Report of the 11th Annual Line P Workshop, Fisheries and Oceans Canada, Institute of Ocean Sciences, Sidney, BC, March 20 2018

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

Introduction

Fifty ocean scientists and technicians met in March 2018 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 ended with a good planning discussion for the Canadian participation in September 2018 to the EXPORTS program.

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. Since we recently purchased a new Rad-Van we need to know **by the end of April 2018** if you are planning on working with radio-isotopes during the 2018 cruises.
- 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 a 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 in Appendix 1 of this report.

- Please invest in your own raingear.
- Line P data are available on the 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. There 'might' be Internet access available all the way to Station P in the near future but it would cost around $3200 per month.
- The Tully has been undergoing a "VLE" – Vessel Life Extension – from October 2017 to May 2018. It is unknown at the moment if the *Tully* will be ready on time for the June 2018 cruise; we should get an update by the end of April.
- The 2018-2019 Line P cruises will be as follow:
    - 2018-26 will go from 5 June to 19 June 2018 (*could* leave a day or so earlier).
    - 2018-40 will go from 11 September to 28 September 2018.
    - 2019-01 will go from 5 February to 23 February 2019.
- Paul Covert (Paul.Covert2@dfo-mpo.gc.ca) has taken over the pCO_2 data QC from Sophie Johannessen.
- Everyone participating to a Line P cruise has to stand a 6-hour watch.

Finally a slide was presented with berths reservations for the next fiscal year, up to February 2019. This slide is 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 Ocean Networks Canada for providing the catering during breaks. I would also like to thank Lindsay Mazzei for dealing with the presentations, and Germaine Gatien and Moira Galbraith for their "welcoming duties".

Debby Ianson (DFO/IOS): *Inorganic carbon sampling on Line P – tightening our belts?*

The Line P inorganic carbon sampling through the years is a treasure, one of the few time-series available that is longer than a decade at a global scale. We have the late C.S. Wong to thank for its creation and Lisa Miller and Jim Christian, among others, to thank for its continuation and the high quality of the data, as well as making the data available globally. Unfortunately this monitoring effort has not been funded in recent years and this short-fall has led to a large backlog of samples to be analyzed. All analysis of DIC and TA samples has traditionally been done on terra firma post-cruise in this program. To allow us to continue collecting samples on Line P and to be able to analyze these samples and provide the data, I have proposed that we reduce our sampling (and so our costs). In the meantime I hope that guaranteed funding can be secured. Specifically I have suggested that P16 be cut entirely and the group suggested that the replicate sampling (full cast of replicates that are archived unanalyzed) at P26 occur only in winter, cutting the spring and summer replicates. Thus far the reductions are minimal but

additional reductions will occur if funds are not made available. I encourage all researchers who rely on these data to provide me with a few lines of text to help me argue for the continuation of this valuable aspect of the Line P program.

Dennis Hansell (U Miami): *Dissolved Organic Carbon on Line P - inferring carbon dynamics from temporal and spatial variability. (Presented by Debby Ianson).*

Dissolved organic carbon (DOC) concentrations vary seasonally in the surface ocean as a product of biological productivity and at depth as a product of exported particles. We have 3 questions about this pool of carbon:

1) What fraction of the net community production accumulates as DOC?
2) How much of this material remains at the end of summer, thus to be exported with overturn?
3) How much variability is there in DOC concentrations in the deep water column, as an indicator of solubilization of sinking biogenic particles?

We have measured full water column profiles on the Line P during the February, June and August 2017 occupations, and we wish to continue making the measurements through 2018 and concluding with the February 2019 occupation. At that point we'll have established the first two years of the time-series, which we hope will be carried forward by others. The work being done is in support of the NASA-sponsored EXPORTS project.

Jennifer Keene (NOAA/PMEL): *2018 Mooring Servicing Plans for NOAA & UW Moorings.*

Since the *CCGS Tully* will unfortunately not be available for mooring ops in 2018, all of the moorings at Station P will be serviced on the same cruise, aboard the *R/V Sally Ride* July 17 - August 4, 2018. The NOAA PMEL surface mooring will be deployed for its 12th year. The PMEL Noise Reference Station mooring will be turned around to continue its acoustic data record, which began in January 2015. There are a total of six different moorings in the water near Station P, maintained through the contributions of at least eight different groups. In order to achieve the highest level of success and collaboration for each mooring, it is important to communicate plans and cooperate among groups.

Jim Thomson (APL/UW): *Surface wave measurements at Station P.*

Surface wave measurements from a Waverider mooring at Station P have been ongoing since 2010, with turnarounds in 2012 and 2015. The more recent mooring broke free in October 2017 and is slated to be replaced during a summer 2018 cruise onboard the R/V Sally Ride (July 17 - Aug 4). Another cruise is planned for the winter/spring of 2019 to conduct additional drifting buoy measurements of breaking surface waves, as part of an NSF-funded project.

Matthew Palanza (WHOI/OOI): *OOI moorings*

Bill Crawford (DFO/IOS): *Update of oxygen concentration along Line P.*

Shea Wyatt (UVic): *Effects of ocean acidification on biogenic silica precipitation and dissolution in diatom assemblages in the northeast Pacific Ocean.*

Little is known about how ocean acidification affects the process of biogenic silica precipitation and dissolution in diatoms. The precipitation of biogenic silica in a diatom frustule during growth is important in coupling silica productivity to carbon. Changes in the silica frustule will affect ballast properties and elemental ratios – these changes need to be better studied to understand the ongoing and future effects of ocean acidification. Natural assemblages of temperate diatoms will be collected and subjected to perturbation experiments in the North Pacific, testing the response to increased temperature and pCO_2. Biogenic silica production rates will be measured with ^{32}Si, while other measures of phytoplankton biomass and productivity will be taken. Preliminary data from 2016 in the North Pacific show that biogenic silica and chlorophyll standing stocks do not correlate directly with silica or carbon uptake rates, highlighting the importance of continuing to directly measure silica productivity rather than inferring the rate from other proxies.

Andrew Ross (DFO/IOS): *Variability in dissolved trace metal concentrations along Line P during "The Blob".*

Andrew Ross (DFO)**,** David Janssen (UVic), Jay Cullen (UVic), Jody Spence (UVic), Kyle Simpson (DFO) and Marie Robert (DFO)

Following seven years of mainly cool conditions, surface waters in the NE Pacific began to warm in 2013 with most extreme warming arriving in early 2014 in the mid-Gulf of Alaska (Crawford 2015). This feature, nicknamed "The Blob", was easily the warmest temperature anomaly ever observed in the region, reaching more than 3°C above normal temperature. Stratification due to formation of the "Blob" inhibited seasonal mixing along Line P, fundamentally altering nutrient conditions in surface waters. To capture the impact of the "Blob" on the availability of micro-nutrients, and other bioactive trace metals, we measured the concentrations of dissolved Mn, Fe, Co, Ni, Cu, Zn, Cd and Pb in seawater samples collected between 2011 and 2016 as part of the Line P Iron Program. Results suggest that certain trace metals may serve as indicators of change in ocean climate and/or contribute to nutrient limitation in offshore surface waters during the stratification caused by major warming events.

Randie Bundy (UW): *Quantifying the importance and bioavailability of recycled iron along the Line P transect.*

Trace metals are biologically essential micronutrients that have a dynamic concentration range along the Line P transect. Specifically, iron has been shown to affect phytoplankton growth in high nutrient low chlorophyll (HNLC) regions, and play a role in shaping community composition in the transition zone. Although several studies have focused on the biological effects of "new" iron in shaping phytoplankton communities, relatively little attention has been paid to the importance of recycled iron on these ecosystems. Data from process studies suggests to up to 90% of the iron uptake in HNLC regions could be due to internalization of recycled iron, contrasted with only 10% uptake of recycled iron in high iron coastal regions. However, a large range in these estimates exists, yielding a wide range of estimates on the importance of recycled iron to low iron regimes. This presentation will discuss a hypothesis to be tested in the Line P

framework with respect to the uptake and bioavailability of recycled iron, and how organic iron-binding molecules such as siderophores may shed some insight onto this important process.

Yuanheng Xiong (U North Dakota): *Measuring the particle size distributions and the volume scattering functions of ocean water along Line P.*

The volume scattering function (VSF) of ocean water, filtered and unfiltered, and the particle size distributions in ocean water (0.1 to 1 μm) were measured along Line P for the first time during June 2017 cruise. LISST-VSF by Sequoia Scientific, Inc. was used to measure the full angle (0 to 155°) volume scattering function (VSF) of water with depolarization and beam attenuation (*c*), and ViewSizer® 3000 by MANTA Instruments, Inc. was used to track the Brownian movement of individual suspended Nano-size particles simultaneously under mixed laser light field and provide accurate amount and size information of particles within a known volume of sample and discrete size intervals, i.e. the PSD. Both instruments were validated by measuring NIST™ traceable size standard beads (100 nm, 150 nm, 200 nm and 500 nm) in the lab prior and after the field measurement. The measurements include all stations from Haro59 to P26 for sampling at surface and all major stations after P4 for sampling extended to several depths (10 m, 25 m, 50 m, 100 m, 300 m and bottom -10 m, when available). Preliminary results indicate that the variation of measured VSFs in the backward direction is more than 2 orders of magnitude and the PSDs vary among the depths and the distances from the shoreline. The next step is to integrate our preliminary result with other data sets, like the CTD data, in order to improve our understanding of the variations of optical properties. The performance of the instruments will be improved continuously, like the depth profiling function of LISST-VSF and the calibration of multiple standard beads measurement for ViewSizer. For the future measurements, the pattern/interval of sampling stations and depths will be modified accordingly.

Grace Ho and Steven Hallam (UBC): *Microbial community of OSP before and during the 2013-2016 Pacific Warm Anomaly.*

Steven Hallam started the talk by introducing the ongoing marine microbial observations in his lab. Metagenomic and metatranscriptomic surveys have been conducted at Saanich Inlet and along the Line-P transect at stations P4, P12, P16, and P26 for over a decade. To date, 490 Gb or 317 human genome equivalents of sequence data have been generated to study the organisms that underpin many of the biogeochemical transformations in the NESAP and the global oceans.

Grace Ho, a former undergraduate student of Steven's then presented the findings from her directed studies term on the microbial ecology of OSP during "the Blob" or the 2013–2016 Pacific Warm Anomaly. While there have been studies conducted on zooplankton and phytoplankton during the Blob, its effects on picoplankton (0.2-2 μm size fraction) have yet to be elucidated. We used a standard workflow consisting of the collection of biomass on sterivex filters (>0.22μm size fraction), extraction of environmental DNA and the clustering of 16S rRNA gene PCR amplicon sequences at 97% similarity to produce an OTU table (a table counts of OTUs per sample). With this and physical and chemical variable measurements, standard ecological analyses was performed to understand how the surface (10-100 m) microbial community changed during the Blob. There were significant changes in alpha and beta diversities at OSP during the Blob. Alpha diversity increased during the Blob, especially in

August Blob samples. When the beta diversity is evaluated using nonmetric multidimensional scaling (NMDS) plots, there is a shift of surface Blob samples in ordinal space which signified the surface communities changed in species composition to more closely resemble samples from 150 and 200 m. Grace concluded the talk by presenting the mean taxonomic compositions from each depth at the phyla level. Differences in taxonomic compositions and the effects below the upper 100 m have yet to be evaluated. The functional implications of the surface anomaly remain to be determined through metatranscriptome sequencing.

Amanda Timmerman (UVic): *Spatial and temporal trends in carbon export and primary production along Line P.*

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. O_2/Ar (net community production) and NO_3^- uptake (new production) are two methods that estimate carbon export to the base of the mixed layer. Carbon export rates (from new production) along Line P are similar in August 2014, June 2015 and August 2015 data. However, rates are higher offshore in June 2016 compared to August 2016. Export rates from new production are similar with higher variability at P4. When comparing the two methods, O_2/Ar are usually higher than NO_3^- uptake estimates. When NO_3^- uptake is normalized to chlorophyll a concentration, onshore-offshore trends are less important. Similarly, primary production (from ^{13}C uptake) has the highest variability at P4. Offshore, June primary production rates are higher or about the same as August rates. When primary production is normalized to chlorophyll a, there is no consistent temporal or spatial trend. Primary production, when integrated to the based of the euphotic zone, shows no consistent spatial or temporal trend. The amount of primary production occurring within the mixed layer versus to the base of the euphotic zone is variable through time and space. Further investigation will examine the controls on primary production and carbon export.

Robert Izett (UBC): *Net community production - Instrument Development and Results from 2017.*

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-to-argon ratio (O_2/Ar). Normalization of O_2 by Ar removes the effects of temperature and salinity-dependent changes on 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. We present refined estimates of NCP, obtained from 2016 and 2017 Line P cruises, that combine underway O_2/Ar sampling, with discrete corrections for the vertical mixing flux, based on measurements of nitrous oxide (N_2O). 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 an update on a new underway optode / gas tension device (GTD) setup that provides high-resolution coverage of O_2 and nitrogen (N_2) measurements. Although the solubility of N_2 differs slightly from that of O_2 and Ar, the O_2/N_2 ratio can be used to trace biological productivity in place of O_2/Ar measurements. During the 2017 Line P cruises, we evaluated the performance of the new system, and compared estimates of NCP derived from O_2/N_2 data with estimates derived through

O_2/Ar. We present the results of this comparison, as well as recent developments in the complete automation of the new instrument platform. The optode/GTD system can be deployed without the need for human-interface on future Line P cruises. Using both O_2/Ar and O_2/N_2 sampling, we are producing a time-series of NCP estimates along the Line P transect that can be used to investigate the links between climate, marine primary production, and high-level ecosystem services, such as fish production, and carbon export.

William Burt (UBC): *High-resolution estimates of phytoplankton biomass, physiology, and productivity along Line P.*

William J. Burt, Toby K. Westberry, Michael J. Behrenfeld, Chen Zeng, Robert W. Izett and Philippe D. Tortell

Estimates of chlorophyll-a (Chl) and phytoplankton carbon (C_{phyto}) derived from our optical sampling platform are shown to provide detailed information regarding the biomass, physiological status, and productivity of phytoplankton along the Line P transect. Our underway optical system yields minute-binned estimates of C_{phyto} and Chl along the transect that capture changes in biological productivity at unprecedented spatial scales. The ratio of C_{phyto}:Chl, a key metric of phytoplankton physiological status, shows approximately 5-fold variability across the transect, highlighting the potential pitfalls of equating Chl concentration to phytoplankton biomass along Line P. Variability in C_{phyto}:Chl is shown to be strongly linked to changes in mixed-layer light levels and macro-nutrient (i.e. nitrate) concentration, with secondary influences of iron-limitation and eddy formation. We also present estimates of net primary productivity (NPP) along the transect, which compare well with traditional ^{14}C-based estimates, while preliminary comparisons with oxygen-based net community productivity (NCP) show potential for high-resolution estimates of carbon export along Line P. The majority of these results and interpretations have been recently published in Global Biogeochemical Cycles and are available at https://doi.org/10.1002/2017GB005783. Research goals for 2018 are centered on the August EXPORTS cruise, where we intend to link our optically-derived data to independent measurements of carbon export made using ^{234}Th.

Sarah Rosengard (UBC): *Optics-based time series of phytoplankton community composition in the Subarctic North Pacific.*

Sarah Z. Rosengard[1,2], Chen Zeng[1,3], William Burt[1], Philippe D. Tortell[1,4,5]

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4. Department of Botany; University of British Columbia, Vancouver, BC, Canada
5. Peter Wall Institute for Advanced Studies; University of British Columbia, Vancouver, BC, Canada

In the Subarctic North Pacific (SNP) Ocean, phytoplankton communities play a critical role in shuttling carbon down the water column and energy to higher trophic levels, including several economically and culturally valuable fisheries. Variability in primary producer community composition over time and space complicates our understanding of these roles, and is challenging to characterize with shipboard measurements alone. We have harnessed the spatial and temporal coverage of three generations of NASA Ocean Color satellites to characterize changes in community composition throughout the SNP, using regional algorithms that relate chlorophyll-a (Chl-a) concentration to phytoplankton taxonomy. Recently, Zeng et al. (in review)

validated these algorithms with *in situ* HPLC and size-fractionated [Chl-a] measurements from several SNP expeditions. Applying these algorithms to satellite-based [Chl-a], we derive the relative abundances of six phytoplankton functional groups and three size classes over two decades. When integrated over biogeochemically significant regions (e.g., Longhurst Provinces) in the SNP, these time-series reveal strong seasonal patterns in phytoplankton relative abundance. Across seasons, these abundances are more variable in coastal provinces than in open ocean provinces; moreover, the relative abundance of larger size classes are more variable than that of smaller size classes. Regressions over the two decade time span suggest regional differences in the pace and direction of change for different phytoplankton groups, as well. Paired with analogous climatology and fish stock time-series, these taxonomy data create opportunities to explore the links among climate, food web structure, and status of economically important fisheries. Specifically, we are keen to apply these data to stock assessment models to test the hypothesis that phytoplankton community composition drives variability in Pacific sockeye salmon populations, including their decline in the last twenty years.

Angelica Peña (DFO/IOS): *Changes in phytoplankton community at OSP during "the blob".*

Theresa Venello (UVic): *Variability in crustacean zooplankton production rates, diversity and ecological efficiency along Line P.*

Theresa A. Venello, John F. Dower, Akash R. Sastri, Karyn D. Suchy, Moira Galbraith

Crustacean zooplankton biomass production rates (BPR) were measured off the west coast of Vancouver Island (WCVI) and along Line P to Ocean Station Papa during 2005, 2009-2011 and 2015-to present using the chitobiase method. In addition, measures of crustacean zooplankton productivity and primary productivity were coupled to directly estimate ecological efficiency (EE). Although generally assumed to be 10%, we have found EE to vary, ranging from 0 to 30%. Off the west coast of Vancouver Island BPR in 2015 was overall higher in September than in May, with no difference between cruises in 2016 and higher BPR in May than September in 2017. EE for both years was higher overall in September then in May. Along Line P, BPR peaked in August in 2016 and June in 2017. Like the WCVI, EE was also highest in August 2016. When WCVI and Line P data are pooled, BPR has significantly decreased over time from 2005-2017. Additionally, there is a significantly negative relationship between BPR and species richness, where low BPR occurs with higher number of species present.

Lian Kwong (UBC): *Zooplankton biomass size spectra along Line P.*

Biomass size spectra (i.e., the distribution of biomass by body size) have been used to describe food web attributes (e.g., transfer efficiency, production) since the 1980s. This simplified approach relies on body size, which is strongly correlated with ecological rate processes. It can be applied to systems where more complex models are limited by sampling and data availability. Biomass size spectra slope can be used to infer transfer efficiency, while y-intercept can be used to infer system productivity (Gaedke, 1993; Sweeting et al., 2009; Murry and Farrel, 2014). Changes in these size spectra attributes can be used to study the effects of fisheries, pollution, and anthropogenic effects on ecosystem health. This project assesses spatial and temporal variability in biomass size spectra attributes (i.e., biomass, abundance, transfer efficiency, productivity) along Line P. Line P is a unique well-studied long-term time series spanning

various productivity regimes. As such, historical Line P samples were processed using a Laser Optic Particle Counter (LOPC) flow-through system in the Pakhomov Lab at the University of British Columbia. To date, zooplankton size spectra have been produced for the top 150 m at P4, P12, P20, and P26 from 1995 to 2010. Preliminary results will be presented. Future analysis will focus on linking phytoplankton, zooplankton and micronekton size distributions along Line P. Furthermore, we will develop a Bayesian belief network to characterize the relationships between productivity, environment, and fisheries over the past 20 years.

David Siegel (UCSB) and Roberta Hamme (UVic): *Canadian collaboration with the NASA EXPORTS program in September 2018.*

EXPORTS is a US NASA funded program that will conduct an intensive study of the offshore NE Pacific near P26 in August-September 2018. The primary goals of the program are to develop ways to predict the export, fates, and carbon cycle impacts of ocean net primary production from satellite and other observations. They will measure carbon export through multiple pathways and by multiple methods as well as system characteristics that may be key to prediction. EXPORTS plans to launch a subsurface float and glider near P26 from the July OOI cruise that they will then follow throughout their experiment, a two-ship (Revelle and Ride) operation with 27 days on site. One ship will conduct detailed process level measurements at the subsurface float site while the other ship will survey the surrounding region. EXPORTS will conduct a second intensive study in Spring 2020 focussing on the North Atlantic. Central scientific questions in EXPORTS have been at the heart of ongoing measurements at Line P for many years, making the potential for Canadian collaboration with EXPORTS especially appealing. Hamme and colleagues have secured an additional two days of ship time during the September 2018 Line P cruise to conduct measurements at the EXPORTS site, arriving approximately 21 September 2018. The current plan is to transit off the Line to wherever the subsurface float is located and conduct a small spatial survey of five stations around the float, including casts meant to calibrate sensors on the float and glider. EXPORTS investigators are being paired with Canadian investigators doing similar measurements to share analysis protocols and sampling plans to maximize data comparability and to collect samples for each other on their respective cruises. Please see the preliminary matchup between PIs in Appendix 3 at the end of this report.

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: Berths reservations for 2018-19.

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.

June 2018 — 11

DFO-IOS	7
Chief Scientist (Robert)	
CTD watch (Galbraith)	
CTD watch (Maclean)	
DMS (Arychuk)	
HPLC (Young)	
TSG-Network (Mazzei?)	
pH (Simpson?)	

UBC	2
Hallam - 1 (Shiller)	
Pakhomov - 1 (Kwong)	

UVic	1
Dower-1 (Venello)	

U Miami	1
Hansell-1 (Lopez)	

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

Sept 2018 — 16

DFO-IOS/BIO	7
Chief Scientist (Robert)	
CTD watch (Galbraith)	
CTD watch (Maclean)	
DMS (Arychuk)	
pH (Caleb?)	
DOC/CDOM (Wright)	
Cesium (Nelson)	

UBC	3
Tortell - 1 (Burt)	
Hallam - 1 (Shiller)	
François - 1 (Sun)	

UVic	6
Dower-2 (Venello,Dower)	
Hamme/Varela - 1	
Cullen - 3 (Cullen, Taves, ?)	

UW	0

Waiting list	
Morgan	1
Pakhomov	1
Varela	1
Orellana	1

February 2019 — 8

DFO-IOS/BIO	7
Chief Scientist (Robert)	
CTD watch (Galbraith)	
CTD watch (Belton)	
DMS (Arychuk)	
pH	
Trace Metal	
DOC/CDOM (Johannessen)	

UBC	1
Hallam - 1 (Shiller)	

UVic	0

UW	0

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

APPENDIX 3: *Line P – EXPORTS PI Match Up:*

Line P Measurements in black – EXPORTS in red

CTD profiles – Temperature, Salinity, Oxygen, Fluorescence, Transmissometry, PAR (when shallower than 2000 dbar) – Hydro team (Siegel / Nelson with help from GSFC/SIO also includes UVP-5 & LISST-Deep on each cast from both ships)

Underway – ADCP currents, Acoustics, Temperature, Salinity, Fluorescence, pCO_2 – Hydro/SIO (Also PI data – IFCB, inline optics, etc.) from both ships (PIs: Boss, Karp-Boss, Sosik, Roesler)

Discrete – Salinity, Oxygen, Macronutrients, Chlorophyll-a, Pheopigments (*Marie Robert*) – Hydro/UCSB (+BSi, POC/N, PIC, DOM, no salts)

DIC, Alkalinity, pH (*Debby Ianson, Kyle Simpson*) – Andrea Fassbender (MBARI) – DIC/TAlk & pH on survey ship / maybe DIC Mannino (GSFC) on Process ship

HPLC pigments + phytoplankton microscopy (*Angelica Peña*) – Hydro/GSFC, phytoplankton (Sosik, Karp-Boss, Graff)

DMS, DMSP; total and dissolved (*Michael Arychuk*) – Not done

Iron? – not done on every cruise (*Andrew Ross*) – Kristin Buck (USF)

Size-fractionated Zooplankton – Bongo net tows (*Moira Galbraith*) – Deb Steinberg (VIMS) & Amy Maas (BIOS) via day/night MOCNESS
Some net tows for collecting animals for experiments

Additional measurements from Academics

Fe, Cd, Cu, Zn from trace metal rosette (*Jay Cullen*) – Buck (USF) – dissolved Fe & bio-bound Fe using Chris Measures' TMC rosette

Productivity rate measurements (24-hr on-deck incubations + exps)

- ^{18}O-H_2O for gross O_2 production (*Hamme*) – not done
- ^{32}Si uptake by diatoms (*Diana Varela*) – Mark Brzezinski (UCSB)
- ^{13}C NPP (*Hamme/Varela*) – Adrian Marchetti (UNC)
- $^{15}NO_3$, $^{15}NH_4$, ^{15}N-urea uptake (*Hamme/Varela*) – Marchetti (UNC) just $^{15}NO_3$ (I think)
- ^{14}C simulated in situ NPP – Jason Graff / Mike Behrenfeld (OSU)
- ^{14}C P vs I curves – Kim Halsey (OSU)
- Phyto growth & microzoo grazing by dilution – Graff and Susanne Menden-Deuer (URI) – also zoo community characterization
- Macrozoo respiration (Steinberg) & gut content grazing (Menden-Deuer)
- Bacterial prod by ^{3}H leucine uptake – Craig Carlson (UCSB)
- Bacterial respiration by O_2 experiments – Scott Gifford (UNC)
- MAYBE nitrification rates on process ship – Alyson Santoro (UCSB)

Productivity rate measurements (in situ)

Triple O_2 isotopes for gross O_2 production (*Hamme*) – not done

O_2/Ar for NCP (discrete – *Hamme*, UBC – *Tortell*) – Nicolas Cassar (Duke) underway both ships (not sure about discrete??)

Particulate backscatter + spectrally-resolved absorption (underway *Tortell* – WetLabs BB-3 and AC-s sensors)

Emmanuel Boss (Maine) process & Collin Roesler (Bowdoin) survey ships (includes some size fractionation)

Also Imaging Flow Cytobots (Heidi Sosik (WHOI) & Lee Karp-Boss (Maine))

^{234}Th export (*Roger François*)

Ken Buesseler (WHOI) / Claudia Benitez Nelson (USC) survey ship

In situ pumping profiles too

Community-level secondary prod via chitobiase (*John Dower*)

Tatiana Ryerson (URI) is doing similar (not certain about details)

Particulate C, N, biogenic Si (*Varela*), DOM (*Maycira Costa*)

POC/N/BSi/PIC (hydro team), DOM & DOM characterization (Carslon & Hansell) – both ships – maybe NH_4 on process (Santoro)

Stable isotopes and fatty acids on copepods (*Dower*)

MacroZoo characterization by Steinberg & Maas

O_2 and gas tension underway (*Tortell*) – none

DMS (underway); N_2O and CH_4 (discrete) (*Tortell*) – none

DNA, RNA, and protein analyses + small subunit ribosomal RNA gene and transcript tag sequences (*Steven Hallam*)

Suspended samples – genetic rRNA barcoding from both ships (Cassar), metatranscriptomics (Bethany Jenkins (URI), Gifford & Marchetti)

Sinking particles – Colleen Durkin (Moss Landing) & maybe Alyson Santoro (UCSB)

Above-water reflectance with bow-mounted Satlantic SAS (*Costa*)

Both ships – Boss & NASA GSFC

In-water Satlantic hyperspectral upward+downward radiometer profiling package ?? (*Costa*)

Both ships – Boss / Siegel / NASA GSFC – Biospherical C-OPS (also Satlantic HyperPro on process ship)

Other EXPORTS things ….

AUV program

- Subsurface float – used to mark project center and mass budgeting – 6 months – Eric d'Asaro & Craig Lee (UW-APL) & Roo Nicholson (WHOI)
- SeaGlider – profiling near float – 6 months – Lee / D'Asaro / Nicholson
- Wirewalker – deployed from ship – rapid profiles during sediment trap deployments – Melissa Omand (URI)
- Two long term floats with chem/bioptics – Fassbender (MBARI)
- Short term hyperspectral float deployed during EXPORTS (Boss)

Sediment trap program

- 5 NBSTs & surface tethered trap array – Meg Estapa (Skidmore)
- Maybe 3 RESPIRE traps on trap array – Santoro & Phil Boyd (UTaz)

Other sampling

- Marine snow catcher – Passow (UCSB)
- Particle size spectra – Zhang (UNoDak), McDonnell (UAlaskaF) & more …
- Phytoplankton C via cell sorting – Jason Graff (OSU)
- Discrete CDOM & phyto abs spectra (Norm Nelson [UCSB] & Roesler)
- There's more but I've got enough for now …

Supporting modeling / analyses

- Adrian Burd (UGA), Laure Resplendy (Princ) & Andy Thompson (CalTech)

David Siegel