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:** 1 March 2022 **TO:** 20 March 2022

SCIENCE CRUISE NUMBER: 2022-001 **SHIP'S PATROL NUMBER:** 21-13

CHIEF SCIENTIST[S]: Marie Robert

SCIENTIFIC PERSONNEL:

Female	Male
Danielle Caleb (IOS)	Mark Belton (IOS)
Moira Galbraith (IOS)	Glenn Cooper (IOS)
Olivia Melville (UVic)	Rowan Fox (IOS)
Marie Robert (IOS)	Jody Klymak (UVic)
	Julian Smith (IOS)

AREAS OF OPERATION: Haro Strait, Juan de Fuca Strait, Line P, Queen Charlotte Sound, Dean Channel, Burke Channel, Queen Charlotte Strait.

INTRODUCTION/PROGRAMS BACKGROUND:

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.

CRUISE OBJECTIVE/OBJECTIVES: Water properties, zooplankton, and trace metal sampling along Line P; deployment of Argo floats for IOS; deployment of drifters for UCSD; MVP survey for UVic/IOS; water properties and zooplankton sampling in BC's north coast channels, weather stations servicing in Queen Charlotte Strait.

CRUISE DESCRIPTION: This cruise got delayed twice. The original dates of 22 February to 13 March were first pushed by a week, the new dates being 1 to 20 March. Our March 1st departure was then delayed again by two more days because of a lack of key personnel aboard the Tully. Fortunately the weather was quite good and we still managed to do most of our planned work. We only had to skip two stations and a bongo along Line P because of weather. Multiple problems were encountered during the cruise but the engineering department did an awesome job keeping us afloat and operational during the whole cruise.

DAYS ALLOCATED: 19

DAYS OF OPERATION: 16

DAYS LOST DUE TO WEATHER: A few hours; two stations, P6 and P7, and the bongos at P8 got cancelled. One weather station servicing could not be completed because of dangerous landing.

SAMPLING:

- The cruise was very successful. Despite numerous gremlins showing up during the cruise most of the work got done, with the exception of stations P6 and P7, and the bongo casts at Haro59 and P8.
- The samples collected include:

  1) Underway: Thermosalinograph (Temperature, Conductivity, Fluorescence), acoustic sounder, ADCP, MVP (Moving Vessel Profiler).

  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) **– UVic (Melville):** chlorophyll, particulate carbon and nitrogen, carbon gels, nutrients, particulate/biogenic silica, silica uptake of rhizaria using PDMPO.

  4) Zooplankton nets: Vertical net hauls using a Bongo, 236 µm mesh size, were done to either 10 m off the bottom, 250 m, or 1200 m. The mini-net (64 mesh size) was used at P4 to 50 m.

  5) Trace metal Go-flos: **IOS and UBC (Caleb):** trace metals filtered, trace metals unfiltered, ligands, nutrients, salinity, bulk trace-metal clean water.

As part of the NOAA-funded Global Drifter Program (GDP; https://gdp.ucsd.edu/ldl/global-drifter-program/), 10 Surface Velocity Program Barometer (SVPB; https://gdp.ucsd.edu/ldl/svpb/) drifters were deployed along Line P out to Ocean Station Papa to enhance the Global Drifter Array in this area. Surface drifters equipped with a barometer are known to have a sizeable beneficial effect on atmospheric reanalysis products as well as Numerical Weather Prediction models and atmospheric pressure measurements from drifters are not only an essential component to accurately constrain the large-scale sea level pressure field, but also to correct errors of numerical atmospheric models in case of fast evolving storms and explosive cyclogenesis [e.g., Centurioni et al., 2017]*.

*Centurioni, L., A. Horányi, C. Cardinali, E. Charpentier, and R. Lumpkin. 2017. A global ocean observing system for measuring sea level atmospheric pressure: Effects and impacts on numerical weather prediction. *Bulletin of the American Meteorological Society* 98(2):231–238, https://doi.org/10.1175/BAMS-D-15-00080.1.

RADIOISOTOPE USE:

No radioisotopes were used during the cruise.

PROBLEMS [SCIENTIFIC GEAR AND OPERATIONS]:

When we got on board the 12 kHz sounder (EA600) wasn't setup as it normally is. The "Transmit Power" and "Pulse length" settings were both at their minimum. We played with numbers to try to make the sounder work but the results were never quite satisfactory.

Later during the cruise it was noticed that the Acoustic Sounder (EK60) was interfering with the ADCP. This could also be part of the problem with the EA600 mentioned above. It seems that no one knows exactly how those three units – the EA600, EK60 and ADCP – are supposed to interact together. Which one should be pinging and which ones should be listening? At what frequency and pulse length and strength? It would be good if someone knew how to operate the three units so they all work well without interference, if some instructions could be posted somewhere near the units, and we had a log book to write any changes or problems happening during a cruise.

The original oxygen sensor that was on the CTD was malfunctioning in a very erratic way. The bad readings were happening at different values of the down- and up-casts at different stations. We tried changing the sensor but that did not fix the problem. It turned out that the cable was at fault.

We had lots of problems with the mercuric chloride dispenser (for DIC sampling) and had to use the pipette a few times. Thanks to Danielle for doing her best to make it work!

The M/V *Anderson* lost reverse propulsion on her starboard side engine on the second day of use.

My only major suggestion would be more clear instructions about the acoustics, particularly the syncing, and to log the acoustics.

Jody Klymak

SUCCESSES [SCIENTIFIC]:

The new science server is up and seems to be running quite well at the moment. The 'old' science server is still the main "brain" for science for now but for the coming May Line P cruise we may be able to use the new server as main data repository while keeping the old server as a back-up. Many thanks to Rowan Fox for his work with the new server, as well as Lucius Perreault for his help getting it ready.

The science work was great, and my group achieved our goal of a long contiguous section from (near) Station P to Cape Scott on the coast.

Jody Klymak

The CTD lab was "redesigned" over the winter period. The new setup is very nice. Consultation with the main user group would have been nice but fortunately improvements can still be made.

A Brown Booby landed on the Tully on Saturday March 12th in the afternoon and stayed with us until Sunday 13th in the afternoon. This was the 19th sighting of this bird within Canada's west coast EEZ and the first recorded sighting since 2019.

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

The remote control to operate the A-frame wasn't working properly. We had to cancel the bongo at Haro59 because of this issue. For most of the bongo casts on Line P two people were required to deploy and recover the bongos: one on the winch, and one at the A-frame controls behind the Trace Metal container. The remote control was fixed by the time we did the Hak1 bongo.

The hydro winch used for Trace Metal (TM) sampling has some spooling issues. At the end of the first TM cast at Station P the line all piled up at one end of the drum. When the weights were put in the water in order to unspool the line the 'bundle' jumped off the drum. And then the winch stopped working. The weights had to be recovered using another block, not trace metal clean, and the crane. Because of this we may have to cut ~165 m of line. It will be inspected once back at IOS. The spooling controls on the winch were barely working when we completed the last cast at Station P.

The port main engine was lost due to a leaking main fuel supply line. There were no spares on board and the engineers had to fabricate one in order to recover the port main engine. This could have been a very serious issue had the fuel leaked on a hot surface, or if the engineers hadn't been able to fabricate a new supply line.

There were many instances of sewage system blockages or overflowing drains. The sewage system on the ship is in need of serious maintenance.

There is a new "chief scientist computer" in cabin A. There are a few issues with it, the main one being that no one could log on, including Shane Fraser (CCG IT tech). Also there is still only one network drop in the cabin. Since that drop is needed to access the computers on the science network, the new chief scientist computer could not be used anyway. In order for the system to really work the second network drop will need to be activated. Thanks to Shane for trying to solve the issue. This is still a "work in progress".

The ship appears to have a mysterious acoustic issue that impacts scientific sounders. So far, I have been unable to pinpoint what causes this, but it can be seen on all sounders (EK80, EA600, and ADCP). It appears to be triggered by certain hull or engine vibrations and can abruptly appear or disappear, presumably based on what is being used to drive the ship. Note this noise only appears significant while underway. At least one instance was clearly related to clutching in the second engine, but unclutching it, or shutting down the second engine didn't clearly stop the noise. The Engineering team's willingness to look into this was very much appreciated.

Ship is showing signs of age, with multiple key systems needing emergency work while at sea. The extensive efforts of the crew meant that science was not materially impacted, but we may not be so fortunate next time. Canada needs to plan a replacement sooner rather than later, and it is unfortunate that during the Ocean Decade, Canada has an oceanographic fleet that is well past its life expectancy.

Jody Klymak

The crane leaked oil during offloading. The Saturday offloading had to be aborted and was completed on Monday morning.

SUCCESSES [SHIP]:

The main success of this cruise in the "ship" category is the way the engineering department managed to fix something pretty much every day, quite often more than one thing in the day, so that we could keep working and did not have to abort the cruise. Some issues were rather serious, like the leaking fuel supply line, and had the problem not been solved we would have had to abort the cruise.

Another major improvement is that there is no longer a need for "tank breaks" during long stations to empty the grey water tanks. This greatly improves the work done on the major stations along Line P.

The more frequent testing for COVID-19, both prior to and during the cruise, made everyone feel "safer" on board.

The use of two engines when appropriate (between P20 and P26) allowed us to avoid a major storm.

Ship handling was excellent, crew and officers were all enthusiastic and very helpful.

Jody Klymak

DELAYS [OTHER THAN WEATHER]:

~2 days waiting for the chief engineer.
~1 hour for a malfunctioning pump.
A few hours to fix the port main engine fuel supply line.
~7 hours in Port Hardy for fuelling.
~1 hr during Saturday offloading because of the crane until offloading was reported to Monday.

SAFETY CONCERNS:

None

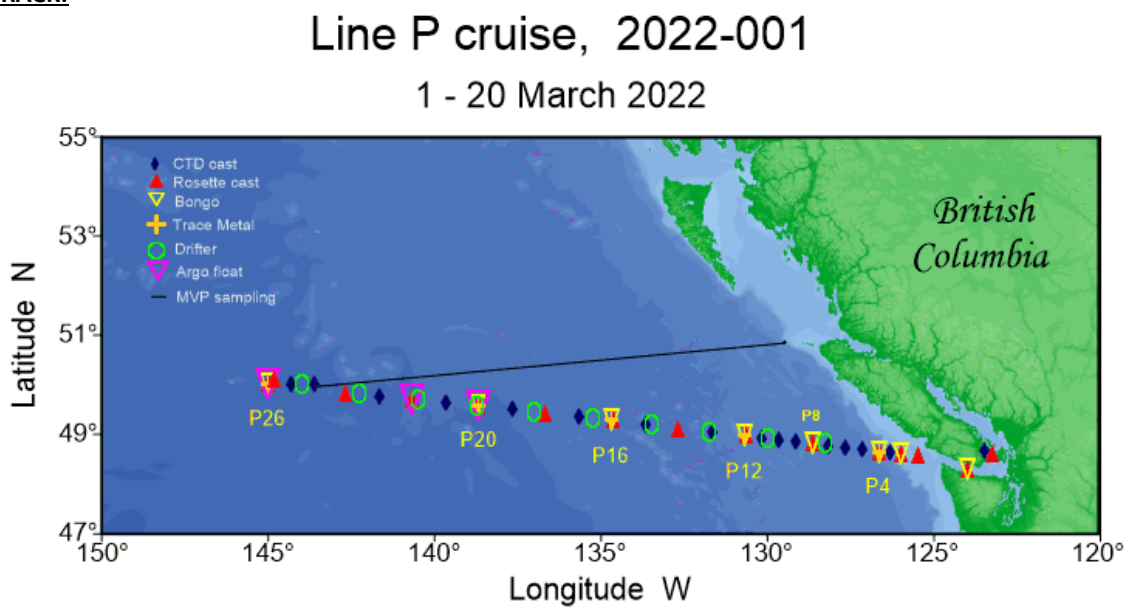
HAZARDOUS OCCURRENCES:

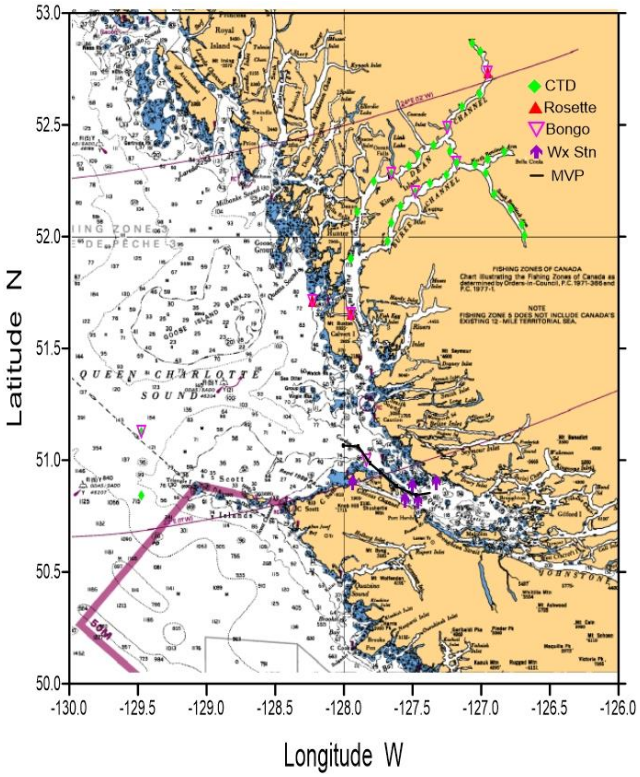
None.

EVENT LOG:

Tuesday 1 March:	Load cube van in the morning. Load equipment on the ship starting at 1230. Safety meeting at 1500.
Wednesday 2 March:	Still at IOS, more set-up while waiting for crew.
Thursday 3 March:	Leave the dock around 1000. Science meeting at 1000. Saanich Inlet test cast. Fire and boat drill. Rosette at Haro59, rosette and bongo at JF2.
Friday 4 March:	P1 to P5. Beginning of bad weather.
Saturday 5 March:	Skip P6 and P7 overnight. Do P8 (no bongo because of bad weather) to P10. Deploy one drifter for UCSD.
Sunday 6 March:	P11 to P13. Deploy two drifters for UCSD.
Monday 7 March:	P14 to P16. Deploy two drifters for UCSD.
Tuesday 8 March:	P19 to P20. Deploy one drifter for UCSD.
Wednesday 9 March:	Complete P20. P21 to P24. Deploy three drifters for UCSD. Deploy two Argo floats for IOS.
Thursday 10 March:	P25, P26, PA-015, P35. Deploy one drifter for UCSD. Deploy two Argo floats for IOS. Start heading east with MVP sampling.
Friday 11 March:	Heading east, MVP sampling.
Saturday 12 March:	Heading east, MVP sampling.
Sunday 13 March:	Heading east, MVP sampling. Station Scott3.
Monday 14 March:	Scott 2, Hak1, Dean Channel stations.
Tuesday 15 March:	Complete Dean Channel sampling, start Burke Channel sampling.
Wednesday 16 March:	Complete Burke Channel stations, KC10, CPE1, first weather station (Bull Harbour).
Thursday 17 March:	Weather stations servicing (Browning Islands, Shelter Bay, start Doyle) and MVP sampling in Gordon Channel.
Friday 18 March:	Weather stations servicing (Doyle - aborted because of weather - and Duncan). Fueling in Port Hardy. Head home.
Saturday 19 March:	Arrive at IOS and start offloading. Offloading stopped due to leaking crane.
Monday 21 March:	Complete offloading.

CRUISE TRACK:





SUMMARY/FINAL COMMENTS:

- The first "thank you" go to the Engineering department. Chief Scott, Angela, Danica, Gavin and Kirstyn, you did an amazing job of fixing things too numerous to count! Without your knowledge, expertise and hard work this cruise couldn't have been this successful.
- Many thanks too to the Galley department. Jody, Darshan, Mimi, Nathaniel, Kari and Matt: we had all those specific requests for 'special foods', and not only was there a choice for every one every day but it was very yummy all the time. And always served with smiles, even when the dumb waiter was broken and food was "walked up" the stairs. Thanks!
- Big thanks to Chase, Alistair and Stephen for being here, for one; also for hours of station keeping and for the "laps" with the MVP.
- Captain Reid: thank you for your help with planning our work around the weather forecasts, and for always being flexible with all our changes of plan.
- Thank you Bruce and your gang – Glen, Bruce, Wesley, Trevor, Tanner, Matthew, Brandon – for all your help on deck and for looking after our equipment so well, including washing our gear!
- Sophie and Mackenzie: I hope that you had a great time "doing science" and that you'll want to be back on the Tully in your future career ☺
- Big big thank you to Shane for helping us with so many things during this cruise, be it computers or monitors or network issues. Even cable issues! ☺ It was definitely helpful to have you on board with us, thanks.
- Special thanks to Jody Klymak for doing his best to understand the sounders / ADCP set-up and writing many notes to help us figure it out.
- Finally thanks to everyone who helped us get ready for the cruise at IOS. Many thanks to Germaine for looking at the data, even on the weekend. Thanks to Scott for forklifting the cages and other heavy gear, and to all those who helped loading.

  Marie Robert
- My sincere thanks to the captain and crew of the John P. Tully, the chief scientist Marie Robert, my watch leaders, and all personnel aboard who helped make this a successful cruise.

  Olivia Melville

Cruise Report: Line-P 2022-001 - March 1st-20th 2022

Olivia Melville
Varela Lab
University of Victoria

Phytoplankton form the base of the marine food web and are extremely important in large-scale Earth processes such as oxygen production and carbon sequestration. The physiological processes of phytoplankton link the ocean, atmosphere, biosphere and lithosphere together in a global biogeochemical cycle. Diatoms, a group of highly abundant phytoplankton, build their shells out of silica thus linking global carbon and silicon cycles. To understand the particular role that diatoms play in the ocean, we can investigate the marine silicon cycle to see how silica concentrations in the ocean fluctuate during the growth and decay of blooms. The standing stock of biogenic silica is often used as a proxy for diatom abundance, however, other silicifiers are present in the water column. Siliceious Rhizaria are zooplankton which take up silicon to create their skeletons. While less abundant than diatoms, Rhizaria are much larger and therefore take up more silicon per individual. Their relative contribution to the global silicon cycle is not well known but is thought to be underestimated. This group is highly understudied in the Northeast Pacific.

Water parameters and zooplankton tows were collected at 7 stations along Line P to examine the relative contribution to the silicon cycle of Rhizaria compared to diatoms. Parameters measured include dissolved and particulate nutrient concentrations, chlorophyll-a and preserved phytoplankton and Rhizaria specimen. Water was sampled from depths between 1000m and 5m using Niskin bottles. Rhizaria were collected from vertical bongo net hauls from 1200m and 250m using a 236 micron mesh. Incubation experiments using the tracer PDMPO (2-(4-pyridyl)-5-[(4-(2-dimethylaminoethylaminocarbamoyl)methoxy)-phenyl] oxazole) were designed to identify which Rhizarian groups are taking up silica at the fastest pace.

At each depth triplicate dissolved silica (dSi), dissolved nutrients and phytoplankton ID samples were collected. Duplicate particulate biogenic silica (bSi), particulate organic nitrogen and particulate organic carbon samples were also taken. In the euphotic zone, transparent exopolymer particles (TEP) and total chlorophyll-a were measured. From bongo net hauls, Rhizaria were picked and incubated for 48 hours with PDMPO. Each incubation included specimen from the same family (Spumellaria or Phaeodaria). At the end of the 48 hours, incubations were terminated by preserving the specimen using formalin.

Acknowledgements

My sincere thanks to the captain and crew of the John P. Tully, the chief scientist Marie Robert, my watch leaders, and all personnel aboard who helped make this a successful cruise.

Cruise Report, LP22a, Jody M. Klymak

Basic Info

Ship: CCGS John P. Tully
Dates: 3 Mar-20 Mar 2022
IOS Cruise ID: 2022-001

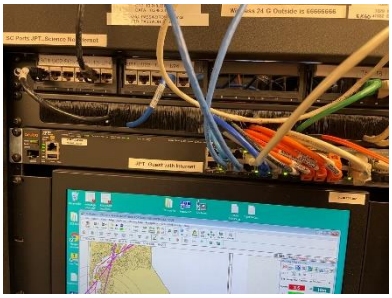
- Captain: Kent Reid
- Jody Klymak
- Rowan Fox (Technician, IOS, MVP help)
- Marie Robert (Chief Scientist, IOS)
- Moira Galbraith, Glenn Cooper, Mark Belton, Julian Smith, Danielle Caleb, Olivia Melville (UVic),
- Chris MacKay (Winch expert, onshore)

MVP Installation

Installation on Tully was smooth. We used the two brown adapter plates on the starboard rear quarter. Boom had to be rotated fully forward so that bongo nets could be deployed, but this didn't result in any issues. We used the 440 V receptacle pictured below.




Software wise, the Tully has a UDP box (in the back of the science rack that serves UDP packets from the Science GPS (10.248.237.222:1025) and the EA600 12 kHz echo sounder's depth value (10.248.237.222:1029). These were listened to with mvpserver (username and password are also mvpserver) which was a mac laptop in stored in the MVP rack. On that machine mvp_relay listened to the UDP packets and relayed them to the MVP acquisition program on the MVP computer. This all worked fine, except the EA600 was not always getting consistent bottoms because there was intermittent noise on all the acoustics from the ship.




MVP operations

Deck tests at IOS were successful.

A manual cast in Saanich Inlet was successful.

In Haro Strait we put fish in water and had ship increase speed to 9 knots. Line out to 62 m was good for the messengers, so we put them at that distance.

After that, no MVP ops until after P26 (and in fact we doubled back a bit to P35 because we had missed it on way out).

The main MVP section was from P35 to Scott 3, consisting of 762 casts.

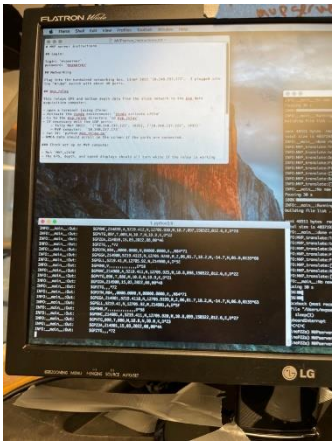
The MVP fish cleared the aft rail if the fish was brought up as high as the termination would allow, so we were able to easily interoperate with the bongo nets, which were also deployed on the starboard quarter.

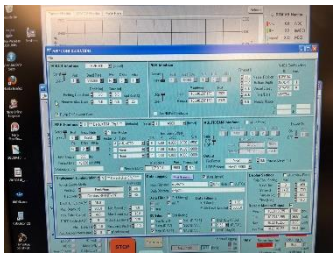
Recovery was usually straight forward; fish was taken out three times at local 12:30, for a quick inspection. At Scott3 it was quite rough (20 knots wind) so we used the hook to keep the line under control. Brought it in relatively slowly like that, and it worked quite well.

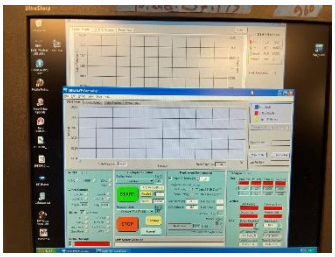
Rigging the fish was as pictured below.

There were no issues with ship handling - both shift officers avoided sharp turns, and we had good communication for taking the fish in and out of the water.

MVP software was run with the recovery at 55% for most of the section.

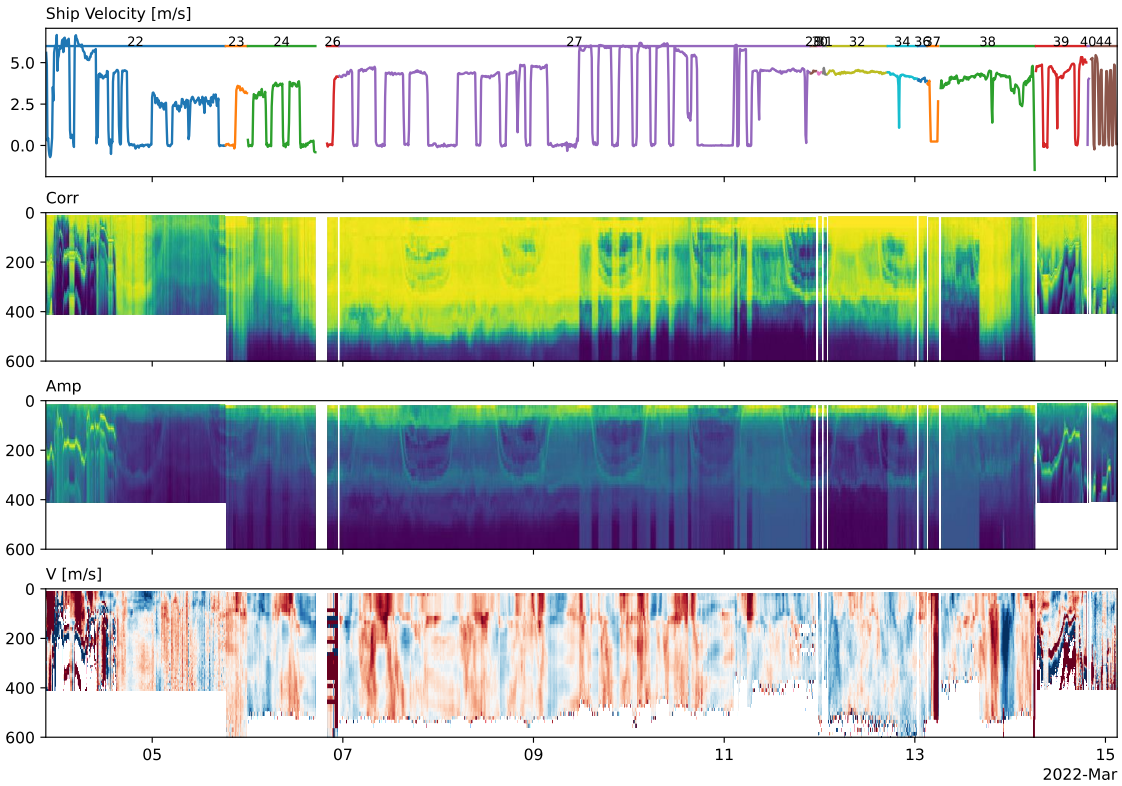






ADCP operations

The ADCP proved somewhat troublesome. Early in the cruise we changed to IOS_BB_NoBottomPing.txt (see ../../data/adcp/raw/SetupFiles/). On March 11, we switched to narrowband mode as the noise was too poor (IOS_NB_NoBottomPing.txt). There appeared to be some noise interference in all the sounders, readily apparent in as low correlation, and high amplitude beyond the depth the ADCP should reach. We switched back to BB a day later.



ADCP Health, Line P trip

The source of the noise was never pinned down. It did not appear correlated with anything obvious in the engine room (e.g. motor changes or generator changes).

The ADPC (and other sounders) also suffered a stoppage of the NMEA relayer, at approximately 13 Mar 03:58 to 06:32 UTC. During this time, the ADCP data is not usable because there is no heading data, and so far as I can tell it was not recorded anywhere else.

Note that the sounders were not syncing until after Scott3. There is the ADCP, the EA600 12 kHz, and the EK80 multi-frequency sounder. There is a switch at the back of the sounder rack that set the trigger to the EK80 (see photo above). Both the ADCP and the EK80 were set in software as the master, so neither was being triggered by the other. After Scott3, I left the EK80 as the master, and changed IOS_BB_BottomPing.txt, IOS_BB_NoBottomPing.txt, IOS_NB_BottomPing.txt, IOS_BB_NoBottomPing.txt, to all listen to the trigger (CX 1,0). This cleaned up interference between the sounders, except the EK80 70 kHz sounder appears to see the long bottom ping every 4 pings, created by the ADCP in bottom tracking mode. Note that if the EK80 ping rate were increased much beyond 1100 ms (where it was for this cruise) the ADCP would not keep up.

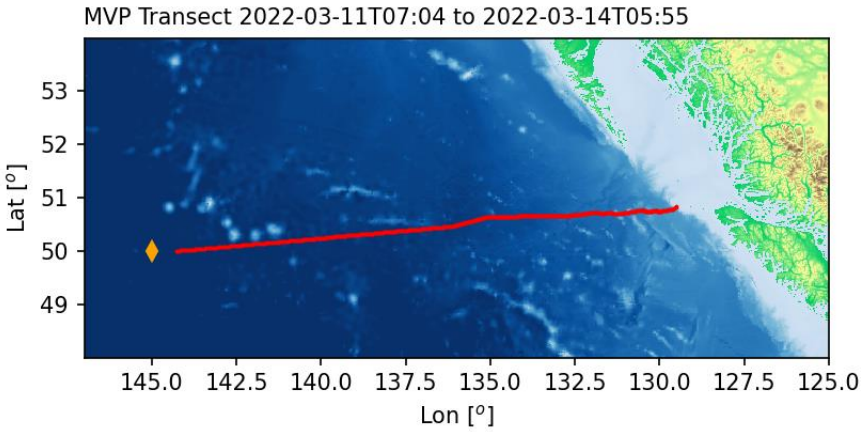
ADCP configuration changes.

File	Config	Notes
23	IOS_NB_BottomPing.txt	(May have been BB&NB?)
23	NB_NoBottomPing.txt	
24	IOS_BB_NoBottomPing.txt	
25	IOS_BB_NoBottomPingPitchRoll.txt	Test to see if pitch and roll are available
26	IOS_BB_NoBottomPingRoll.txt	
27	IOS_BB_NoBottomPing.txt	
28	IOS_BB_NoBottomPing.txt	Turned off ADCP because of interference.
29	IOS_BB_NoBottomPing.txt	Second test
30	IOS_NB_NoBottomPing.txt	Data was bad, so switched to Narrow band
31	IOS_BB_NoBottomPing.txt	back to BB for engine swap
32	IOS_NB_NoBottomPing.txt	Engine swap didn't help.
33	IOS_BB_NoBottomPing.txt	Generator swicthed before this
34	IOS_NB_NoBottomPing.txt	Generator swicth didn't help
35	IOS_BB_NoBottomPing.txt	Going slower
36	IOS_NB_NoBottomPing.txt	Still bad
37	IOS_BB_NoBottomPing.txt	But GPS off!
38	IOS_BB_NoBottomPing.txt	GPS back on
39	IOS_BB_BottomPing.txt	On shelf, so bottom ping
40	IOS_BB_BottomPing.txt	Turned off and then on to check trigger with EK80
41	IOS_BB_BottomPing.txt	testing sync
42	IOS_BB_BottomPing.txt	testing sync
43	IOS_BB_BottomPing.txt	testing sync
44	IOS_BB_BottomPing.txt	Syncing from EK80

Note that between 2022-03-13 03:58 and 22-03-13 06:32 there was no heading or GPS data. Given that there is no heading, there is no usable ADCP data.

Note that there was also a period using broad-band where the signal-to-noise was too low to get good correlations at many depths

Data

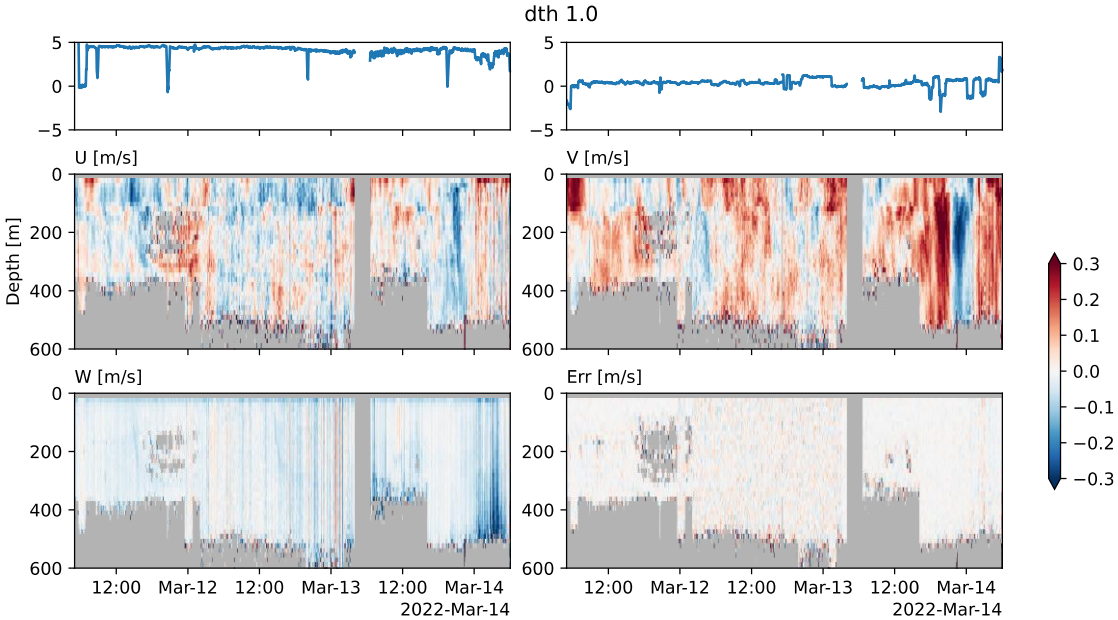


ADCP

ADCP data was logged using VM-DAS and monitored using WinADCP. Data comes in serial ports supplying feeds NMEA1 and NMEA2 to VM-DAS; for the data analysis here we will look at the short-term-averages, which are composed of 100-s ensembles.

Data is corrected for ship motion using the GPS to compute the ship's speed over land. Heading comes from the navigational gyro. So far as I can tell, there is no pitch or roll sensors on the Tully.

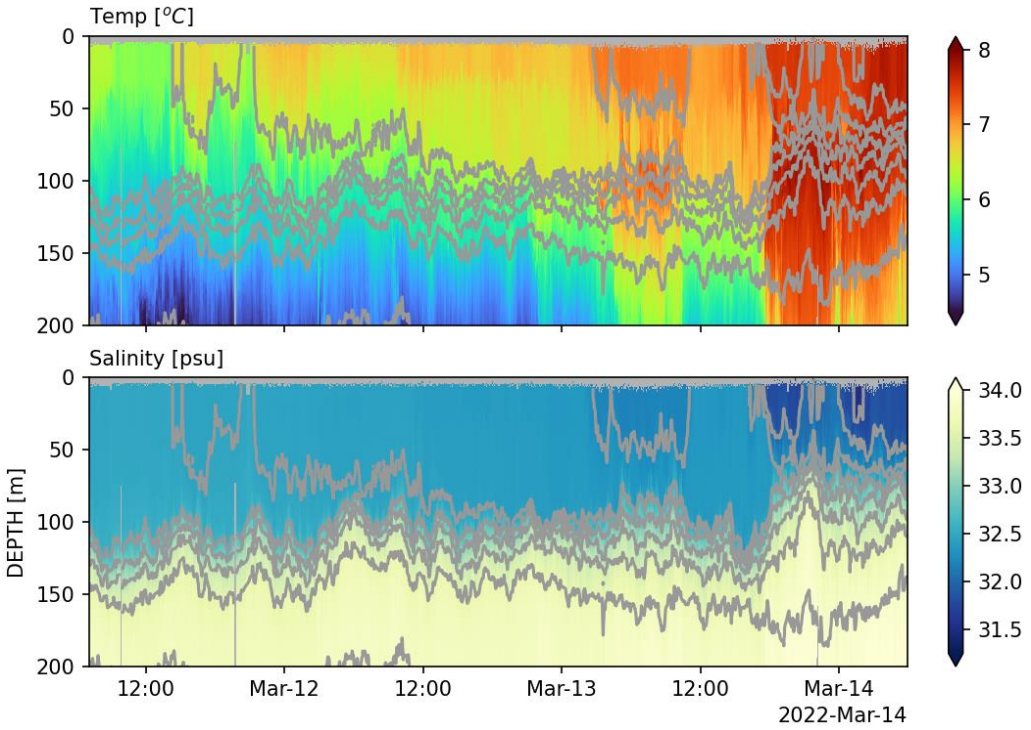
The data set during MVP collection was hampered by the data dropouts mentioned above due to the GPS/Heading not being relayed and due to the acoustic noise on the ship. For the noise narrowband seemed to fix the problem, and for upcoming cruises I am going to suggest we switch to narrowband all the time.

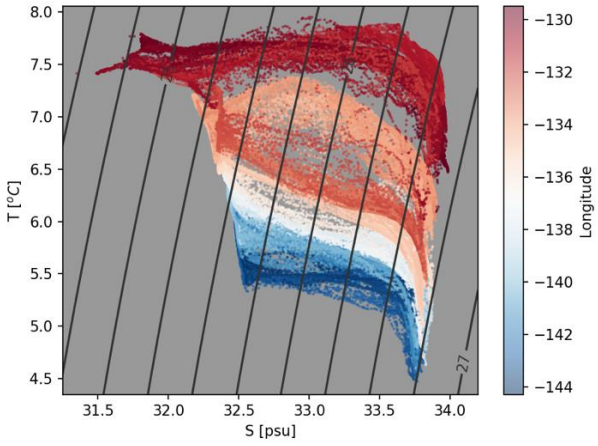


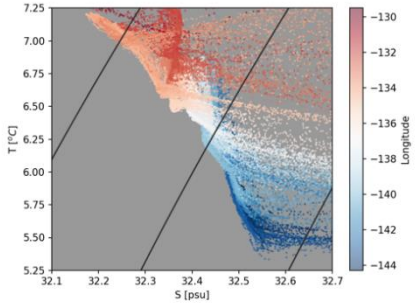
MVP

The mixed layer shows substantial variability during the section, showing signs of significant stratification even this early in the year and during relatively strong winds. Salinity is well-mixed to 100 m or so, but there is some temperature stratification along most of the section. There is an interesting T/S envelope to the near-surface water that I don't quite understand.

The MVP data shows a lot of fascinating lateral structure between the offshore Gulf of Alaska water and the nearshore California Current water.







Ship Issues

Ship handling was excellent, crew and officers were all enthusiastic and very helpful.

The ship appears to have a mysterious acoustic issue that impacts scientific sounders. So far, I have been unable to pinpoint what causes this, but it can be seen on all sounders (EK80, EA600, and ADCP). It appears to be triggered by certain hull or engine vibrations and can abruptly appear or disappear, presumably based on what is being used to drive the ship. Note this noise only appears significant while underway. At least one instance was clearly related to clutching in the second engine, but unclutching it, or shutting down the second engine didn't clearly stop the noise. The Engineering team's willingness to look into this was very much appreciated.

Ship is showing signs of age, with multiple key systems needing emergency work while at sea. The extensive efforts of the crew meant that science was not materially impacted, but we may not be so fortunate next time. Canada needs to plan a replacement sooner rather than later, and it is unfortunate that during the Ocean Decade, Canada has an oceanographic fleet that is well past its life expectancy.

Science Issues

The science work was great, and my group achieved our goal of a long contiguous section from (near) Station P to Cape Scott on the coast.

My only major suggestion would be more clear instructions about the acoustics, particularly the syncing, and to log the acoustics.