LMG 18-01: 05 Jan -- 07 Feb. 2016 LTER Cruise 26
Weekly Science Report 2
14-21 January, 2018

"Palmer Antarctica LTER (PAL): Land-Shelf-Ocean Connectivity, Ecosystem Resilience and Transformation in a Sea-Ice-Influenced Pelagic Ecosystem"

The big story of this week was our success in occupying more of the sampling grid stations than has been accomplished in a decade! We have managed to occupy all our intended hydrographic stations on the 600, 500, 400, 300, 200, 100, 000, and -100 lines of the PAL survey grid. We successfully recovered one physical oceanography mooring, though it was damaged and approximately half of the string did not come to the surface and is considered lost, perhaps sheared off by an ice berg or the string parted for some other reason. We tried to recover two other moorings, but had no succees in communicating with them. We will revisit one of the mooring sites later in the cruise, specifically at the 200.140 location. After finshing the -100 line, but unable to visit Charcot Island due to thick ice, we visited the British Rothera Base on Saturday-Sunday. Our annual visit is part of a formal collaboration beween Palmer LTER and the British Antarctic Survey's Rothera Time Series Program. After leaving Rothera on Sunday morning the 21st, we deployed the seabird team onto Avian Island for five days, and then commenced our second Process Study in the Margurite Bay region.

Thanks to the skilled officers and crew under the command of Captain Ernest Stelly and ASC crew led by Lindsey Loughery for such efficient and excellent support as we worked diligently through the main sampling grid.

Individual Team Components:

C-019: Phytoplankton Ecology (Oscar Schofield, PI, Rutgers University).

Field Team Members: Nicole Waite, Carly Moreno, Taylor Dodge, Steve Weber

The objective of this component of the Palmer LTER is to understand the physiological ecology and the spatial/temporal distribution of phytoplankton along the WAP. Field efforts are focused on three areas. The first is to maintain the core time series of the Palmer LTER. Core time series of the phytoplankton time series are chlorophyll a, HPLC to provide phytoplankton accessory pigments, chlorophyll *a* fluorescence induction measurements of photosynthetic quantum yields, and daily 14C-radioisotope uptake experiments. This year we are adding species identification to the time series through selected the addition of an automated imaging flow cytobot. We additionally characterize the bio-optical properties of the water column to provide optical baseline measurements for remote sensing approaches through the deployment of the profiling Bio-Spherical C-OPS spectral radiometer.

Additionally, during the cruise, we are also conducting manipulation experiments to assess factor driving the overall community composition within the LTER grid during process stations. This we are conducting deckboard incubations we are assessing the physiological signatures of iron limitation using fluorescence and RNA-based approaches in partnership with the laboratory of

Professor Adrian Machetti at the University of North Carolina at Chapel Hill. We have conducted We are also conducting experiments on selective grazing by phytoplankton species by Antarctic peninsula in partnership with the Steinberg laboratory at the Virginia Institute of Marine Sciences and the laboratory of Professor Grace Saba at Rutgers University. The deckboard manipulations are being conducted on the 01 deck of the Gould representing discrete short term incubations (12-24 hours). The water at the end of the incubations is being analyzed for fluorescence-based estimates of phytoplankton photophysiology, HPLC pigments, chlorophyll, RNA-profiling and phytoplankton species composition.

To date we have conducted 6 of these manipulations. The manipulations were paired where an inshore station (likely iron replete) was compared to an offshore station (likely iron limited). The manipulations were conducted for the 600-, 400-, and 200- lines. The manipulations will assess whether alleviation of iron limitation is associated with a decrease in the relative fraction of detached photosystem II reaction centers. These detached photosystems II centers have been hypothesized to be a cellular signature of iron limitation based on data collected from the 17-01 LTER cruise as well as data collected in the Amundsen.

We are also coordinating with the team at Palmer Station, the operation of two Slocum gliders. One deep-class glider (2000m) was sent to survey the area on the northern peninsula region. The flight design was developed in collaboration with the NOAA AMLR efforts at Cape Sheriff. At the request from NOAA we redirected our northern survey to sample the waters near Astoblade island, which will help them developed their nascent glider program. This glider is headed back to Palmer station, and should be recovered next week. The second glider (2000 m class) was launched from Palmer station and has surveyed the shelf south of Palmer Station and then loitered offshore Avian island before heading to Rothera. In transit to Rothera, the glider encountered issues. The glider apparently ran into the sea floor and became stuck. After 24 hours the glider, in a programmed response, blew its ejection weight. This resulted in the glider becoming a surface drifter and required recovery. The Gould having completed the grid lines on the WAP shelf and was in transit to Rothera. The glider was recovered the morning January 19th after allowing the sea to lay down after a strong gale encountered on the 18th (**Figure 1**). The recovery was successful due to the strong coordination between the RV Gould and shore-side glider scientists in NJ.

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During this week, the team completed the full line sampling grid occupying three stations for the 600, 500, 400, 300, 200, 100, 000, -100 lines. This is the first time in a decade when ice did not keep of us from completing the full grid. Generally, the grid showed increased primary

Figure 1. The happy zodiac team after a successful glider recovery.

productivity across the board compared to the process stations conducted in Palmer deep in Week 1 of the cruise. On the grid, nearshore stations had the highest productivity compared to offshore stations. Generally, there was an increase in the carbon fixation for the Southern stations, with productivity rates almost doubling. The high productivity rates were mirrored with high quantum yields of photosynthesis. Finally, the imaging flow cytobot showed a gradient increase in the number of large versus small cells along with a distinct change in the phytoplankton community composition between northern to southern stations.

B114 Cruise LMG 18-01

Project Researchers: James T, Hollibaugh and Brian N. Popp

Sampling collection for nitrification rate measurement is proceeding smoothly. Measurements have been initiated for a total of 85 samples using ^{15}N-labeled nitrite, ammonium and urea, with a subset (39 samples) analyzed for oxidation of ^{15}N from putrescine. Nineteen measurements have been completed to date, with the remainder (from the LTER 500 and 400 lines) currently in the incubator. We have also measured nitrite and ammonium concentrations in the same samples (these are consistently <100 nM). Samples for determining nitrification rate have been frozen at -80 ^{0}C awaiting del^{15}N determination in Popp's lab at the University of Hawaii. Chemoautotrophy

measurements (incorporation of $NaH^{14}CO_3$) have been run on 24 samples. These will be counted onboard in the next week.

We have collected particulate DNA from this same set of samples. These samples, which are in Sterivex filter capsules, have been fixed with lysis buffer and frozen at -80 ^oC pending analysis in my lab at UGA after the cruise ends.

We have not encountered any insurmountable issues with our program, other than those related to weather.

C-020. Zooplankton Component (Debbie Steinberg, VIMS; PI)

Field Team Members: Joe Cope, Patricia Thibodeau, Andrew Corso, Kharis Schrage, and Colleen McBride.

During the second week, we deployed our 1- and 2-m nets along the 300, 200, 100, 000 and -100 grid lines. Large abundances of the krill *Thysanoessa* and copepods were seen throughout this region, as seen in previous years. The salp blooms were present at the slope stations, which had low ice concentrations compared to last year. *Euphausia superba* and *E. crystallorophias* were common in the coastal waters. After being nearly absent last year, Antarctic silverfish, *Pleurogramma*, larvae were taken at several stations. We conducted southern onshore and offshore fecal pellet production rate experiments on *E. superba*. We continued to collect animals for gut fluorescence and for future physiological measurements.

Tricia, a Ph.D. Candidate in Dr. Deborah Steinberg's lab, is conducting experiments with an open ocean snail, a shelled pteropod *Limacina helicina Antarctica* (**Figure 2**). Tricia is interested in determining how increasing temperatures and limited food availability affect pteropod respiration and excretion. She has been conducting a series of these experiments monitoring their metabolism as the ARSV Gould samples along the WAP PAL LTER grid. In collaboration with the Hollibaugh group (B-119) on board, initial ammonia (NH_3) excretion results indicate *L. antarctica* exposed to

Figure 2. Graduate student Patricia Thibodeau and the *Limacina helicina Antarctica* she is studying.

higher temperature (4°C) conditions excrete more than those exposed to ambient temperatures (1°C). She aims to conduct further experiments during the cruise incorporating a CO_2 component into the experimental design.

C-024: Cetacean Biology & Ecology (A. Friedlaender, University of California, Santa Cruz, PI).

Field Team Members: Doug Nowacek (Co-PI) and Julian Dale, Duke University.

Week 2 was relatively quiet for the 'whalers' as the work on the sampling grid continued apace for the other teams. Visual surveys during the grid work resulted in several whale sightings, especially off the west coast of Adelaide Island, but one attempt at biopsy sampling came up empty as the whales could not be relocated after deploying the zodiac. A thorough survey of the eastern side of Marguerite Bay yielded only one cetacean sighting of a juvenile humpback whale. The whale team spent the week analyzing data from the tags attached during week one and will continue to do so during the rest of the cruise. Lastly, the whale team was scheduled for a flight from the Rothera base, continuing the collaboration and memorandum of understanding with the British Antarctic Survey (BAS) to map whale and seal sightings in the WAP region. Also planned for this year was an effort to align satellite imagery with sightings from the flight so as to investigate the efficacy of using satellite images for whale sightings. Unfortunately, due to a backlog of supply and other flights, Rothera was unable to provide an aircraft this year.

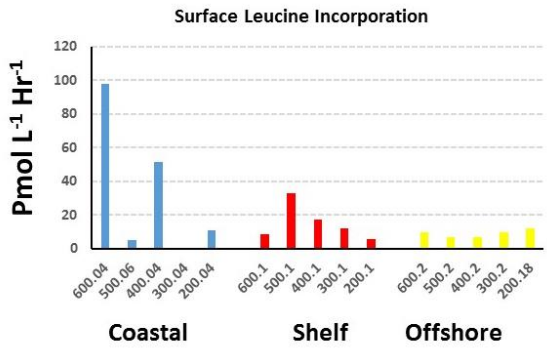

Figure 3. Surface leucine incorporation rates at grid stations, January 2018

C-045: Microbial Biogeochemistry Component (H. Ducklow, Lamont Doherty Earth Observatory; PI).

Field Team Members: Hugh Ducklow, Naomi Shelton, Rebecca Trinh, Hugo Berthelot, Mar Arroyo and Shana Lesko

We completed all planned cardinal stations on the extended LTER Grid (600 to -100 lines). This is the first time since we started occupying the three southern lines (100, 000 and -100) in 2009 that we were able to occupy all 9 stations on these lines. This is due to a lack of heavy sea ice cover in this region. We did occupy two stations (000.040 and -100.040) in 9/10 cover with loose ice floes.

All systems and procedures are working well. We obtained vertical profiles of all properties including Thorium-234 and leucine incorporation at all but one station. Leucine incorporation rates, a proxy for the rate of bacterial biomass production, were very low throughout the grid (**Figure 3**) by as much as two orders of magnitude compared to some previous years. Even so the expected patterns were observed: highest rates near the surface, and in the coastal waters, and low rates in deeper water and offshore.