Regional Operations Centre
Canadian Coast Guard – Pacific

PACIFIC REGION CCG VESSEL - POST CRUISE REPORT

Line P Program – Fisheries and Oceans Canada

NAME OF SHIP/PLATFORM: John P Tully

DATE: **FROM:** 30 January 2021 **TO:** 18 February 2021

SCIENCE CRUISE NUMBER: 2020-001 **SHIP'S PATROL NUMBER:** 20-12

CHIEF SCIENTIST[S]: Marie Robert

SCIENTIFIC PERSONNEL:

Female	Male
Moira Galbraith (IOS)	Michael Arychuk (IOS)
Marie Robert (IOS)	Mark Belton (IOS)
Cindy Wright (IOS)	Glenn Cooper (IOS)
	Rowan Fox (IOS)
	Kyle Simpson (IOS)

AREAS OF OPERATION: Haro Strait, Juan de Fuca Strait, Line P, Clayoquot Sound, Nootka Sound, Esperanza Inlet, Hecate Strait, Douglas Channel, Gardner Canal.

INTRODUCTION/PROGRAMS BACKGROUND:

Line P: Line P is a long standing monitoring program which surveys a 1400 km long section 3 times annually. Data have been collected along this line since 1956 and show evidence of the impact of climate variability on ocean productivity. It is the only Canadian long time-series that allows scientists to monitor climate changes so far offshore in the Pacific Ocean. It is also the best opportunity for other programs (e.g. Universities) to do research in the Pacific since the Line P data give them background as well as current water properties. Unfortunately, due to the pandemic, no university students could be part of this cruise.

Argo float deployments: Argo is an international program that uses profiling floats to observe temperature, salinity, currents, and, recently, bio-optical properties in the global ocean; it has been operational since the early 2000s. DFO's contribution to Argo, deploying 12-20 floats per year in the Northeast Pacific, is essential to provide sufficient float coverage in our region; over the last two decades, the real-time data provided by Argo have become indispensable for ocean forecasting, monitoring and reporting on the Northeast Pacific.

Weather stations program: The application of FVCOM (Finite Volume Community Ocean Model) to model the hydrodynamics in BC coastal regions where aquaculture occurs requires meteorological data (including wind speed and direction, solar radiation, air temperature). The model is being used in Discovery Islands, the west coast of Vancouver Island (Nootka Sound and Clayoquot Sound), and Queen Charlotte Strait. We have used two sources to acquire these data; Environment Canada's High Resolution Deterministic Prediction System (HRDPS) at 2.5 km resolution, and weather stations installed and maintained at specified locations within the FVCOM model domain.

Existing data from meteorological models cannot adequately resolve the wind field in some of the more topographically complex regions, or identify some diurnal variability in the wind field. In these locations, weather stations have been installed to directly measure the meteorological parameters (wind speed and direction, and atmosphere/ocean heat flux).

A four-year monitoring program to directly observe the meteorological conditions using weather stations was proposed and funded in 2016. Starting in 2017 weather stations were installed in two configurations; in the Discovery Islands as stand-alone units at locations used in a previous monitoring program (these stations require a maintenance visit every 100 days to download the data), and internet connected weather stations installed on fish farms in Nootka and Clayoquot Sounds, and Queen Charlotte Strait. The stations located on fish farms require maintenance when the fish farms change position, there is an internet malfunction at the fish farm, or when upgrades are required to the weather station firmware.

OPP Ocean Modelling:

The development of port-scale high-resolution ocean forecasting systems to support safe navigation and environmental emergency response in Canada's major ports is a cornerstone of the Government of Canada's commitments under the Oceanography sub-initiative of the Oceans Protection Plan (OPP). Accurate forecasting of ocean surface currents, which are most relevant to mariners and key to predicting oil spill behaviour, requires accurate meteorological inputs to the system. During the "Tully 5" mission in October 2020, five shore-based weather stations were installed in the fjords between Kitimat and Hecate Strait to support the development of appropriate atmospheric forcing for the ocean model. A partial CTD survey of the fjord system will be performed this February to complement the analogous summer survey performed during the mooring installation and recovery mission in Jul/Aug 2020 as well as the fall data of October. The mission also aims to conduct some CTD casts in Hecate Strait, which will serve as useful validation data for the new CIOPS-W regional ocean forecast system developed under OPP. Hecate Strait is one of the less frequently surveyed parts of the coast, but a critical region for determining surface water properties in the NE Pacific. This work is essential to meeting the commitments DFO Science has made to ECCC and CHS under the oceanography sub-initiative of the Oceans Protection Plan.

North Coast Water Properties:

Comprehensive observations of the water properties of the BC North Coast region in the winter yield important information about the response of the shelf region and the inlets to the anomalously warm water detected offshore from 2018 onwards, as marine heat waves are generally thought to be driven by a lack of cooling in the fall and winter months. In addition the winter data may provide a leading indicator of the water conditions at depth in the inlets in the summer. To properly characterize water properties throughout the region, the CTD survey in the Douglas Channel region will be complemented by stations in Hecate Strait and Queen Charlotte Sound, as well as Observatory Inlet and Burke Channel, time permitting. These inlets have been selected as they are dynamically very different and measurements here will support ongoing work to characterize the recovery of deep fjord waters from recent marine heat wave events. Further, DFO Science work in these regions will strengthen existing relationships with local First Nations and the Hakai Institute.

CRUISE OBJECTIVE/OBJECTIVES: Water properties, zooplankton, and trace metal sampling along Line P; deployment of seven Argo floats along Line P; servicing of weather station as well as data collection in Clayoquot Sound, Nootka Sound and in Douglas and Gardner channels.

CRUISE DESCRIPTION: The first part of this cruise, along Line P, went amazingly well. Prior to the first day of the cruise everyone sailing had to self-isolate for four days (at home for the scientists, on the ship for the crew) then got tested for COVID-19. Since we were planning on doing the weather stations servicing in Clayoquot Sound and Nootka Sound, we could depart IOS knowing that we would be in cell phone range to receive the results in the following days. Forty-eight hours after leaving Pat Bay one result came in as "indeterminate" for one crew member. The person got immediately taken to Tofino, the closest port to our location near Clayoquot Sound, without any impact to the program. The following day another crew member joined the ship (after having tested negative) from Gold River. Again, since we were in Nootka Sound at the time, there was no impact to the program. We could then head offshore knowing that everyone tested negative for COVID-19. Despite those test results the standard COVID safe procedures (social distancing, wearing a mask, cleaning surfaces, hand washing, etc.) were followed for a full 14 days after departure. The weather along Line P was really good, especially for a February cruise. All stations were visited and only two deep bongo casts had to be cancelled. Shortly after leaving Station P the weather turned stormy. We were heading into the wind and waves for just under three days, which slowed us down and made for a very uncomfortable ride. Finally once in Hecate Strait we started to work again. The work there included CTDs, rosettes, bongos, and weather stations servicing.

DAYS ALLOCATED: 19 **DAYS OF OPERATION:** 19

DAYS LOST DUE TO WEATHER: ~Two hours at P16 due to high winds. ~20 hours going from P26 to Hecate Strait because of slower speeds and weather course.

SAMPLING:

- The cruise was very successful. All Line P stations were sampled as planned and all casts were done with the exception of two 1200m bongos. We also managed to do a calibration cast at the PA-014 NOAA mooring, and 55 more stations for the North Coast Monitoring program.
- Seven Argo drifters were successfully deployed along Line P, five with dissolved oxygen sensors. One deployment at P26 had to be done between 1200 and 1400 local (ship) time. Although the timing worked well this time, hopefully this will not become the standard practice as it would be difficult to coordinate.
- The samples collected include:
  1) Underway: Thermosalinograph (Temperature, Conductivity, Fluorescence), acoustic sounder, ADCP, pCO_2.
  2) "E-data" from CTD: Pressure, Temperature, Conductivity, Dissolved Oxygen, Transmissivity x2, Irradiance, Fluorescence.
  3) From the Rosette: Dissolved oxygen, salinity, nutrients, chlorophyll, pigments (HPLC), dissolved inorganic carbon (DIC), alkalinity, phytoplankton, total organic carbon (TOC), dissolved organic carbon (DOC), coloured dissolved organic matter (CDOM), Oxygen-18, suspended particulate concentration (SPC).
  4) Zooplankton nets: Vertical net hauls using a Bongo, 236 µm mesh size, with casts to the bottom when shallower than 250 m and for coastal stations; 250 m casts and 1200 m casts offshore.
  5) Trace metal Go-flos: trace metals filtered, trace metals unfiltered, ligands, speciation of trace elements, lead, nutrients, salinity.

RADIOISOTOPE USE:

No radioisotopes were used during this cruise.

PROBLEMS [SCIENTIFIC GEAR AND OPERATIONS]:

We realised about half-way into the cruise that the flow meter on the TSG is mounted backwards. From that moment on, the flow was determined by actually measuring the volume of water per minute.

OSD should buy a satellite phone for shore-based work. Fortunately we had high bandwidth internet on this cruise so troubleshooting of problems at some weather stations could be done using MSTeams from the Tully to relay messages, but being able to communicate directly with IOS from the weather stations would have been more efficient. There were also some weather stations where the *Anderson* would lose communication with the Tully on the regular VHF frequency. Having a satellite phone would have been a good safety tool for the shore party.

The regular "PAR box" wasn't on board. When we did the first CTD cast deeper than 2000 dbar, we had to remove the cable going from the CTD to the PAR sensor in order to "dummy plug" the CTD itself. Eventually the correct plug for the PAR sensor cable was found, but not the box.

The DMS system was working well and P2, P4 and P12 were completed. After P12 the hard drive of the PC failed and the system could not be started therefore DMS samples were no longer collected or analyzed. There were also no more samples collected for DMSP as the value of that data is directly related to that of DMS.

There were a lot of problems with the pCO_2 system losing communication with the GPS feed. When this would happen the whole system would need to be re-started and further communication problems would occur because the system requires a shutdown to be done in a specific way and the loss of GPS feed would freeze up the system and cause a cascade of other problems. This is an issue related to the ships network and it is perhaps time to get an independent GPS feed for the pCO_2 system and move away from the ship's feed. (See Problem: Ship equipment section).

Attempts were made to service the northern weather stations, but there seems to be many issues with the way they are setup. It seems that many components need to be more of the "Plug and Play" type. Also before another effort is made at servicing them again, more spare parts have to be made available.

SUCCESSES [SCIENTIFIC]:

Once again we had full bandwidth of the ONC satellite system for this cruise. The servicing of the weather stations, which needed instant communication with people from IOS, would have been extremely challenging, as well as expensive, if this troubleshooting had to be done over the Iridium ship phone. (See Problems: Scientific gear section).

The ONC signal repeater worked flawlessly again during the whole cruise. This is an essential element in the communication setup with IOS since there are many issues with the network feed in the chief scientist's cabin (See Problem: Ship equipment section).

The new altimeter works much better than the old one, that's a great improvement.

The cruise plan was designed with the forethought that not all COVID test results would be received by the time we left the dock. With the events that followed, having a contingency plan proved very useful as one crew member had to be replaced, and this was done with no impact to the program, partly due to our location at the time.

PROBLEMS [SHIP'S EQUIPMENT/OPERATIONS/PLATFORM SUITABILITY]:

The winch counter electric cable for the bongo winch got wet while sitting on deck and shorted.

A hydraulic fluid leak on the aft-deck soaked the bongo nets in oil.

Some computers, including the chief scientist computer in cabin A and the pCO_2 laptop in the main lab, get kicked off the network from time to time. For clarity, we are referring to the network, not the internet. When this happens, connection to the internet is lost, but more importantly we lose the GPS string, either coming from the bridge in Cabin A's case, or the science GPS feed for the lab computer. Both those computers use wired connections, not Wi-Fi, and actually have Wi-Fi disabled. Another impact of this loss of network connection is the inability to access the TullyCS email account. This has to be done via a web browser since the connection to the ship's server to access email directly with Outlook has been disabled in the chief scientist cabin. We can't figure out what causes those interruptions in network connections. The GPS feed is vital information for our data collection.

The stormy conditions we sailed in returning from Station P shook up some sludge in the loop line, which came out in our loop water. The whole loop line needs to be flushed and clean.

The brake caliper on the LARS head leaked a bit of hydraulic fluid on the rosette at the end of the cruise.

SUCCESSES [SHIP]:

The replacement of the crew member who received an "indeterminate" COVID result was accomplished very well, with no impact whatsoever to the program.

The longer tables in the officer's mess accommodate the physical distancing required by the safe COVID protocols in such a way that meal times don't have to be staggered.

The two days of ship time that were added to the original cruise plan allowed us to accomplish a lot of very important work as part of the North Coast Monitoring program. Winter data are scarce in that area and it was invaluable to be able to perform all those casts. The servicing of the weather stations was also very important and possible only due to the addition of those two days.

In addition to the two extra days, the Tully arrived in Pat Bay earlier than planned and the crew started to load the heavy gear (winches and containers) on the day before the "official start" of the cruise, which allowed us to leave on the evening of the first day. Very valuable time was added with the overnight sailing.

DELAYS [OTHER THAN WEATHER]:

None.

SAFETY CONCERNS:

None.

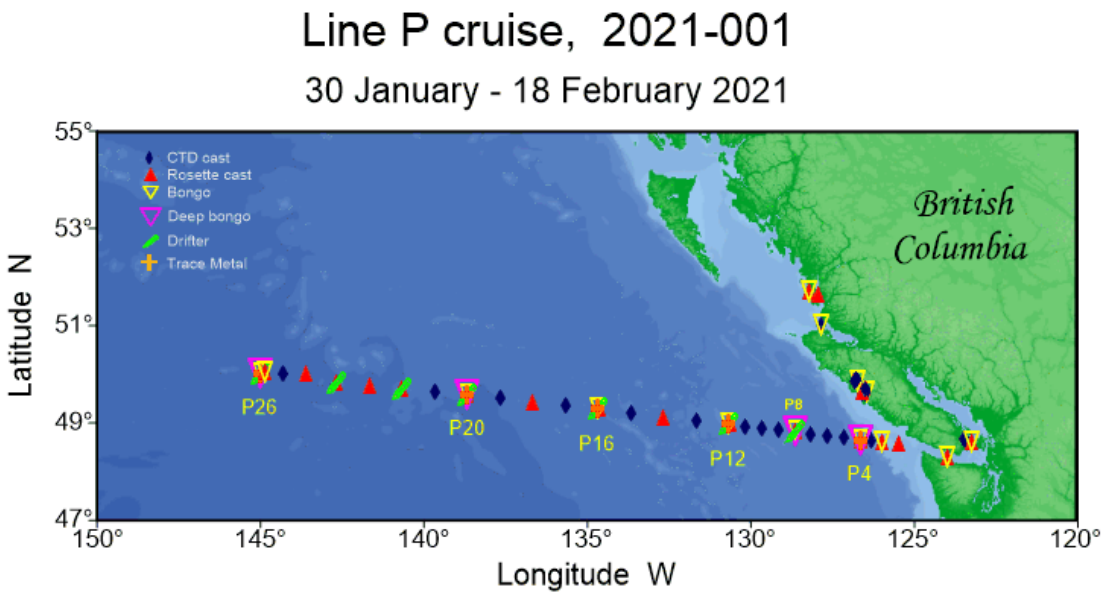
HAZARDOUS OCCURRENCES:

Hydraulic fluid spill on aft-deck.

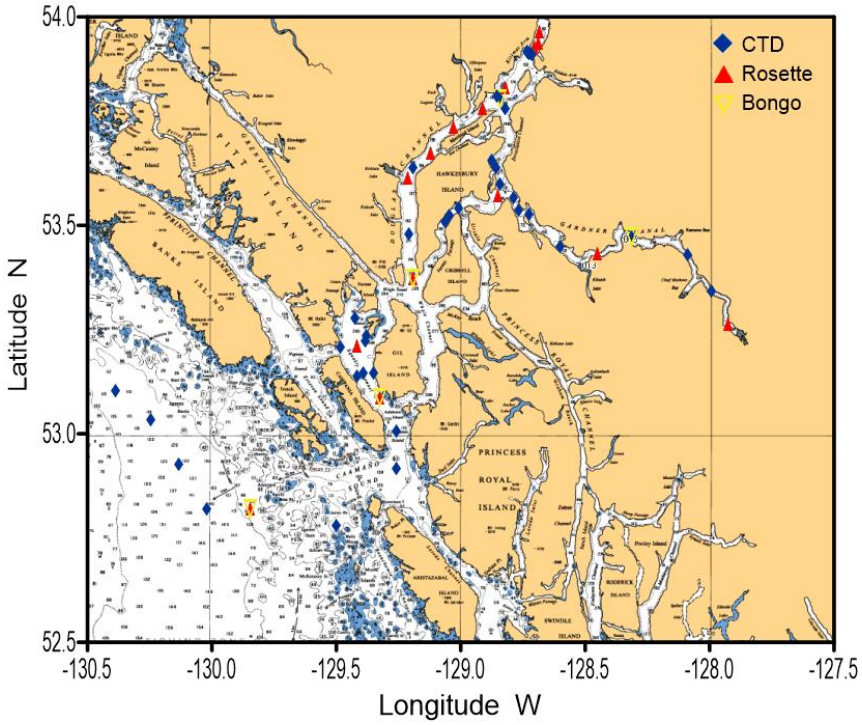
EVENT LOG:

Tuesday 26 January:	Science crew start self-isolating at home.
Friday 29 January:	IOS loading team loads equipment in the trucks and fork-lift more equipment to the Tully. Tully loads winches and containers.
Saturday 30 January:	Science COVID testing between 1115 and 1145. Then load the science equipment on board. Short science meeting in the afternoon. Safety meeting at 1630. Leave Pat Bay around 1815. Saanich Inlet test cast. Some COVID tests results already received. Haro59.
Sunday 31 January:	JF2, P1 to P3. Fire and boat muster.
Monday 1 February:	Weather stations servicing and water sampling in Clayoquot Sound. One crew member leaves the ship because of 'indeterminate' COVID test result.
Tuesday 2 February:	Weather stations servicing and water sampling in Nootka Sound. One new crew member joins the ship.
Wednesday 3 February:	P4 to P8.
Thursday 4 February:	Complete P8, P9 to P12. Deploy Argo floats at P8 and P12.
Friday 5 February:	P13 to P15.
Saturday 6 February:	P16 to P18. Deploy Argo float at P16.
Sunday 7 February:	P20 and P21. Deploy Argo float at P20.
Monday 8 February:	P22 to P35. Deploy Argo floats at P22 and P24.
Tuesday 9 February:	P26, PA-014. Deploy Argo float at P26. Start transiting to Hecate Strait.
Wednesday 10 February:	Transit to Hecate Strait.
Thursday 11 February:	Transit to Hecate Strait.
Friday 12 February:	Start North Coast monitoring work. Stations SRN, MT02, MT03, MT04, HEC1, CAM1, CAM2, CMP1, SC69.
Saturday 13 February:	Fin Island and Verney weather stations servicing. Stations HB-GIL, SC64, HB-CAM, HB-OTTER, SC61, LP53, HB-FIN, SC58, VP39, VP39B, VP39C, Doug02, Kit1, Doug04, Doug-5A, Doug-5B, Doug-05, Doug-5D, Doug-5E, Doug-11, Doug-12.
Sunday 14 February:	Gardner Canal weather station servicing. Stations DeC-26, GC74, GC68, GC60, GC51, GC44, GC38, GC31, GC28, GC26, DeC-24, DeC-21.
Monday 15 February:	Emilia weather station servicing. Stations DeC-19, DeC-12, Doug-12B, Doug-16, FOC1, Doug-26, Doug-29, Doug-31, KSK1, Doug-45. Start heading south.
Tuesday 16 February:	Stations HAK1, KC10, CPE1.
Wednesday 17 February:	North-Ajax CTD cast. Arrive in Pat Bay.
Thursday 18 February:	Offload at IOS.

CRUISE TRACK:



North coast monitoring



SUMMARY/FINAL COMMENTS:

- Many thanks to everyone at IOS who loaded the gear in the trucks on Friday 29 January. Thanks to Scott for doing all the fork-lifting both at the beginning and at the end of the cruise.
- Thanks to OSD for paying for the ONC High bandwidth internet service.
- Thank you to the whole Tully crew for having us on board again, checking our temperature every day, constantly cleaning, wearing your mask for the first 14 days, for all the hand sanitizer dispensers; etc.
- Captain Reid: Thank you. For everything.
- Thanks to Simon for "lending us" your crew and your winter clothing for the *Anderson* operations.
- Thanks to Al and Stephen for hours of station keeping, and mainly for putting up with the constant last minute changes of plan, especially in the last few days!
- Thanks to Bruce and your whole deck crew for your help with bongos and Go-flos and all those little requests we have all the time, as well as for loading the heavy equipment and our cages onboard before the official start of the cruise.
- Special thank you for the crew members who spent hours on stand-by in the *Anderson* while Glenn and Mark were doing the northern weather stations servicing.
- Very big thanks to Sheila for organizing the purchase and pick up of our gear in Kitimat, all this from somewhere in the middle of the Pacific Ocean. That was fantastic and so helpful, thank you.
- Chief and your crew: thank you for all your help too! Despite all the other big problems that you have to face on board, you always still find time to get us the bits and pieces that we're missing.
- Karl and Lachlan: hopefully we'll sail with you guys again in the future!
- Thanks to JP for all the nice flowers, and to Sheila for the 'special notes' …
- And last but definitely not least: thanks to Sheila and the whole "hospitality" department for looking after us so well. Doug and Darshan, you were amazing with accommodating all our little special requests, and there were sure many of them! Mimi, your salads are always very yummy. And Virginie and "miss Kari", it was a great day the day you took off your masks and we could see the smiles hidden too long under them … THANK YOU!