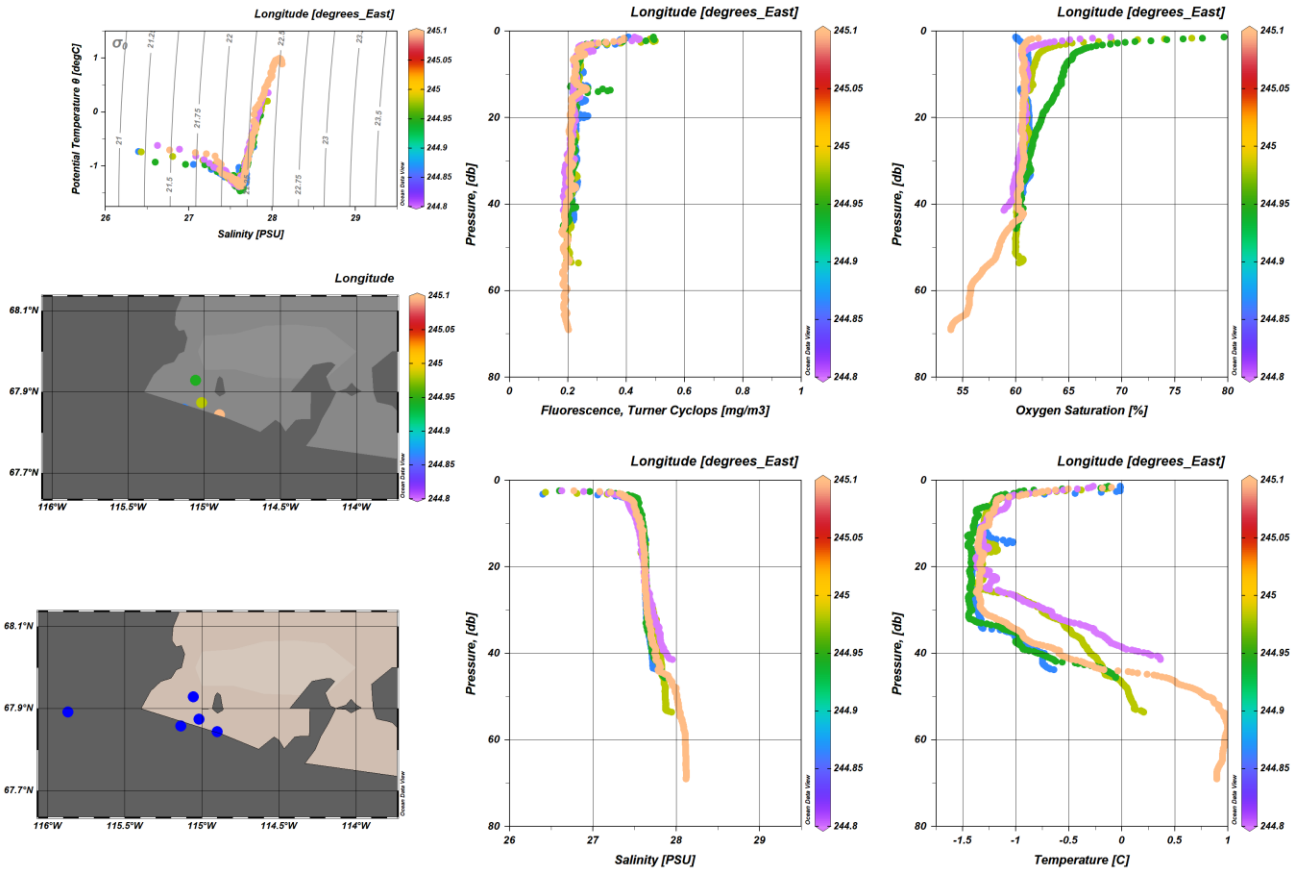


Figure 5. 2020 Kugluktuk stations by longitude