Report of the Tenth Annual Line P Workshop, Fisheries and Oceans Canada, Institute of Ocean Sciences, Sidney, BC, March 9 2017

Chaired by **Marie Robert**, Line P program manager, Institute of Ocean Sciences, Fisheries and Oceans Canada (DFO/IOS).

Introduction

Forty ocean scientists and technicians met in March 2017 to share recent observations along Line P, as well as to present their current research interests and proposed future sampling plans. "Line P" is a 1400-km-long set of ocean stations off Canada's West Coast, monitored for 60 years by weatherships and research vessels. It began with sampling from weatherships during their transits to and from Ocean Station Papa (OSP) at 50N, 145W, from the 1950s until 1981. Fisheries and Oceans Canada has financed ship time and core scientific programs since 1981. With more international and academic partners joining the program, leading to more diverse studies, it became useful to meet annually to compare insights and plan future sampling programs. At the 1st workshop in February 2008 scientists met to discuss future experiments and techniques. The 2nd workshop in March 2009 focused more on scientific results, as well as on promoting collaborations and optimizing ship time and space. Since then the workshop has been very beneficial every year in allowing scientists to share their observations of conditions along Line P as well as in introducing new partners into the Program. This year the workshop was back to the Institute of Ocean Sciences after being held at the Mary Winspear Centre, in Sidney, in 2016.

Marie Robert (DFO/IOS): *Overview of the Line P Program.*

Since quite a few new Line P Program or workshop participants were present this year, the full version of the "overview of the Line P Program" talk was presented, detailing the work that DFO employees perform on Line P cruises and giving important details for those who sail on Line P cruises. The main points of interest were:

- Requests for security clearance and radioisotope use have to be started preferably three months prior to a cruise. Please contact **Marie Robert** if you want to participate in a cruise. Do NOT contact the DFO security clearance officer directly. Regarding radioisotope use please contact **Michael Arychuk** (Michael.Arychuk@dfo-mpo.gc.ca) or **Kyle Simpson** (Kyle.Simpson@dfo-mpo.gc.ca), keeping Marie Robert in the loop so that the Rad-Van can be booked and loaded on the Tully.
- Try not to send untrained people on a cruise on their own. But if you have to, at least give them as much information about the cruise as possible. Tell them about the cruise report expected of them, and let them know that demands like "dry ice" need to be addressed well before the end of the cruise.
- Although this year a reminder was not read to the supervisors on how new students or technicians need to behave at sea, the reminder is still included as Appendix 1 of this report.
- If you are going to be a regular Line P participant, please invest in your own raingear.

- Line P data are available on Website at https://www.waterproperties.ca/linep, or contact me at Marie.Robert@dfo-mpo.gc.ca. The DFO Line P Website is presently not being updated.
- 16 berths are available at the moment for science on the *Tully*. Modifications will be done to the cabins to accommodate more people in the future but the timing of these changes is unknown.
- There is now a Wifi on the Tully which allows people to access "Internet at sea". Internet access is usually available along Line P until around P18 or so.
- The Tully will be undergoing a "VLE" – Vessel Life Extension – from October 2017 to May 2018. The February 2018 cruise will be on the *CCGS Sir Wilfred Laurier*. It is unknown at the moment if the *Tully* will be ready on time for the June 2018 cruise.
- The 2017-2018 Line P cruises will be as follow:
    - 2017-06 will go from 4 June to 20 June 2017.
    - 2017-08 will go from 15 August to 31 August 2017.
    - 2018-01 will go from 18 February to 8 March 2018 on the *Laurier.*

    Because of this later time, the 2018 Line P Workshop may be before the cruise, or else there may not be a 2018 Line P workshop.

Finally two slides were presented with berths reservations for the next two fiscal years, up to February 2019. These slides are included in Appendix 2. **Please confirm your berths bookings, and/or let me know as soon as possible if you would like to have your name on the waiting list.**

I would like to thank Aaron Chan and Andrew Burke for their help setting-up "WebEx" so that Ed Dever could present his talk from Oregon.

Melanie Quenneville (DFO/IOS): *Notes on radioisotopes work.*

Radioisotope work and mainly regulations are being taken very seriously by the Radiation Safety Officer (RSO), the Regional RSO, and the National RSO, all three of them working at the Institute of Ocean Sciences. Important regulations are brought to ship users' attention to ensure that rules are followed properly. The main points discussed were:

The RSO – Michael Arychuk (Michael.Arychuk@dfo-mpo.gc.ca) – has to be informed of all radioisotope use on all vessels **three months** before the beginning of a cruise. If the intent of use is received less than three months before a cruise he has the right to decline the request.

ALL radioisotope use has to be declared, **no matter** what quantity is being used. Even if you are planning to use a quantity of radioisotope that is less than the "exemption quantity" it has to be declared; one reason for this is that your quantity added to someone else's quantity could bring the total amount to a level higher than permissible. Another reason is to ensure uncontaminated facilities are provided, and the DFO contamination criteria are lower than the regulatory limits.

The Hot Lab at IOS will not be decommissioned; this does not mean that you can count on IOS personnel to deal with receiving/shipping your radioisotopes.

Ed Dever (OSU): *NSF Ocean Observatories Initiative (OOI) Station Papa 2016 Deployment 5 Activities and Data Return.*

The 2017 OOI cruise to Station Papa occurs from 7 – 23 July 2017 on board the R/V Sally Ride. The cruise departs from and returns to the OSU ship operations facility at Newport, Oregon. There is still berth space available. The cruise has similar objectives to past years - namely the deployment and recovery of a profiling mooring in the vicinity of the NOAA surface mooring, the deployment and recovery of 2 subsurface flanking moorings and the retrieval of 1 glider and deployment of 5 gliders at the site. CTD casts and the usual underway ship observations will also be taken on the cruise. This year the team will be again from Oregon State University and Woods Hole Oceanographic Institution (WHOI).

The 2016 as deployed and 2017 target mooring locations are indicated below.

2016 Mooring Designation	2016 as deployed position	Deployment date and time (PDT)	2017 target position
GP02HYPM-00004	50° 04.77628' N; 144° 48.3441' W	2 July 2016 19:05 PDT	50° 06.870' N; 144° 54.966' W
GP03FLMA-00004	49° 58.4605' N; 144° 14.3835' W	30 June 2016 18:07 PDT	50° 01.344' N; 144° 21.660' W
GP03FLMB-00004	50° 19.7557' N; 144° 23.8809' W	4 July 2016 16:07 PDT	50° 22.560' N; 144° 30.846' W

Note that the 2017 target positions are approximately 11 km northwest of the 2016 as deployed positions. Our intent is to deploy the new moorings before recovering the 2016 moorings.

Information about the OOI Station Papa observational platforms and instruments can be accessed at: http://oceanobservatories.org/array/global-station-papa/

The OOI Station Papa observations include profiled CTD, O2, chl-a fluorescence and optical backscatter, and point velocity from 310 to 4000 m. Two profiling gliders are assigned to sample the upper 1000 m near these profilers. These gliders have photosynthetically available radiation and nitrate in addition to the other parameters. Fixed subsurface sensors include pH, temperature and conductivity at multiple depths, acoustic Doppler current profilers and three channel active bio-acoustics sensors.

The OOI Station Papa moorings have been maintained since June 2013 and have been turned on a yearly basis in June or July. OOI data are now coming online. Interested users can register at the OOI website (oceanobservatories.org). Data return thus far has been reasonable, but data quality control is not yet implemented.

OOI contacts include:

- Global Scale nodes Project Manager: Paul Matthias, WHOI, pmatthias@whoi.edu
- Global Scale nodes Project Scientist: Bob Weller, WHOI, rweller@whoi.edu
- 2017 Station Papa deployment cruise chief scientist: Ed Dever, Oregon State Univ., edever@ceoas.oregonstate.edu
- Data Manager: Mike Vardaro, Rutgers Univ., vardaro@marine.rutgers.edu
- Communications: Leslie Smith, Consortium for Ocean Leadership, lsmith@oceanleadership.org

Meghan Cronin (NOAA/PMEL): *Station P Surface Mooring Activities.*

There are now 6 moorings deployed in the Station Papa area: the NOAA surface mooring, the UW/APL waverider mooring, the NOAA Noise Reference Station (NRS), and the 3 NSF OOI moorings. In general when turning around the NOAA surface mooring, we want to deploy first before recovering the old mooring. Thus during mooring operations there is a 7th mooring also deployed. In order to have safe operations, we need to have a 5.5 km avoidance circle radius. No moorings should be deployed in the avoidance circle ! For scientific reasons, we want the alternating year NOAA surface moorings and NSF OOI profiling mooring to be as close as is safe. These therefore have overlapping avoidance circles. Please be mindful of this during all mooring operations. The NOAA surface mooring watch circle radius is 1.25 km. Please do not take any CTD casts within the watch circle. The NOAA Ocean Climate Stations (OCS) group respectfully requests shiptime aboard the June 2017 Line P cruise to turn around the NOAA surface mooring. Patrick Berk (UW JISAO) and Mike Craig (PMEL) can participate on this cruise. OCS has been busy writing proposals this year. A collaborative research proposal is pending at NSF to do a process study, "Carbon Hot Spot", at the Kuroshio Extension Observatory (KEO) in January 2018. As part of this proposal, OCS would have 2 Saildrone (remotely controlled sailboat instrumented with physical and BGC sensors) circle the KEO buoy for 6 months, while other investigators would be surveying the ocean spatial variability using gliders and underway shipboard measurements. Carbon Hot Spot would have strong synergy with the NASA EXPORT program. We also plan to submit a proposal to NASA to have 2 back-to-back 6-month-long Saildrone missions at Station P. The Saildrone will be able to map out the spatial gradients in surface properties and current profiles from which vertical velocity can be computed. These measurements will help us determine the role of eddy processes in closing the carbon budgets. The measurements would also provide surface forcing and information about the sources of turbulence that affect the export of carbon from the mixed layer measured by other assets in the EXPORTS field program. For more information on the OCS project, please visit: www.pmel.noaa.gov/OCS/. **Meghan** has also launched a special collection of AGU papers: "Midlatitude Marine Heatwaves: Forcing and Impacts". When you submit your "Blob" paper to an AGU journal, indicate that it should be included in this collection.

William Burt (UBC): *High-frequency measurements of the Carbon:Chlorophyll ratio using autonomous shipboard sensors.*

Phytoplankton productivity is a primary driver for the entire marine ecosystem, yet in the Subarctic Pacific, in-situ measurements are limited to discrete chlorophyll sampling made with low spatial and temporal resolution. Furthermore, chlorophyll alone cannot determine phytoplankton biomass, because the carbon to chlorophyll ratio (C:Chl) in biomass varies significantly in response to various environmental factors. However, recent advances in the field of ocean optics have facilitated measurements of phytoplankton carbon and chlorophyll using the inherent optical properties of water, which can be done at high-frequency in a flow-through system. As a result, we present C:Chl measured at a 1-minute resolution along three summer 2016 cruises in the Subarctic Pacific (including June Line P). These datasets span a wide range of productivity and hydrographic regimes, and capture rapid changes across frontal zones. The high-resolution optically-derived Chl data compare well to discrete measurements, and may prove useful to examining underway fluorescence data from past or future Line P and La Perouse expeditions. C:Chl ratios are centered around 50 (comparable to the commonly applied value in

many studies), but range from <20 in highly productive upwelling regions, to >200 in oceanic waters, and show interesting spatial patterns along the Line P transect.

Chen Zeng (UBC): *Optical and satellite based estimates of phytoplankton taxonomic composition.*

High-resolution flow-through measurements of absorption and attenuation, obtained with a WetLabs AC-S meter, provide a new hyperspectral approach to understanding the phytoplankton composition and community along Line P. Using a non-linear fitting approach, we produce spatial distributions of different phytoplankton size classes (i.e. micro, pico, nanoplankton) during the June 2016 cruise. After removing the signals associated with pure water and colored dissolved organic matter (CDOM), data from our underway system agree well with discrete samples of chlorophyll-a concentration, phytoplankton absorption, and micro-plankton fraction. Micro-plankton fractions were highest at P26, P21, and P4, implying that 1) diatoms and dinoflagelletes dominated the phytoplankton communities, and 2) a nutrient-rich environment was present at these major stations during the summer of 2016. Our future work will focus on utilizing the linear relationship between phytoplankton absorption spectrum slope and micro-plankton fraction to begin estimating micro-plankton fraction across the Subarctic Pacific Ocean from space.

Lindsay Fenwick (UBC): *N_2O/CH_4 data from 2015/2016.*

Time- and depth-resolved CH_4 and N_2O profiles are essential to understand the processes driving their biogeochemistry, and their sensitivity to environmental perturbations. There are few time series measurements of methane (CH_4) and nitrous oxide (N_2O) in the world ocean, and the sources and sinks of these gases are not well-defined. As the oxygen minimum zone in the subarctic Pacific expands and intensifies, the cycling of CH_4 and N_2O (which is strongly oxygen-mediated) will change, affecting the concentration and sea-air fluxes of these potent greenhouse gases.

We measured depth profiles of CH_4 and N_2O concentrations at P4, P8, P12, P16, P20, and P26, in February, June, and August from 2015 to 2016. This provided a 3-dimensional and time-resolved view of CH_4 and N_2O distributions across Line P. Nitrous oxide concentrations were slightly super-saturated in the mixed layer at nearly all stations and sampling times, but increased to a maximum up to 50 nmol L^{-1} (400 % supersaturation) in the oxygen minimum zone between 800 and 1200 m depth. The relationship between ΔN_2O, N*, and apparent oxygen utilization (AOU) revealed signatures of both nitrification and denitrification as N_2O sources. CH_4 concentrations were close to atmospheric equilibrium in the open ocean mixed layer at all sampling times, but declined to well below atmospheric equilibrium at depth, implying biological consumption. At the coastal stations, CH_4 concentrations were much more variable. We observed maximum CH_4 concentrations exceeding 20 nmol L^{-1} (600% supersaturation), with the highest measured concentrations in close proximity to previously identified gas seeps. We plan to continue our time series measurements of N_2O and CH_4, integrating collaborations with the Hallam Lab for microbiological sampling.

Robert Izett (UBC): *Refined estimates of net community production in the Subarctic Pacific derived from ΔO_2/Ar measurements and N_2O-based correction for vertical mixing.*

Net community production (NCP) defines the balance between gross primary production and total respiration, and sets the upper limit on carbon export from marine surface waters. Recent developments in autonomous, ship-based instrumentation have facilitated estimation of NCP at high spatial and temporal resolution, using underway measurement of the mixed layer oxygen-argon ratio (O_2/Ar). Normalization of O_2 by Ar removes the effects of temperature and salinity-dependent changes in O_2 solubility, but does not account for physically-induced changes in O_2 concentrations resulting from vertical transport of low O_2 sub-surface waters into the mixed layer. Recent work suggests that surface water nitrous oxide (N_2O) supersaturation can be used as a tracer of this flux, as N_2O is primarily produced through nitrification below the euphotic zone. To date, this approach has not been applied to field data. We present N_2O-corrected NCP estimates from the 2016 Line P and La Perouse cruises in the Subarctic Northeast Pacific, spanning a coastal-to-open ocean gradient. We use discrete profiles of N_2O and measurements of surface N_2O supersaturation to estimate the vertical flux of O_2 into the mixed layer. Our data provide high spatiotemporal coverage of NCP measurements in a region of strong coastal-oceanic productivity gradients. Our results show that mixing is a significant term in the O_2 mass balance of dynamic coastal waters, particularly during periods of upwelling, with lower mixing contributions in the stratified open ocean waters. We also present data from a new underway optode / gas tension device setup that will be used for subsequent high-resolution measurements of O_2 and N_2 on future cruises.

Roberta Hamme (UVic): *Deriving productivity estimates from oxygen sensors on BCG-Argo floats and gliders using increased O_2/Ar sampling along Line P to calibrate those estimates.*

The export of organic carbon from the surface to the deep ocean removes carbon from contact with the atmosphere and lowers atmospheric carbon dioxide levels. New satellite-based estimates are emerging to quantify this key value of global annual carbon export. However, high accuracy estimates of annual carbon export from ocean-based measurements are lacking outside the major time series sites. Carbon export can be quantified from net biological oxygen production. Oxygen sensors on profiling Argo floats and gliders provide a potential means of increasing spatial and temporal coverage of ocean-based estimates. Station P has been a testbed for this technique on Argo floats with recent papers from Bushinsky and Emerson (2016) and Plant et al. (2016). The most important barriers to achieving accurate net productivity estimates from in situ sensors are calibration of the sensors and accounting for other fluxes of oxygen. My group has recently made progress on in situ calibration of oxygen sensors on Argo floats in the Labrador Sea, and we will test whether similar techniques are applicable to the NE Pacific. We also plan to work on developing analysis and interpretation techniques for the many floats carrying oxygen sensors that have been launched by Argo Canada in the Line P region and for the new DFO glider program that will also carry oxygen sensors. To judge the success of these techniques, we need more ship-based data to compare to, so we propose to also collect O_2/Ar samples from many of the minor stations in addition to our continuing program at the major stations. This will provide a more complete dataset from which to derive spatial averages in the region for comparison to the sensor-based estimates.

Laura Lorenzoni (NASA/EXPORTS): *EXPORTS.*

This presentation focused on the EXport Processes in the Ocean from RemoTe Sensing (EXPORTS) program – a NASA-sponsored field campaign that will provide critical information for quantifying the export and fate of upper ocean net primary production (NPP) from satellite observations. Ocean ecosystems play a critical role in the Earth's carbon cycle and climate, and the quantification of how ocean ecosystems and ocean biogeochemistry are impacted for present conditions and future predictions remains one of the greatest challenges in oceanography. The overarching goal of EXPORTS is to develop a predictive understanding of the export and fate of global ocean primary production and its implications for the Earth's carbon cycle in present and future climates. Research will link field-based, process-level studies with geospatial data products derived from satellite sensors, building a foundation for improving the analysis and modeling capabilities needed to understand the export and fate of ocean net primary production and predict how such changes will impact the global carbon cycle. It is envisioned that a successful EXPORTS program will (1) create a predictive understanding of both the export of organic carbon from the well-lit, upper ocean (or euphotic zone) and its fate in the underlying "twilight zone" (depths of 500 m or more), where a variable fraction of that exported organic carbon is respired back to CO_2 (2) generate a new, detailed understanding of ocean carbon transport processes and pathways linking phytoplankton primary production within the euphotic zone to the export and fate of produced organic matter in the underlying twilight zone using a combination of field campaigns, remote sensing and numerical modeling, and (3) establish mechanistic relationships between remotely sensed signals and carbon cycle processes, thereby ensuring the ability of the NASA oceanographic community to successfully achieve the scientific goals associated with its future satellite missions, such as NASA's Plankton, Aerosol, Cloud, ocean Ecosystem (PACE) mission. The scientific rationales and overall societal importance for EXPORTS, as well as specific science questions to be addressed and the study's top-level requirements, are documented in the *EXport Processes in the Ocean from RemoTe Sensing (EXPORTS): A Science Plan for a NASA Field Campaign* document (http://cce.nasa.gov/cce/pdfs/EXPORTS_Science_Plan_May18_2015_final.pdf).

EXPORTS is currently being competed by NASA. Proposals are due to the agency on April 13, 2017. It is anticipated that awards will be made in July/August of 2017, with a first field deployment to the Northeast Pacific slated for mid-2018. NASA welcomes discussion regarding potential collaborations with domestic and international research groups and programs working within the EXPORTS Study Domain, such as Line P, with the aim of building strong, mutually beneficial scientific partnerships.

Amanda Timmerman (UVic): *Temporal trends in carbon export and primary production along Line P by comparing methods.*

Biological productivity is an important process controlling the export of carbon to the deep sea. By comparing methods, primary production and carbon export can be better quantified. Using NO_3^- uptake (new production) as a way to estimate carbon export, station P4 had the highest variability over time. O_2/Ar (net community production; NCP) is another way to estimate carbon export and does not agree with the new production spatial trends, where the highest export rates are at P4 and P26. Generally, the O2/Ar method has higher rates than the NO_3^- uptake method, which is in agreement with previous studies along Line P. Preliminary data suggest there was a

diatom bloom at P26 during the June 2016 cruise that caused increased carbon export and primary production rates.

Theresa Venello (UVic): *Variability in crustacean zooplankton productivity and trophic transfer efficiency along Line P.*

Using the chitobiase method, we have only just started to piece together the extent at which crustacean zooplankton productivity varies along Line P. Secondary production rates were estimated at the 7 main zooplankton sampling stations along Line P from February 2016 to February 2017. Overall, BPR for February 2016 was lower than June and August. BPR was 0 mg C m^{-2} d^{-1}at P12 and reached a max at 110 mg C m^{-2} d^{-1} at P20. June was overall higher than August in 2016 (29- 66 mg C m^{-2} d^{-1}), with the exception of P4 in August (375 mg C m^{-2} d^{-1}). BPR in February 2017 was much lower than in February 2016, 0- 30 mg C m^{-2} d^{-1}. Additionally, trophic transfer efficiency estimates were also made using chitobiase-based secondary productivity and O_2/Ar, ^{14}C primary productivity methods. Overall, NCP trophic transfer efficiencies were highest at the inshore stations along Line P. TTE ranged from 0 – 15 % in February 2016, 8.5 – 22 % in June 2016 and 0.7 – 22 % in August 2016. Max TTE for February and June 2016 occurred at P8, while the TTE max in August 2016 was at P4. ^{14}C TTE was higher over all than NCP estimates. Max TTE for June 2016 occurred at P16 (103 %) and at P12 (58 %) in August 2016. Again, inshore/transition area stations (P4, P12, P16) had higher than offshore stations TTE for both months. Assessing the natural variability of crustacean zooplankton productivity and trophic transfer efficiency is essential to furthering our understanding of ecosystem processes in the NE Pacific and their response to a changing climate.

Dave Janssen (UVic): *Particulate cadmium concentration and isotopes along Line P in August 2014.*

Cadmium (Cd) behaves as a trace metal micronutrient in the global ocean, with a distribution driven by biological uptake of dissolved Cd in surface waters and remineralization of sinking biogenic particles with depth. Dissolved Cd shows a strong correlation with phosphate (PO_4^{3-}), which can be used to infer expected Cd distributions and deviations from these distributions. Cadmium stable isotopes ($\varepsilon^{112/110}Cd$) are a useful tool for investigating biological, physical and chemical processes acting in the Cd biogeochemical cycle. The oceanic $\varepsilon^{112/110}Cd$ inventory is heavy relative to currently known sources and sinks, illustrating an imbalance in current knowledge of the global ocean $\varepsilon^{112/110}Cd$ cycle. Previous work along Line P has identified a deficit of dissolved Cd relative to PO_4^{3-} in low-O_2 waters, which was attributed to the formation of Cd sulfides in the O_2-depleted ocean interior, and has demonstrated a nearly uniform deepwater dissolved $\varepsilon^{112/110}Cd$ composition.

Here we present depth profiles of particulate (0.8-51 μm) Cd and $\varepsilon^{112/110}Cd$ ($p\varepsilon^{112/110}Cd$) from stations P26 and P4 in 2014, the first $p\varepsilon^{112/110}Cd$ profiles in the global ocean composed of more than 5 depths. Particulate $\varepsilon^{112/110}Cd$ shows a dynamic Cd cycle within the water column that is not imprinted upon dissolved $\varepsilon^{112/110}Cd$, with the heaviest $p\varepsilon^{112/110}Cd$ in the surface, light $p\varepsilon^{112/110}Cd$ at intermediate depths (200-600 m), and intermediate $p\varepsilon^{112/110}Cd$ in the deepest samples (>1000 m). Relative to a Martin F curve, which is used to model exponential decay of particulate organic carbon, particulate Cd shows a slight enrichment at depths where dissolved Cd is depleted. This is consistent with removal of dissolved Cd or retention of Cd in the

particulate phase in O_2-depleted waters through Cd sulfide formation. Particulate $\varepsilon^{112/110}$Cd at intermediate depths is among the lightest values ever reported for natural telluric samples. This may represent an important sink of light Cd from the oceans, which would help to balance the known sources and sinks with the oceanic $\varepsilon^{112/110}$Cd inventory.

Xiaodong Zhang (U. North Dakota): *Measuring the volume scattering functions to infer detailed concentration and composition distributions of particles of sizes 0.02 to 200 μm in the ocean.*

Particles, small or large, scatter light. And the angular pattern of the scattered light, called the volume scattering function, contains the information on the characteristics of the particle population such as sizes, composition, shape and structure. We will measure the volume scattering functions along the Line P and infer the concentration and composition distributions of particles of sizes from 0.02 μm to 200 μm. The data provide not only a measurement of the VSF, a key, yet scarcely measured, optical property of the ocean, but also the size and composition distributions of particles, which will contribute significantly to the biogeochemical studies of the ocean.

Ian Perry (DFO/PBS): *IOS zooplankton research along Line P: current activities; future plans.*

We present a short summary of current analyses of Line P zooplankton data, and plan for future activities along Line P.

Working conclusions to date include:

- The large changes in crustacean (decreases) and gelatinous plankton (increases) biomass observed along the continental shelf of WCVI over past 3 years were not observed at the outer Line P locations
- Interannual patterns of variation of crustacean and gelatinous zooplankton differ between Southern SCVI Offshelf and 'Outer' Line P stations (P16-P26)
- After 2005, anomalies of Crustacean zooplankton biomass at the outer Line P stations (P16-P26) were all positive
- Taxonomic composition of zooplankton at the outer Line P stations (P16-P26) were similar within:
    - 1997-2001
    - 2002-2004
    - 2005-2008
    - 2009-2010
    - 2011-2013
    - 2014 and 2015 were different from adjacent years

Current activities include:

- Analyses of plankton data, in light of unusual ocean conditions (warming) over past 3 years, and relationships with driving variables (e.g. climate)
- Collaborations with:
    - Peña on phytoplankton taxa and ecology
    - Ianson on pteropods and dissolution with ocean acidification;
    - Dower lab (U Vic) on questions of plankton secondary productivity;

- Pakhomov and Hunt labs (UBC) on plankton size spectrum analyses;
- Tortell lab (UBC) and NSERC Strategic Grant on ecosystem services in the Subarctic North Pacific

Future plans:

- Continue collection of plankton on Line P surveys
- Continue above collaborations
- Updating changes in zooplankton life history timing
- (Hopefully) Add more sampling for potentially harmful algal bloom taxa

APPENDIX 1: *Notes for supervisors, to pass on to students and technicians:*

1. Going to sea with DFO is a privilege, not an entitlement or a right.

   Your students have to understand that it's a privilege to go to sea with DFO, it's not an entitlement or a right. DFO will sail no matter if you guys are onboard or not, and if we have to say no we can and we will. Also the DFO mandate takes priority. Of course when a student is in the middle of a PhD, getting one more cast can seem like a matter of life and death, and sometimes they don't understand why I put priority on "only CTD casts" instead of their rosette cast. These CTD casts are part of DFO's monitoring program.

2. We don't work for you.

   Again this comes with the idea of "entitlement" that some students seem to have. We have our own work to do when we're out there, AND when we're at IOS. It may seem like nothing to "go receive my radioactive materials for me", but there is lots of paperwork involved with this and we have our own boxes to pick up. And at sea we have our own work to do. In the same vein, the crew doesn't work for you either. If we can we'll gladly help, but don't expect or request it.

3. We may not have PhDs but we do have experience that you can't get in textbooks.

   Many students seem to think that, because we don't understand everything they do, either at sea or back in the lab, there's nothing we can teach them. I may only understand 10% of what you do with your samples or your instruments, but I know how to tie a bowline, and I've been in very rough seas. When we say "carry and store your chemicals in spill-proof containers", it's because we've seen what a spill can do. The experience we have accumulated at sea in 5, 10, or for some of us 25 or 30 years can be beneficial to them, if they can only be humble enough or smart enough to listen to us.

4. It's a small community out there and there has to be respect between people.

   Without wanting to sound "old fashioned", there is something about today's generation that makes it seem very "me" oriented. When you're at sea with the same few people for a certain length of time, but isolated from the rest of the world, it's even more important to respect everyone around, and also to respect the environment you are in. Some rules are "sea rules", for example the famous "no hat in the mess", and it's not up to us to change these rules. These are mariners' rules, and when in Rome, do as the Romans do. It's the same thing regarding how you treat your cabin mate, or even your cabin. You would be surprised of the "notes" we take … "oh yeah, I'd think twice before hiring this person, did you see the *mess* in the cabin!!!" It's a *society* out there, one we cannot get out of for the whole length of the cruise. When there's a bad feeling or attitude on board it spreads and creates problems in NO time.

   It is therefore **very** important that the students/technicians coming to sail with us keep these things in mind.

   Marie Robert

APPENDIX 2 a: *Berths reservations for 2017-18.*

If you would like to book a berth, have your name on the waiting list, or cancel a reservation already made please contact me at Marie.Robert@dfo-mpo.gc.ca. Please note that, until further notice, the maximum number of berths available for science on the Tully is 16. Note also that since the February 2018 cruise will be on the *Laurier*, there may be less than 16 people sailing, therefore your place on board is NOT assured even though it is on the list below.

June 2017 — 16
4-20 June

DFO-IOS	6
Chief Scientist	Robert
CTD watch	Yelland
CTD watch	Belton
DMS	Arychuk
pH	Cooper
Trace Metal	Ross

UBC	3
Tortell - 2	
Hallam - 1	Shiller

UVic	4
Dower-2	Venello/?
Hamme-2	Timm/Q?

NOAA	2
Cronin-2	Craig/Berk

UND	1
Zhang-1	

Waiting list	
Morgan	1
Quay	1
Pakhomov	1
Orellana	2
Bishop	2
Zhang	1
Hallam	2

August 2017 — 16
15-31 August

DFO-IOS/BIO	7
Chief Scientist	Robert
CTD watch	Galbraith
CTD watch	Maclean
DMS	Arychuk
pH	Cooper
Trace Metal	
Cesium	Nelson

UBC	3
Tortell - 2	
Hallam - 1	

UVic	4
Dower-1	Venello
Hamme-1	
Cullen-2	Oldham/?

UW	1
Orellana-1	

UND	1
Zhang-1	

Waiting list	
Morgan	1
Bishop	1
Zhang	1
Pakhomov	1
Bishop	2
Quay	2
Grundle	2

February 2018 — 16
18 Feb - 8 March

DFO-IOS/BIO	7
Chief Scientist	Robert
CTD watch	Yelland
CTD watch	Belton
DMS	Arychuk
pH	Cooper
Trace Metal	
Cesium	Nelson

UBC	3
Tortell - 2	
Hallam - 1	

UVic	2
Dower-2	

UW	2
Orellana-2	

UND	2
Zhang-2	

Waiting list	
Morgan	1
Pakhomov	1
Grundle	2

APPENDIX 2 b: *Berths reservations for 2018-19.*

Please keep in mind that, as indicated on page 2 of this report, the June 2018 cruise may be delayed or cancelled. The "August" cruise may also be delayed.

June 2018	16
DFO-IOS	**6**
Chief Scientist	
CTD watch	
CTD watch	
DMS	
pH	
Trace Metal	
UBC	**3**
Tortell - 2	
Hallam - 1	
UVic	**2**
Dower-2	
NOAA	**2**
Cronin-2	
UW	**2**
Emerson-1	
Orellana-1	
UND	**1**
Zhang-1	

Waiting list	
Morgan	1
Quay	2
Pakhomov	1
Varela	1
Bishop	2
Zhang	1
Grundle	2

August 2018	16
DFO-IOS/BIO	**7**
Chief Scientist	
CTD watch	
CTD watch	
DMS	
pH	
Trace Metal	
Cesium	
UBC	**3**
Tortell - 2	
Hallam - 1	
UVic	**4**
Dower-1	
Hamme - 1	
Cullen - 2	
UW	**1**
Orellana-1	
UND	**1**
Zhang-1	

Waiting list	
Morgan	1
Pakhomov	1
Varela	1
Zhang	1
Orellana	1

February 2019	14
DFO-IOS/BIO	**7**
Chief Scientist	
CTD watch	
CTD watch	
DMS	
pH	
Trace Metal	
Cesium	
UBC	**3**
Tortell - 2	
Hallam - 1	
UVic	**2**
Dower-2	
UW	**2**
Orellana-2	

Waiting list	
Morgan	1
Zhang	1
Pakhomov	1
Varela	1
Grundle	2