Report of the 12th Annual Line P Workshop, Fisheries and Oceans Canada, Institute of Ocean Sciences, Sidney, BC, 16 April 2019

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 April 2019 to share historical and recent observations along Line P, as well as to present their current research interests and proposed future sampling plans. "Line P" is a 1425-km-long set of ocean stations off Canada's West Coast, monitored for 64 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 a special presentation discussed preliminary results from the September 2018 cruise of which two days were dedicated to the EXPORTS program.

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

Since there are always new Line P Program or workshop participants present every 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 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. Again the process has to be started **at least three months prior to the cruise.**
- 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.
- A number of documents and videos has been provided by the *CCGS John P Tully*'s officers for all supernumeraries to read/watch before getting onboard. You will receive an email before the cruise with the list and how to access them.
- 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.
- 15 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; negotiations are underway with Coast Guard and Ocean Networks Canada.
- The Tully ADCP is presently out of commission. Assessment of the problems with the instrument cannot be performed until October 2019 when the *Tully* will be in dry-dock. Hopefully a 'quick fix' can be applied otherwise no ADCP data will be available until the next dry-dock period which should be in approximately 2-years time.
- If you leave chemicals at IOS between cruises, **make sure to leave SDS with the chemicals, as well as very clear contact information of the owner. Unidentified chemicals left at IOS will be disposed of.**
- The 2019-2020 Line P cruises will be as follow:
    - 2019-006 will go from 2 June to 18 June 2019.
    - 2019-008 will go from 13 August to 29 August 2019.
    - 2020-001 will go from 7 February to 25 February 2020.
- 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 2020. 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, Steve Romaine for dealing with the presentations, and Tamara Fraser for her "welcoming duties".

Patrick Cummins (DFO/IOS): *A review of climatic trends in water properties at Station P in the northeast Pacific.*

Patrick Cummins and Tetjana Ross.

Measurements of temperature, salinity and dissolved oxygen made at OWS P since 1956 represent one of the longest uninterrupted records of subsurface ocean conditions available over the world ocean. As such, this record is especially valuable for documenting and monitoring long-term and ongoing changes in the subarctic waters of the North Pacific. This talk will focus on climatic trends in dissolved oxygen and mixed layer depth, properties of particular relevance

to marine life. While no long-term trend is detected in mixed layer depth, statistically significant declines in oxygen are observed down to at least 2000 m depth. Fitted linear trend lines show a loss of about 12 ± 6% in 0 - 4000 metre depth-integrated oxygen over the period, 1960-2018. This is well above the global average loss of 2%, underscoring the northeast Pacific as a region of marked deoxygenation.

Frank Whitney (DFO/IOS – emeritus): *Line P surface variability.*

Surface waters have been monitored for more than 60 years (T and S) and for nutrients close to 50 years. A freshening of surface waters is enhancing upper ocean stratification, leading to shallower mixing during winter and slightly declining nutrient levels. Using draw down ratios of nitrate and silicate, I suggest there are years when diatom production must be very weak. This is likely due to reduced iron supply from pycnocline waters.

Bill Crawford (DFO/IOS – emeritus): *Changes in oxygen concentration all along Line P.*

Low concentrations of subsurface oxygen (O_2) are normally observed on the continental shelf of southwest Vancouver Island near P1 and P2 in late summer. O_2 has been monitored regularly at Station LB08 in this region since 1979. O_2 at this station decreased from typical values of 65 µmol/kg in 1979 to very low values of 35 to 50 µmol/kg in 2006 to 2014. Higher concentrations were observed in 2015 and 2016, attributed to warm, buoyant waters. However, with the intrusion of saltier, denser water in 2018, O_2 decreased to a very low concentration of about 35 to 40 µmol/kg.

On the continental margin to about 700 km offshore (P4 to P12), O_2 on constant density surfaces in the thermocline increased between the decades of 1950s to 1980s. O_2 has declined since then except for higher O_2 in 2014 to 2017 attributed to cooler fresher water. Farther offshore (P20 and OSP) there has been a linear decrease since the 1950s, accompanied by an oscillation similar in period to the lunar nodal cycle of 18.6 years. P16 lies in a transition region and its oxygen concentration is irregular due to Haida Eddies that often pass through this station.

Debby Ianson (DFO/IOS) and Ana Franco (UBC): *DIC sampling update and a first look at DIC trends on isopycnals at Station P.*

Thanks to the efforts of many, the inorganic carbon sampling on Line P has been alive for approximately half of the existence of the program. That makes 30 years of Dissolved Inorganic Carbon (DIC) and Total Alkalinity being sampled in the whole water column almost constantly at the major stations (P26, 20, 16, 12 and 4). The unique temporal and geographical consistency of these five time-series will allow us to resolve the vertical and onshore-offshore variations in the observed DIC long-term trends. An initial analysis of such trends shows an increase in surface DIC with time in each of the major stations. We assume that this trend is a clear signal of the larger amount of anthropogenic carbon dioxide present in the atmosphere now than at the beginning of the time-series in the 1980s. As expected, the positive surface DIC trend becomes weaker with depth, but the rate of decrease is variable. We contrast the vertical variability of the long-term DIC trends at Station P, where data have been collected most consistently and briefly discuss the potential physical and biological processes driving such variability in an effort to expand our view of the changes occurring in the inorganic carbon cycle in the north-east Pacific. Finally we provide a brief update on continuing inorganic carbon monitoring efforts on Line P.

Paul Covert (DFO/IOS): *Line P Underway p_{CO2}: How is it working and where are the data?*

Paul Covert and Michael Arychuk.

Surface seawater CO_2 partial pressure (p_{CO2}) has been measured along Line P since 1973. Over nearly five decades of operation, the analytical and computational methods for p_{CO2} determination have continually been refined. The last iteration of refinements have occurred over the past year, with several changes in the physical construction of the Line P underway p_{CO2} data acquisition system and in the data processing workflow. These changes will be discussed in the context of improving reliability and timeliness of final data product. Additionally, the processing and quality control status of the past decade's worth of data will be presented.

Jim Thomson (APL/UW) and Meghan Cronin (NOAA): *Station P surface moorings.*

We present an update on the surface moorings at OWS-P. Data collection is ongoing from 1) the NOAA mooring measuring surface meteorology and upper ocean profiles, and 2) the UW-APL mooring measuring surface waves and ambient noise. Recent observations and seasonal trends will be presented, including the modulation of short wind-waves by ocean swell. Both moorings are slated for turnarounds in 2019: the NOAA mooring in the summer as part of a collaborative cruise, and the UW-APL mooring in early winter as part of a dedicated science cruise studying bubble plume generation during surface wave breaking.

Heather Reader (MUN): *Organic matter dynamics along Line P.*

Heather Reader and Dennis Hansell (U. Miami).

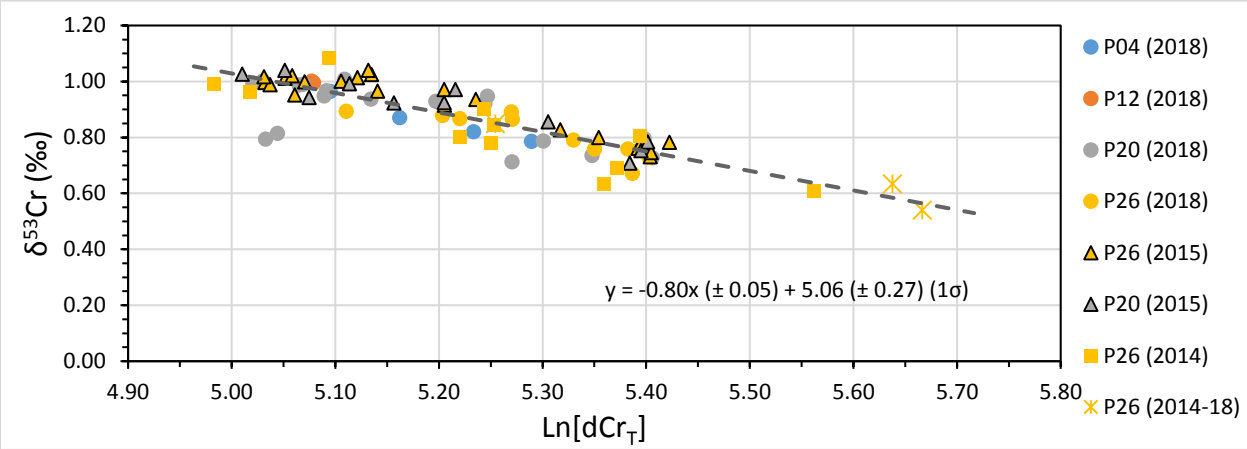
Dissolved organic carbon data (DOC) were presented from the 2017 and 2018 Line P cruises. In February 2017, DOC data measured as total organic carbon (TOC) were slightly elevated in the surface, while in June and August, elevated levels of TOC in the surface were more pronounced. These areas coincide with elevated chlorophyll-a. Deep water concentrations were in line with low expected deep pelagic TOC concentrations. In 2018, February and September showed similar distributions of DOC as in 2017. However, in June 2018, there are several notable "hot spots" of high TOC at depth. The elevated concentrations extend well below the mixed layer, though the source of this TOC has yet to be identified. Continued monitoring of TOC in the future as part of the Line P program will help to determine the source of this deep pelagic TOC.

Isabelle Baconnais (U. Sask): *Preliminary study on the variation of dissolved chromium concentration and isotope ratios along the Line-P.*

Isabelle Baconnais and Chris Holmden.

Measurements of total dissolved chromium concentration ([dCr(VI) + dCr(III)] = $[dCr]_T$) and isotopic ratio ($^{53}Cr/^{52}Cr$) in the oceans has increased with the need to evaluate both the opportunities and pitfalls of a Cr isotope proxy for tracing the history of ocean redox changes in the geological past. The acquisition of seawater from several stations on the Line-P (P4, P12, P20 and P26) in various seasons (February, August and September) and years (2014, 2015 and 2018) have allowed us to observe variations of $[dCr]_T$ from 146.0 to 289.0 $ng \cdot Kg^{-1}$ and $\delta^{53}Cr$ from +0.54 to +1.08‰. The data are strongly correlated on a $\delta^{53}Cr$ *vs.* $\ln[dCr]_T$ diagram (see figure) and plot with other seawater data from the world's oceans on the global Cr array.

The -0.8 ‰ slope of the array is interpreted to reflect the globally unique fractionation factor associated with the dominant process by which soluble Cr(VI) is reduced to isotopically-light and particle reactive Cr(III) species, which are susceptible to scavenging and removal on sinking particles. Export of reduced Cr(III) from the photic zone drives surface waters to higher $\delta^{53}Cr$ values and deeper waters to lower $\delta^{53}Cr$, as a result of Cr(III) remineralization and re-oxidization to Cr(VI). The export flux of Cr(III) reaches the sediment in productive settings overlying the continental shelf and slope. Here, dCr is released to bottom waters. Sedimentary release of Cr has previously been documented for the continental slope and rise of Cascadia Basin (Cranston, 1983), which is located to the south of Line P along the North American margin, but no isotopes of Cr were measured in that study. During the September 2018 and February 2019 cruises, we collected shelf and slope waters down to 1500 m and deeper. These data will be analyzed with the aim of looking for evidence of a release flux of isotopically light Cr from sediments draping the North American continental margin in the vicinity of line P, which is an important input flux of recyled Cr to the oceans both today and in the geological past. In this talk, we will present preliminary data from the 2018-040 (Sept 2018) stations P4, P12, P20 and P26 profiles for $[dCr_T]$ and $\delta^{53}Cr$, which will give us a preliminary look at whether shelf sediment is an important source of dCr to the subarctic Pacific.



Jody Klymak (UVic): *Canadian Pacific Robotic Ocean Observing Facility.*

C-PROOF is an ongoing project to operate a fleet of gliders, autonomous floats, moorings, etc in the NE Pacific ocean. This will be a brief update on the status of the project with time for discussion and questions as we move into the stage where decisions need to be made as to exactly what instruments will be acquired.

Roberta Hamme / EXPORTS (UVic): *Results from the US/Canada EXPORTS collaboration in Aug/Sept 2018.*

David Siegel (UCSB): EXPORTS is a US NASA funded program that conducted 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. The 2018 field campaign was very successful with many productivity and export methods deployed by two ships and autonomous

assets centred around a Lagrangian float targeting water movement at 95m. Of particular note were high concentrations of salps in the early part of the campaign that disappeared later and an increase in chlorophyll fluorescence following the departure of the US ships.

Roberta Hamme (UVic): The Canadian collaboration with the EXPORTS program involved sampling at five additional stations in the P26 area. EX-C was located at the Lagrangian float marking the centre of the US EXPORTS study. EX-F1 was located near Fassbender's BGC-Argo float. EX-W, EX-N, and EX-E were located approximately northwest, northeast, and southeast of the EX-C central station, respectively. Conditions were very similar at these five stations with EX-E and EX-W having slightly higher chlorophyll, EX-E having slightly lower nutrients, and EX-N having slightly cooler SST. Net community production numbers from O_2/Ar mass balance showed generally low values at the EXPORTS stations as well as P26 and the NOAA mooring station, with slightly higher values detected at EX-E.

Sile Kafrissen and Diana Varela (UVic): The Varela lab from the University of Victoria sampled at 5 main stations along the September 2018 Line P cruise, including the central EXPORTS station (EX-C). A suite of samples was taken at each station in order to quantify the primary productivity along Line P. Data were presented for total and size-fractionated Chl-a, particulate biogenic silica, dissolved ammonium, and nitrate. Of particular note were high ammonia concentrations at P20 associated with doliolids, a predominance of small size-class chlorophyll even at P4, and high particulate biogenic silica concentrations at EX-C. Data for dissolved urea and carbon, nitrate, ammonium, urea, and silicic acid uptake rates are still being processed.

Robyn Taves and Jay Cullen (UVic): Trace metal samples were quantified using offline extraction and triple quadrupole ICP-MS/MS for EXPORTS stations EX-C and EX-N. Typical profiles for iron and zinc were observed with the exception of relatively high concentrations within the mixed layer. Manganese showed low concentrations in the mixed layer due to biological uptake, a maxima below the mixed layer, and subsequent redox and scavenging effects at depth. Little to no change was observed between the two stations.

Robert Izett (UBC): Results from nitrous oxide (N_2O) sampling at the five Canadian EXPORTS sites revealed little variability in absolute concentrations between all stations. However, N_2O was undersaturated at all locations within the upper 100 m, and regions of N_2O saturation state minima were found to correspond with the occurrence of O_2 maxima approximately 20 m higher in the water column. Nitrous oxide profiles and N_2O-derived mixing rates were similar among stations sampled during the Canadian and US "Process" programs.

Angelica Peña (IOS/DFO): HPLC analyses revealed very similar pigment concentrations and thus phytoplankton composition at all 5 EX stations. Haptophytes were the dominant phytoplankton group as usually observed at P26 in August/September.

Methods tests and intercomparison from Sept 2018

Nina Nemcek (IOS/DFO): An HPLC pigment intercomparison was carried out on 15 samples comprised of duplicates, triplicates and quadruplicates collected at the EXPORTS stations. One set was analyzed at IOS immediately following the cruise with the replicates shipped to NASA for analysis. Results indicated very good agreement (<10%CV) for the most abundant pigments present above the limits of quantification. NASA results had better precision between replicates and slightly lower limit of detection than IOS results likely due to hardware differences.

Roberta Hamme (UVic): Winkler oxygen samples analyzed by UVic and by IOS from the same Niskin bottles at P16 compare very well at higher oxygen concentrations but UVic was lower than IOS by about 0.5 µmol/kg at the lowest concentrations. Niskins from the oxygen minimum sampled after 2.5 hours sit-time on the deck (with no headspace) showed detectable increases of oxygen compared with Niskins sampled immediately, but the effect was less than 1 µmol/kg at a total concentration of 12-13 µmol/kg. Winkler oxygen samples collected from the loop showed inconsistent offsets from 5m Niskin bottles closed at the same time of -1.5 to +1.0 µmol/kg.

Robert Izett (UBC): *Net community production – Results from 2018 and an empirical algorithm for estimating it from Line P data.*

Net community production (NCP) defines the balance between gross primary production and total respiration. As such, it sets upper limits on regional fisheries production, and the capacity for carbon export from marine surface waters. A common approach to estimating mixed layer-integrated NCP involves the use of ship-based O_2 sampling, where high-resolution coverage can be obtained from underway measurements obtained via mass spectrometry or using O_2 Optodes. In either case, measurements of O_2 must be normalized to that of an inert gas analog (e.g. Ar or N_2), in order to isolate the biological and physical fractions of the O_2 pool. Subsequently, NCP can be equated to the magnitude of diffusive air-sea O_2 exchange, when corrections for biases due to vertical mixing are made. We present NCP results from the 2018 Line P surveys. Estimates were derived from simultaneous measurements of O_2 and Ar (O_2/Ar via membrane inlet mass spectrometry; i.e. MIMS) or O_2 and N_2 (O_2/N_2 via Optode and Gas Tension Device, respectively; i.e. the PIGI system). The PIGI system is a fully-autonomous sampler capable of making high-resolution measurements from the seawater loop. It is cost-efficient, simple to use, and may be suitable for deriving NCP estimates in place of MIMS. We thus also present results of NCP derived from side-by-side deployments of the MIMS and PIGI systems, in order to evaluate the suitability of using O_2/N_2 measurements instead of O_2/Ar. Finally, using data obtained from Line P and La Perouse surveys since 2015, we present an empirical algorithm for estimating NCP from more commonly-measured oceanographic variables (e.g. chlorophyll *a*, sea surface temperature, mixed layer depth). Using this, we show that a time-series of NCP estimates along Line P can be re-constructed using archived data. Ultimately, this will enable investigation into the links between climate, NCP, and ecosystem services, such as fish production and carbon export.

Philippe Tortell (UBC): *Autonomous primary productivity measurements along Line P using FRRF-based active chlorophyll fluorescence methods.*

One of the major goals of the Line P time-series program is to measure the spatial and temporal patterns of primary productivity in coastal and oceanic waters of the subarctic Pacific. Traditionally, most productivity measurements have utilized ^{14}C incubations in discrete bottle samples, but this method has limited spatial resolution and may introduce sample containment artefacts. For this reason, our group has put significant efforts into developing and applying autonomous, incubation-free methods to assess primary productivity. Most of our work to date has focused on dissolved gas measurements (see presentation by Izett et al), but we (led by former PhD student Nina Schuback) have also made progress on the use of fast repetition rate fluorometry (FRRF) to derive estimates of gross primary production from measurements of photosynthetic electron transport around photosystem II. FRRF methods have been employed in

oceanography for more than two decades, yet significant uncertainty remains in the best practices for instrument deployment, and the analysis and interpretation of resulting data. Recently, I initiated a new SCOR working group - *Active Chlorophyll fluorescence for autonomous measurements of global marine primary productivity* (https://scor-int.org/group/156/) that will bring together world-experts in FRRF to design standards of best practice for the global oceanographic community. In this presentation, I will highlight the key objectives of SCOR WG 156, and discuss the implications for FRRF-based primary productivity measurements along Line P. I anticipate a concerted effort to deploy FRRF instruments and ^{14}C incubations on the John P. Tully, to resolve sources of variability that influence the interpretation of active chlorophylla fluorescence data. Key variables include variability in the electron requirement of photosynthesis, and spectrally-dependent absorption characteristics. Understanding the factors driving such variability will not only improve FRRF-based productivity measurements, but also provide insight into underlying photo-physiological responses to environmental conditions (e.g. iron limitation).

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

We use biomass size spectra (BMSS) to evaluate changes in zooplankton production and transfer efficiency (TE) along line P from 1995-present. BMSS slope can be used to infer transfer efficiency, while the y-intercept can be used to infer system productivity (Gaedke, 1993; Sweeting et al., 2009; Murry and Farrel, 2014). Taking this a step further, we can apply empirical size-based equations for growth rate and mortality to obtain estimates of both production and TE. Our goal is to understand how production and TE vary spatially and temporally along Line P over the past 25 years. To date, we have produced zooplankton size spectra for the top 250 m at P2, P4, P12, P16, 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 to understand the impacts of climate change in the region.

Maite Maldonado (UBC): *The biogeochemical cycling of dissolved Cu in the subarctic NE Pacific.*

Anna M. Posacka, David M. Semeniuk, Jay T. Cullen, Kristin Orians, Maria T. Maldonado.

We investigated biogeochemical cycling of dissolved copper (dCu) along the Line P transect, in the subarctic Northeast Pacific. Concentrations of dCu ranged from 1.4–3.7 nmol kg−1 throughout the water column along the transect, and were elevated in the upper and bottom waters near the continental margin (< 300 m and > 1100 m, respectively) as well as in the upper waters offshore (< 300 m). These trends were attributed to the fluvial and sedimentary sources near the coast of BC, and upwelling of deep, dCu rich waters in the Alaska gyre offshore. In addition, we conducted a temporal investigation of dCu at Station PAPA over three consecutive years (2010−2012), which revealed dynamic variability in the top 300 m that was accompanied by elevated sub-surface concentrations, indicating Cu supply from atmospheric deposition. We explore atmospheric inputs in the Gulf of Alaska and suggest that they may play a significant role in moderating dCu distribution in this region. Consistent with previous investigations in the North Pacific, dCu distributions in the nutricline throughout the transect were strongly linked to those of phosphate and silicate. However, within the Northeast Pacific Oxygen Minimum Zone (OMZ) silicate and dCu distributions were noticeably decoupled suggesting a deficit or loss of dCu in these deep, oxygen depleted waters.

Sachia Traving (UBC): *Microbial responses to a warm temperature anomaly in the Northeast subarctic Pacific Ocean.*

Sachia Traving, Grace Ho, Colleen Kellogg, Ryan McLaughlin, Marie Robert, Tetjana Ross & Steven Hallam.

Extreme weather events including catastrophic hurricanes, floods, wild fires and droughts appear to be increasing as global temperature rises. While many of these impacts can be visibly recognized in terrestrial ecosystems, much less is known about the effects of increasing temperature on marine ecosystem functions and services. Recent studies on the emerging risks of marine heat waves describe surface water temperature anomalies persisting for days to months causing changes in food web structure and bloom dynamics, loss of biological diversity and increased mortality among a wide range of plant and animal species. However, little information is currently available on the potential impact of marine heat waves on microbial communities inhabiting surface and interior regions of the ocean. These communities are responsible for driving major biogeochemical fluxes with resulting feedback on both food web structure and the climate system. Here we present a time-resolved study on the impact of a warm water temperature anomaly colloquially known as "the blob" observed in surface waters of the northeast subarctic Pacific (NESAP) Ocean in the vicinity of 42°N 148°W, extending 30 degrees of longitude and 8 degrees of latitude between 2013-2016. As part of the Line P program we repetitively sampled the water column at the terminal station Ocean Station Papa (OSP) between 0 – 4000 m filtering waters for microbial biomass collection (> 0.22 µm size fraction). Genomic DNA was extracted from these samples and used to generate molecular fingerprints based on small subunit ribosomal RNA (SSU rRNA or 16S) gene amplicon sequencing. Resulting sequences were clustered at the 97% identity threshold resolving 1,310 operational taxonomic units (OTUs) that were assigned taxonomy using the SILVA132 database. Multivariate statistical analysis identified strong depth- and season-dependent trends in microbial diversity with significant temperature effects in surface waters above 200 m during the protracted blob interval. These effects included a flattening of seasonal changes in diversity and proportional shifts in the relative abundance of specific taxonomic groups. The extent to which these observations reflect changes in the metabolic network remain to be determined and will be a future goal to be evaluated in relation to other stressors including deoxygenation to resolve cumulative effects on biogeochemical fluxes in surface and interior waters of the NESAP.

Angelica Peña (DFO/IOS): *Phytoplankton community composition along Line P during and after "the blob".*

Significant changes in the abundance and composition of phytoplankton (as determined by HPLC-derived phytoplankton pigment concentrations) were observed along Line P as a result of a rapid warming of surface waters in 2014-2015 ("the blob"). The increase in stratification during "the blob" led to nutrient limitation, a decline in phytoplankton biomass, and dominance of cyanobacteria in the transition zone of Line P, whereas phytoplankton biomass increased at the offshore HNLC region. By 2016, phytoplankton assemblage composition seem to have returned to values similar to those observed before the warming occurred, except for unusually high abundance of diatoms in June 2016 and August 2017 at the most offshore stations. However, in June 2018 an increase in the abundance of diatoms and low silicate concentrations were observed at many stations (P13 to P23) along Line-P. These changes at the base of the food web could have ecosystem-wide implications.

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 2019-20.

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 15.

June 2019 — 12

DFO-IOS	5
Chief Scientist (Robert)	
CTD watch (Galbraith)	
CTD watch (Romaine)	
DMS (Arychuk)	
TM (Simpson)	

UBC	3
Hallam - 2 (Shiller, Haag)	
Packomov - 1 (Kwong?)	

UVic	1
Varela - 1 (Livingston)	

NOAA	2
Higley, Anderson	

MBARI	1
Fassbender -1 (Haskell)	

Waiting list	
Morgan	1
Quay	2
Bishop	2
Grundle	2

August 2019 — 14

DFO-IOS/BIO	5
Chief Scientist (Robert)	
CTD watch (Maclean)	
CTD watch (?)	
DMS (Arychuk)	
Cesium (Nelson)	

UBC	4
Hallam - 1 (Shiller)	
Maldonado - 2	
Packomov - 1 (Lueskow)	

UVic	3
Varela - 1 (Livingston)	
Cullen - 2	

U Sask	1
Holmden - 1 (Mohanta)	

DOC/TOC/CDOM	1
1 (MBARI or UMiami)	

Waiting list	
Morgan	1
Orellana	1

February 2020 — 8

DFO-IOS	6
Chief Scientist (Robert)	
CTD watch (Galbraith)	
CTD watch (Belton)	
DMS (Arychuk)	
Trace Metal	
DOC/CDOM	

UBC	1
Hallam - 1	

UVic	1
Varela - 1	

Waiting list	
Morgan	1
Zhang	1
Grundle	2