# 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:** 15 August 2017 **TO:** 30 August 2017

**SCIENCE CRUISE NUMBER:** 2017-08 **SHIP'S PATROL NUMBER:** 17-06

**CHIEF SCIENTIST[S]:** Marie Robert

**SCIENTIFIC PERSONNEL:**

| Female | Male |
|---|---|
| Ashley Arnold (UBC) | Michael Arychuk (IOS) |
| Moira Galbraith (IOS) | Glenn Cooper (IOS) |
| Annaliese Meyer (UVic) | Hugh Maclean (IOS) |
| Marie Robert (IOS) | Connor Morgan-Lang (UBC) |
| Theresa Venello (UVic) | Richard Nelson (BIO) |
| Chen Zeng (UBC) | Brent Summers (USF) |

**AREAS OF OPERATION:** North East Pacific, Line P, Station P.

**INTRODUCTION/PROGRAM BACKGROUND:** Line P is a long standing 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 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:** Repeat hydrography section (physics, chemistry, zooplankton), repeat Cesium sampling, Trace Metal sampling.

**CRUISE DESCRIPTION:** This cruise (2017-08) went rather well. The weather was very good in general but because of a day of rougher weather at P20 that station as well as P21 had to be cancelled on our way west and sampled on the way back. There were a few hiccups with the main gear at the beginning of the cruise (CTD computer) but this seems to be the norm now. The Trace Metal sampling went really well despite one Go-flo bottle and one messenger being broken. We were also using the ONC satellite dish system to get internet at sea; this system provided a much better signal than the ship's system and it lasted all the way to Station Papa (145°W), as opposed to the ship's signal which we lost around 137°30W. On the other hand, the presence of the satellite dish dome prevents the A-frame to be used to its full range and the system required some 'baby-sitting'. Finally, unfortunately one person of the science party could not sail as planned because the security clearance process wasn't completed on time.

**DAYS ALLOCATED:** 17 **DAYS OF OPERATION:** 16

**DAYS LOST DUE TO WEATHER:** about ¼ day.

**SAMPLING:**

- The Line P survey was 100% successful. All stations were visited and all standard casts were performed.
- Trace Metal samples were collected using the Go-flo bottles on the Kevlar line at all major stations (P4, P12, P16, P20, P26).
- The samples collected include:

  1) Underway: **IOS**: Thermosalinograph (Temperature, Salinity, Fluorescence), acoustic sounder, ADCP, $pCO_2$ – **UBC (Zeng):** PIGGY ($O_2$, total gas tension ~$N_2$), OPTICS (backscatter, absorption, attenuation).

  2) "E-data" from CTD: Pressure, Temperature, Conductivity, Dissolved Oxygen, Transmissivity, Irradiance, Fluorescence.

  3) From the Rosette: **DFO-IOS:** dissolved oxygen, salinity, nutrients, DMS, DMSP, chlorophyll, pigments (HPLC), dissolved inorganic carbon (DIC), alkalinity, pH, demoic acid, DOC (for D. Hansell, U. Miami), GELS (for M. Orellana, UW) **– DFO-BIO (Nelson):** Cesium, $^{129}$Iodine **– UBC (Ashley, Morgan-Lang):** high-resolution bacterial DNA sequencing, number of cells per millilitre, single cell DNA analysis, virus analysis, viral counts – **UBC (Zeng):** methane and nitrous oxide ($N_2O$) – **UVic (Venello):** secondary productivity, zooplankton, 'bugs' (for E. Pakhomov, UBC.

  4) **DFO-IOS and UVic (Galbraith, Venello):** Zooplankton using vertical net hauls (Bongo to 250 m and 1200 m, single fine-mesh net to 250 m, and one MPS to 1500 m).

  5) From the Go-flo: **U. South Florida (Summers) - and UVic (Meyer):** Filtered seawater samples collected for Fe isotopes, Cu(II) ligands, cadmium concentration, and zinc concentration; Unfiltered seawater samples collected for nutrients and salinity.

**RADIOISOTOPE USE:**

No radioisotopes were used on this cruise.

**PROBLEMS [SCIENTIFIC GEAR AND OPERATIONS]:**

There is still a piece of copper pipe in the thermosalinograph set-up, despite this being mentioned in last June's cruise report. Not only is it a bad idea to use copper when you look at biological properties, this piece of copper pipe is set-up just before the fluorometer. It is surprising that the problem has not yet been addressed as the people in charge of the TSG were both at sea between the June cruise and this one and could have dealt with that issue while on board.

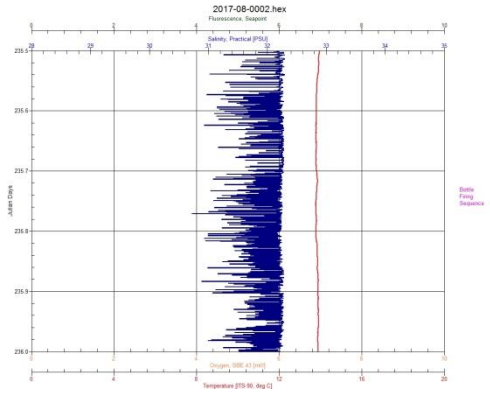
At the beginning of the cruise the CTD software wasn't setup properly. We were not able to load past setup files for some reason, which would have been very useful. After resetting everything the monitors would all go black and we would lose our new setup. We finally created a new setup file, but the problem kept reoccurring. Some emails to people who were on board just a few weeks prior didn't help resolving the problem. We then found out that the problem was caused by a bad connection in a USB cable going from the laptop to one of the monitors. After sending this information back to "the office" we discovered that this was a known issue but the information was not passed onto us. We removed a piece of tape that was supposed to be "a fix" and the issue went away for a few days, but then came back. After cleaning the USB port in the laptop and the malfunctioning cable the problem finally stopped reoccurring.

During the back-and-forth emails regarding the 'monitors black-out issue' and the 'badly connecting cables', we also learnt that the back-up CTD laptop we have on board does NOT have the proper setup to be used on the Tully. It is actually a back-up computer used on the Vector. With the number of laptops that are all around the Institute, and with the daily price of ship-time – not only in money and in labour, but also in the fact that each station is a "one time only deal" – there should be a backup computer, or even two or three, that can replace the main unit in the time it takes to boot them. This discovery was quite shocking.

Some of the wires at the top of the rosette termination were bent as we got on board. This issue should have been mentioned by the last users of the rosette so that it could have been addressed during loading day. This is the kind of information that needs to be passed on between groups, and not just via the cruise report.

The ADCP software is still crashing regularly, at least 2-3 times per day. Since it is being used to trigger the sounders as well as collecting the currents data, this is a twofold problem. Fortunately the VNC software, available on most computers, and the presence of the science network on board allow us to constantly keep an eye on the status of the ADCP software and restart it when needed.

The salinity signal from the thermosalinograph was extremely spiky in rough weather, probably due to the presence of many bubbles in the line (see the blue trace on the graph below for 12 hours). In order to get rid of the bubbles we have to increase the flow to a value too high for the system. Hopefully the new TSG will work better.




The Trace metal container needs to be replaced. The door handle wasn't working when the container was picked up in the yard. The handle got replaced, but then the door could not close properly. The crew had to grind a good part of the door in order for it to close. The rest of the container is very old and falling apart. That container cannot be brought to sea anymore. Also the electrical cable coming from the container did not have a plug at the end of it, so the engineers had to devise a way to plug it to the ship.

**SUCCESSES [SCIENTIFIC]:**

During this cruise we had the ONC (Oceans Network Canada) satellite dish on board. Even though it took a little bit of babysitting, it was fantastic to have. Not only was the signal much faster than the ship's internet signal, it lasted during the whole cruise all the way to Station P. Some conditions would make us lose the signal – like heavy seas or very thick fog – but it was always possible to get the signal back, thanks to the invaluable help from Jarrett Little of ONC and Kenneth Weed of Verizon. During a Line P cruise we normally have no internet access for a week to 10 days. It is much better for the general morale on board when people are able to stay in touch with the loved ones at home, as well as being able to pay bills and the like.

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

Moira Galbraith: The aft deck centre winch, running through the A frame block, has a problem with controlling pay out speed; either all or nothing. At P4 the MPS was deployed but the cast was cut short to 500 m instead of 1500 m. It was too difficult to control descent rate using the remote controls. The MPS was deployed again at P20 using local controls and a clamping system to hold the descent rate at the desired pay out rate. It is hoped that the controllers can be fixed when the ship is at IOS, before the La Perouse cruise leaves.
Moira Galbraith: The aft deck starboard (Bongo) winch had a small issue with the spooler missing its rubber cushion on the control wheel causing the line to pile up in one spot when retrieving or jump loops on deployment. The deck crew was able to come up with a working solution and will get the winch shop to look at it when the Tully is in at IOS.

**SUCCESSES [SHIP]:**

Despite the fact that the ONC dish was wonderful to have onboard, the chief scientist email account was essential in troubleshooting the ONC dish and getting it back online. When the ONC signal was down, that email account was the only way to get instructions on what to do with the dish. Since we don't normally have that luxury (which nowadays is not a luxury but a right, according to Canada's new rules), it is necessary to get the general science email account as previously requested.

The loop water draining in the main lab sink used to flood most cabins on the science deck as well as the instrument lab. The engineers have found a way to prevent this from happening.

**DELAYS [OTHER THAN WEATHER]:**

None.

**SAFETY CONCERNS:**

None.

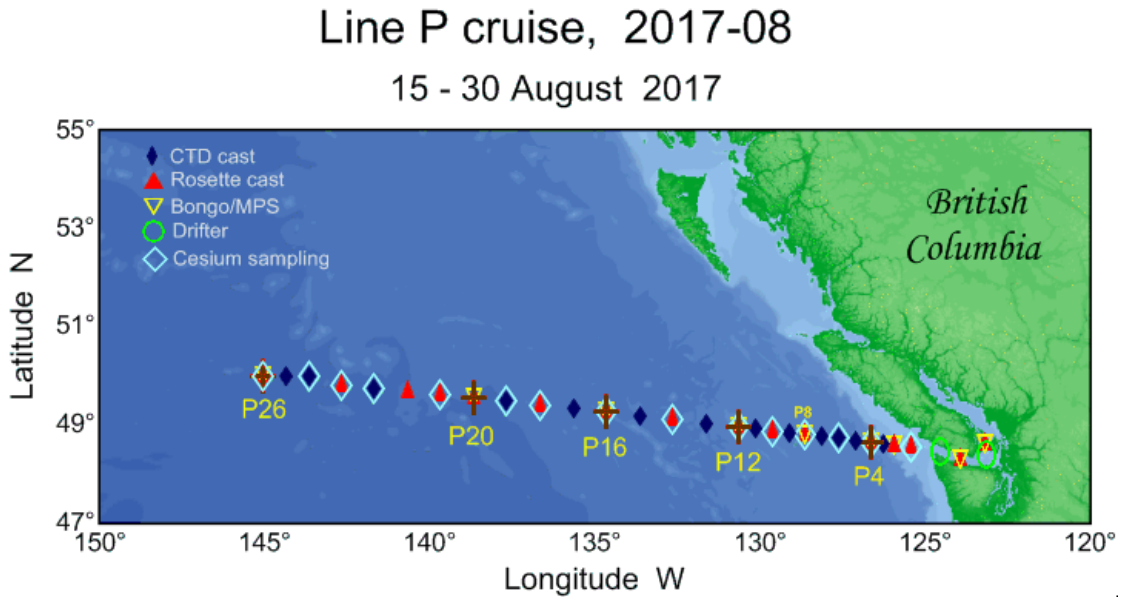
**HAZARDOUS OCCURRENCES:**

One employee had her fingers pinched while trying to steady the rosette during recovery. There was no serious or permanent damage done and no loss of work time followed the incident.

**EVENT LOG:**

| | |
|---|---|
| Tuesday 15 August: | Start loading scientific equipment around 1300. Some containers were already loaded. |
| Wednesday 16 August: | Safety meeting at 0900. Science meeting at 1000. Departure at 1030. Fire drill at 1300. Stations Haro59 and JF2. Deploy drifters for IOS. |
| Thursday 17 August: | Stations P1 to P4. |
| Friday 18 August: | Stations P4 to P9. |
| Saturday 19 August: | Stations P10 to P12. |
| Sunday 20 August: | Stations P13 to P15. |
| Monday 21 August: | Stations P16 to P17. |
| Tuesday 22 August: | Stations P18 and P19. Have to cancel P20 and P21 because of weather. |
| Wednesday 23 August: | Stations P22 to P24. |
| Thursday 24 August: | Stations P25 to P26. 3 Go-flo casts, 3 rosette casts, and 3 net casts at P26. |
| Friday 25 August: | Complete work at Station Papa: 2 rosette casts and 1 Go-flo cast. Rosette cast at PA-011 (NOAA mooring site). Then head to P21. |
| Saturday 26 August: | Stations P21 and P20. |
| Sunday 27 August: | Stop at P16 for a Go-flo cast. |
| Monday 28 August: | Heading east. |
| Tuesday 29 August: | Rosette at P4. |
| Wednesday 30 August: | Back to IOS, offload. |

**CRUISE TRACK:**




**SUMMARY/FINAL COMMENTS:**

- Many thanks to everyone at IOS who have helped make this cruise a success: Kenny, Kelly, Tamara … your help is always greatly appreciated! Thanks for the extra hand (and backs!) while loading.

- Big thank you to Theresa Venello who ended up sampling all the "extra samples" for DOC and GELS.

- Thanks to Oceans Network Canada for the use of their satellite dish, very big thanks to Jarrett Little for dealing with the gear and the extra container at the beginning and end of the cruise, and special thanks to Jarrett and Kenneth Weed of Verizon for helping me trouble-shoot the dish and modem during the cruise so that we would not lose the internet signal. You guys made many people very happy!

- Thanks to the entire galley crew for keeping us so well fed, and for a great BBQ. Very special personal thanks to Meghan for offering a vegetarian option to everyone instead of only having a special meal for the "official" vegetarians. Even though some of us do eat meat occasionally, it is nice to have the option of not eating meat on a regular basis. Thanks also to Al and Phil for dealing with our "put-aways".

- Thanks to everyone on deck for the extra help when we needed it, and for the officers of the watch for doing most of the station keeping without the use of bow-thrusters!

- Finally thanks to the engine room staff for dealing with our "on" and "off" (retention) requests.

  I'm not sure when we'll sail with you guys again; hopefully soon though!

  Marie Robert

- I would like to thank the crew of the Tully for making everything work and a special thanks to Kenny Scozzafava for taking the time to set up the oxygen system.

  Moira Galbraith

- We would like to thank all of those who assisted in the collection of these samples, in particular Rick Nelson. Your help was truly appreciated.

  Glenn Cooper

- Thanks to the officers and crew of the CCGS John P. Tully for the work to make this a successful cruise. Special thanks to Marie Robert for all of the wire time and everyone who helped carry the 24 ℓ carboys.

  Richard Nelson

- I am a person with very severe seasick, but traveling with Tully makes me feel better. It was very nice sailing with this science team. Thanks, Marie, organize and arrange every details and manage the whole Line P trip. Our lab greatly appreciates all of the help we receive on maintaining the instruments and taking all of the calibration and profile samples. An extra thank to Ashley and Connor for helping me collect gas samples in all major stations.
  Thank you to the entire crew of the Tully for their assistance and taking care of us. The engineering staff was very helpful for the underway system setups. The First Aid staff was very careful on my fingers emergency. All the thorough help we have received optimize our work.
  Thanks to anyone who helped us!

  Chen Zeng

- We'd like to thank the Captain and crew of the *Tully* for all their assistance and hard work throughout the cruise, additional thanks to the galley crew for keeping us well fed. Thanks to Marie Robert and the IOS science crew for having us on board to do this work and accommodating our sampling needs.

  Theresa Venello

- We extend our profuse thanks to the crew and to the rest of the science contingent, all of whom were incredibly helpful and knowledgeable.

  Annaliese Meyer and Brent Summers

- We'd like to thank the captain and crew of the *J. P. Tully* for their assistance, excellent work, and willingness to work around the clock. Thanks to the IOS team and our fellow scientists for their help and their humour on deck and in the lab. Our watch leaders Moira Galbraith and Hugh Maclean were instrumental in keeping all members safe and working efficiently during the shifts. And finally, a great big thank-you to Marie for flawlessly organizing the entire cruise and for being a great source of expertise and positivity.

  Ashley Arnold and Connor Morgan-Lang

## PROJECTS AND RESULTS:

**Water masses** – Marie Robert, DFO/IOS.

The weather during this cruise has been very nice. One night of strong winds made us cancel stations P20 and P21 but that was the only windy time. The water temperature along Line P seems to be back to "normal", with positive and negative anomalies compared to the 1956-1991 averages. In August 2016 the waters were still very warm following the presence of the "Blob". This August some near surface areas of warm water remain in the inshore part of the lime, but cooler than average water can be seen offshore. (See figure 1).

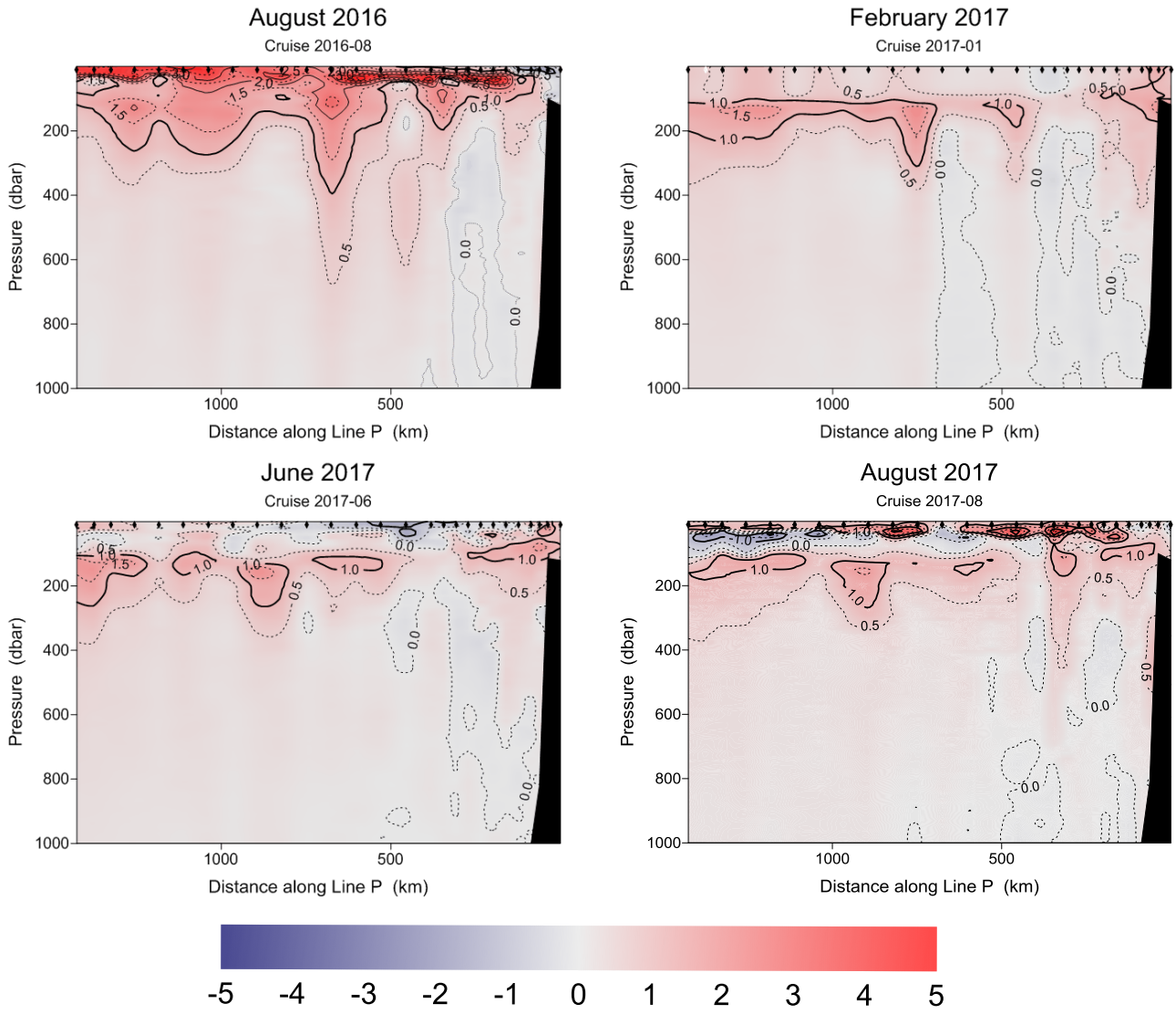



Figure 1: Temperature anomaly field with respect to the 1956 – 1991 averages for August 2016 (top left panel), February 2017 (top right panel), June 2017 (bottom left panel), and August 2017 (bottom right panel). The warm anomaly seems to be getting much smaller and much deeper with time. Please note that the February and June 2017 data are not processed.

## **Zooplankton** – Moira Galbraith, DFO/IOS.

- 12 Bongos, one shallow 250 m and one deep 1200 m, from Line P: P4, P8, P16, P20, P26
- one shallow each from P2 and P20
- additional Bongo samples were taken at Haro59 and JDF2 for the Strait of Georgia zooplankton program
- MPS was deployed at P12 and P20 for a total of 10 samples.

Total zooplankton samples collected this trip was 24. At each station where DIC was collected, a subsample of *Limacina helicina* was taken from the bongo. Additionally, small number of juvenile euphausiids was set aside from selected stations for secondary production use.
The aft deck centre winch, running through the A frame block, has a problem with controlling pay out speed; either all or nothing. At P4 the MPS was deployed but the cast was cut short to 500 m instead of 1500 m. It was too difficult to control descent rate using the remote controls. The MPS was deployed again at P20 using local controls and a clamping system to hold the descent rate at the desired pay out rate. It is hoped that the controllers can be fixed when the ship is at IOS, before the La Perouse cruise leaves.

The aft deck starboard winch had a small issue with the spooler missing its rubber cushion on the control wheel causing the line to pile up in one spot when retrieving or jump loops on deployment. The deck crew was able to come up with a working solution and will get the winch shop to look at it when the Tully is in at IOS.

Other thoughts: computer used for the rosette control program needs be more robust for sea going work. The cables and wiring for the computer and monitors should be cleaned up and clearly marked, not a rat's nest. All connections should be cleaned before each trip and replaced if corroded. The closet itself needs a good cleaning, with a vacuum. Fully working and up to date virus detections programs need to be on all sea going computers, should not be getting a request to buy virus subscription or update programs in the middle of a cast. And need a better solution to the rosette winch crane head eating the conducting wire at the termination wraps.

And of course I would like to thank the crew of the Tully for making everything work and a special thanks to Kenny Scozzafava for taking the time to set up the oxygen system.

## **Carbonates** – Glenn Cooper, DFO/IOS.

1) Seawater pH analysis:

Seawater pH was determined using the spectrophotometric method developed by Clayton and Byrne (Deep Sea Research, 1993). Seawater was collected directly from rosette niskins into 10cm path length glass cuvettes. Purified meta-cresol purple indicator dye (m-CP), obtained from the Byrne laboratory, was used and validated prior to the cruise at Institute of Ocean Science (IOS). All work was performed in the temperature control lab onboard the John P. Tully. Seawater was scanned at 434nm, 578nm and 730nm, without and with the addition of indicator dye. At various samples representing the spectrum of seawater pH found, extra dye was added in order to back calculate the perturbation of the dye on the sea water sample.
The following major stations were sampled: Haro59, JF2, P01, P02, P04, P12, P16, P20, and P26. One set of triplicate samples were taken at stations JF2, P01 and P02, whereas all other casts had two sets of triplicates. Replicates will be used to determine precision for the entire cruise. A calibration cast was performed at P19 where triplicates were taken from 5 niskins which were closed at all the same depth of 2000m.

2) Dissolved Inorganic Carbon and Alkalinity sampling:

DIC/alkalinity samples were collected into 500ml glass bottles, which were over flowed by 1.5 volumes, and preserved with 100ul of saturated $HgCl_2$ at the following stations: Haro59, JF02, P1, P2, P4, P12, P16, P20, P26. A calibration cast was performed at P19 where triplicates were taken from 5 niskins, all of which were closed at same depth of 2000m. Stoppers were greased with Apeizon grease and taped closed with electrical tape, placed into a walk in cooler until unloaded at IOS for onshore analysis. At P26, a complete extra set of samples were collected for archiving.

We would like to thank all of those who assisted in the collection of these samples, in particular Rick Nelson. Your help was truly appreciated.

## **Cs-137 and I-129 Sampling** – Richard Nelson, DFO/BIO.

An earthquake triggered tsunami on March 11, 2011 caused extensive damage to the nuclear generating station at Fukushima Japan resulting in the discharge of large amounts of Cs-137 and other radionuclides directly to the Western North Pacific ocean during the months following the accident. The radioactive plume was transported northeastward under the influence of the Kuroshio current and was expected to approach the Canadian coastline several years after the accident. A Canadian monitoring program was established to detect the arrival of Fukushima radioactivity in the water columns of the eastern North Pacific and the Arctic oceans.

Water samples were collected at stations occupied on the "Line P" missions on the CCGS J P Tully beginning in June of 2011, 2012 and 2013. The program was expanded in 2014 to include both the Feb and Aug Line P missions.

**Sampling 2017-08:**

Five full profiles were collected at stations P4, P10, P16, P21 and P26 at depths 500, 400, 300, 200, 150, 100, 50 and 5 meters. As the signal from Fukushima moves towards the coast and begins to slowly sink it is expected that Cs-137/Cs-134 isotopes will be detected at the deeper depths of the profile. Sixty liter samples were collected at all depths.

In addition 60 liter surface samples were collected from the underway loop system after the ship was on station at P1, P6, P8, P12, P14, P18, P19, P23, P24, P25. A duplicate sample was collected at P4 from the underway loop system for comparison to the rosette samples. A total of 51 samples were collected.

In addition 500 milliliter samples were collected for I- 129 analysis from the rosette at all of the profile stations. A total of 40 samples were collected.

The samples for Cs were extracted onto KCFC ( potassim cobalt ferrocyanide ) ion exchange resin at flow rates of approximately 300 ml's per minute, then sealed for return to the Bedford Institute of Oceanography.

The resin samples were then dried, placed in appropriate counting geometries and the Cs-137 and Cs-134 radionuclides were determined by Gamma ray Spectroscopy using HPGE (high purity Germanium) detectors.

Thanks to the officers and crew of the CCGS John P. Tully for the work to make this a successful cruise. Special thanks to Marie Robert for all of the wire time and everyone who helped carry the 24 ℓ carboys.

## **Cruise Report** – Chen Zeng (Tortell Lab; UBC, Earth, Ocean & Atmospheric Sciences)

**Objectives:**

Our participation in this cruise was focused on measuring the distribution of biogenic gases, as well as indices of phytoplankton community composition and biomass, along the Line P transect. We deployed several automated instruments for real-time analysis, and collected discrete surface and depth profiles for subsequent laboratory analysis. A key aim of these efforts was to quantify net community production and various components of phytoplankton productivity at high spatiotemporal resolution along the Line P transect.

**Gas Measurements and Quantification of Net Community Production:**

At the major stations (P4, P8, P12, P16, P20, and P26) we collected discrete profile samples for analysis of methane and nitrous oxide ($N_2O$), contributing to an almost-ten year time-series of these gases along the Line P transect.

Continuous measurements of surface $O_2$ and total gas tension were made by pumping seawater through an oxygen optode and gas tension device (GTD) using a SBE pump. Unlike previous deployments (June 2016 – June 2017), the instruments were run on the bench-top in the main lab. Overall, the instrument required very little maintenance, and data quality appears strong. As in previous cruises, discrete $O_2$ samples were taken from the seawater loop at the major stations to calibrate the offset in the optode.

**Optical Instrumentation:**

We continued our measurement of optical properties from the seawater loop, including particulate back-scatter and spectrally-resolved absorption and attenuation. These measurements will be used to derive estimates of Chla, phytoplankton carbon, as well as the relative abundance of different pigment classes (which can be used to indicate phytoplankton taxonomic abundances) in surface waters. As was the case last summer, the wall-mounted setup was ideal, and the addition of the outward-facing grating facilitated an even more compact, more easily-adjusted setup. Similar to Miss Piggy, the optics suffered from bubble contamination

during particularly rough parts of the cruise, but overall, we were able to get good measurements along the entire length of the transect, and were consistently able to take measurements on-station, when the ship roll was less violent. The data obtained here will provide a useful seasonal comparison to existing and future summer datasets. Also, calibration against discrete Chl measurements in very low-productivity waters will prove useful.

Samples for size-fractioned Chla (20um, 2um and 0.2um filters) were taken from the seawater loop on numerous stations (collected when rosette was near 5m). These samples will be used to calibrate the high-resolution absorption/attenuation spectral data from the optical system, and for comparison between our in-situ data and satellite algorithms.

**Comments:**

I am a person with very severe seasick, but traveling with Tully makes me feel better. It was very nice sailing with this science team. Thanks, Marie, organize and arrange every details and manage the whole Line P trip. Our lab greatly appreciates all of the help we receive on maintaining the instruments and taking all of the calibration and profile samples. An extra thank to Ashley and Connor for helping me collect gas samples in all major stations.

Thank you to the entire crew of the Tully for their assistance and taking care of us. The engineering staff was very helpful for the underway system setups. The First Aid staff was very careful on my fingers emergency. All the thorough help we have received optimize our work.

Thanks to anyone who helped us!

## **Line P – August 2017-08:** Theresa Venello, UVIC (Dower Lab)

**Objectives:** Quantifying crustacean zooplankton productivity along Line P using the chitobiase-method. Comparing production rates from the *Tully's* seawater loop system and 5 m rosette Niskin bottle. Linking zooplankton community composition to crustacean zooplankton productivity.

**Sampling:**

500mL of seawater was taken from 6 depths (5, 10, 20, 50, 150, 250 m) at all 7 major stations that have a bongo net cast (P2, P4, P8, P12, P16, P20, P26). Samples were taken on the way out to P26 with exception of P20 which was collected on the way back. Loop seawater samples (500 mL) were also taken at each of these stations.

In addition, loop seawater samples were taken at P6, P10, P14, P19, P22, P24 to increase the spatial resolution of our production rate estimates. All loop samples were collected on the way out to P26.

Water was taken from the rosette, filtered through 54µm mesh and into 500 mL Nalgene bottles. Water samples were then 'spiked' with a homogenate made from ground krill and/or copepods (depending on what was in the bongo sample); filtered every three hours over a 12 hr period to create a decay of the moulting enzyme chitobiase. Samples were assayed and read using a fluorometer while on board.

Zooplankton samples were also collected from the rosette at P2, P4 and P26 by filtering whole niskin bottles at three depths (5, 50, 100) through a 63 µm mesh sieve. The white ring net (64 µm) was also used at P2, P4, P8, P16, P20 and P26 to collect an additional zooplankton taxonomy sample. All samples were collected on the way out to P26 with the exception of P20 which was collected on the way back. This work was conducted for Evgeny Pakhomov and Lian Wong at UBC.

**Comments:**

All of our sampling goals for this cruise were met.

We'd like to thank the Captain and crew of the *Tully* for all their assistance and hard work throughout the cruise, additional thanks to the galley crew for keeping us well fed. Thanks to Marie Robert and the IOS science crew for having us on board to do this work and accommodating our sampling needs.

**Trace Metal sampling** – Annaliese Meyer – NSERC Student Researcher, University of Victoria; and Brent Summers – PhD Student, University of South Florida

**PI**

Dr. Jay Cullen
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College of Marine Science
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**Samples Collected**

- Filtered seawater samples collected for Fe isotopes, Cu(II) ligands, cadmium concentration, and zinc concentration
- Unfiltered seawater samples collected for nutrients and salinity

**Introduction**

Trace metal sampling was completed over the course of the CCGS John P. Tully cruise from Sidney, British Columbia along the Line P time series to Station Papa. These samples will primarily be used in the study of the dissolved stable iron isotope composition of seawater and marine source materials like atmospheric dust to identify the importance of iron sources to the ocean. These sources can be determined by their unique iron isotope signatures. Identifying these sources can help estimate the flux of oceanic and terrestrial sediments, hydrothermal vents, and atmospheric dust. By understanding the flux estimates of iron to the ocean, we can better constrain the marine iron cycle in order to fully understand the role iron plays as an essential micronutrient for marine phytoplankton and thus its effect on primary productivity and carbon cycling.

**Methods**

*Go-Flo casts*

12 L Go-Flo bottles on a Kevlar line were deployed at P4, P12, P16, P20 and P26 to collect water samples from depths ranging from 3500 m below surface (at P26, 4000 m) to 10 m below surface. At P4, 3 casts of 4 bottles each were performed. At P12, P16, and P20, 3 casts of 5 bottles were performed, and 4 casts of 5 bottles were completed at P26.

*Sample collection*

Sample collection was performed in a HEPA-filtered, closed container on the aft deck to prevent contamination of samples. Filtered water was taken at every depth for analysis of iron, cadmium, and zinc isotopes. Separate filters were used for P4 and for deep (below 300 m) and shallow (300m and up) offshore stations. For the top 10 depths, 4 L of water was collected from each in Teflon bottles. Below that, two 1 L aliquots were collected in Teflon bottles. 500 mL samples were taken at each depth in LDPE bottles exclusively for analysis of iron content. At 25 m for each station, 3 L of filtered water was collected for Cu(II) ligand analysis in Teflon bottles, then frozen. 250 mL of unfiltered water was taken from every depth except for station P4 and from station P20 due to a shortage of the required LDPE bottles. Salinity was collected at the bottom depth of each cast, and at the mid depths for several casts. Nutrients were collected for every depth and frozen, with duplicates taken and cooled at all depths below 500 m.

Bulk unfiltered seawater was taken upon return to P16. One cast with 5 bottles deployed at 25 m, 31 m, 37 m, 43 m, and 45 m was performed and the bottles were emptied into two 20 L clean carboys.

**Cruise Notes**

At P4, the 500 m bottle (1) did not fire due to a jammed messenger. Salinity was taken from Bottle 2 at 300 m, and another cast was performed to obtain the 500 m sample.

A bottle was dropped while being secured inside the trace metal container. The spigot was broken off and later repaired by the CCGS *Tully* crew with two-phase epoxy at P12. A spare Go-Flo bottle was used for all subsequent casts.

At P16, a radio miscommunication resulted in a Teflon messenger colliding with the top of the winch. The internal threads were damaged and we were unable to secure the top third to the rest of the messenger. For the following casts, the connection was supplemented with duct tape, and casts proceeded nominally. Additionally, the Cu(II) ligand samples at P16 did not get frozen immediately, so another set of Cu(II) ligand samples were taken on return.

We extend our profuse thanks to the crew and to the rest of the science contingent, all of whom were incredibly helpful and knowledgeable.

**August 2017 Line P –** Ashley Arnold and Connor Morgan-Lang, Hallam lab, UBC.

**Objectives:**
Describe the taxonomic and metabolic diversity of the microbial communities in the cycling of major nutrients along Line P, focusing on the communities in the oxygen minimum zone. Additionally, samples are taken and preserved for viral (phage) community analyses through collaboration with Ohio State University.

**Sampling summary:**
At 5 stations (P4, P12, P16, P20, and P26):

1) 2 L seawater samples (at 16 depths) were filtered and preserved for high-resolution (HR) DNA sequencing.
2) 50 mL seawater samples were taken per depth to count microbial population density using flow cytometry and single cell DNA analysis. Samples were aliquoted and preserved using glutaraldehyde and glycerol+trisEDTA, respectively.

Additionally, at 3 major stations (P4, P12, and P26), the following were sampled at four depths: 10, 500, 1000, and 2000 (bottom+10 at P4) across the oxygen minimum zone:

1) Large volumes (20 L; LV) at each depth were filtered to create genomic libraries of the microbial communities.
2) To extract viruses from these samples, iron chloride was added to the filtered water. After the samples were incubated, to allow viruses to bind to the particles, the seawater was filtered again using a 0.22 micron filter.
3) For viral counts, samples were taken and preserved using glutaraldehyde and betaine. Filtered seawater was also collected without preservatives in order to isolate and culture viruses in the lab.
4) 50 mL seawater samples were collected per depth to count microbial population density using flow cytometry and single cell DNA analysis. Samples were aliquoted and preserved using glutaraldehyde and glycerol+trisEDTA, respectively.

**Comments:**

All of our sampling objectives for this cruise were accomplished. The work area was more than adequate for our sampling and processing needs.

We'd like to thank the captain and crew of the *J. P. Tully* for their assistance, excellent work, and willingness to work around the clock. Thanks to the IOS team and our fellow scientists for their help and their humour on deck and in the lab. Our watch leaders Moira Galbraith and Hugh Maclean were instrumental in keeping all members safe and working efficiently during the shifts. And finally, a great big thank-you to Marie for flawlessly organizing the entire cruise and for being a great source of expertise and positivity.