LMG 20-01: 30 Dec. 2020 – 05 February 2020 LTER Cruise
Weekly Science Report III
Palmer Long Term Ecological Research Project: Looking Back in Time Through Ecological Space.
Cruise Overview (O. Schofield, Chief Scientist):

After a very busy week with the LTER focused on sampling our historical shelf station grid we ended up at Rothera (Figure 1). After Palmer Deep Process Station 1, the LTER team completed the 600, 500, 400, 300 and a 1/3 of the 200 lines. At the end of the 600-line (600:200) the krill team completed a 2nd set day/night MOCNESS tows. On the 300-line there was significant effort (13 hours) devoted to attempting to recover the mooring deployed at the 300:100 station by the Shadwick team a year before. Despite much time and several acoustic systems being utilized, we had no luck. We heard one ping during the 13 hours but the mooring releases did not respond to "release" codes. We plan to return to the 300:100 line and attempt to recover the mooring again before deploying a second mooring on the line. Before steaming to Rothera, the Penguin team was deployed on Avian Island where they will census the bird populations. After their deployment and some whaling the Gould was at the docks at Rothera in early AM. The long-standing goal of this annual visit is to ensure the United States and United Kingdom's signature Antarctic time series are cross calibrated. This involves occupying three stations each year with the Gould's and Rothera's CTDs together. The British scientists were enthusiastic, and the CTD Baltic room aboard the Gould was packed leading to not only great data collected but interesting science/cultural exchanges (Figure 2). Upon completion of this activity, this evening the Gould will conduct whaling surveys as it relocates to the mouth of Marguerite Bay to

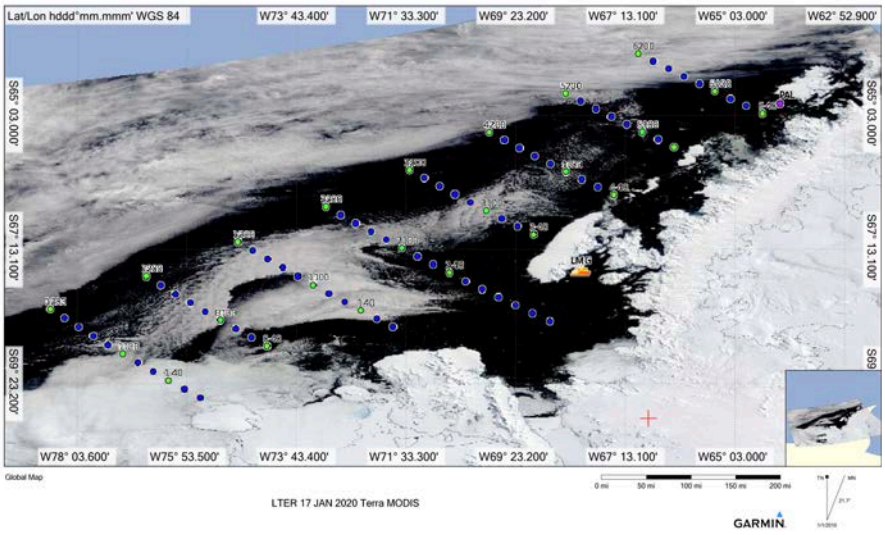

Figure 1. Location of the LMG near Rothera and the historical sampling grids of the LTER. Blue circles indicate underway station, green circles full process stations.

Figure 2. Rothera UK scientists joining the RV Gould scientists in a crowded but friendly CTD control Baltic room.

begin Process Station 2. The effort will be focused on paired day-night coastal-open ocean MOCNESS surveys, acoustic surveys and begin a series shipboard incubations. Upon completion of the Process Station, we recover the birders from Avian and head further south. Specific efforts of the individual teams are highlighted below. Also as always our success mirrors the great ASC and Edison Chouest Offshore partners, who are the best science support team I have had the pleasure of sailing with.

C-045: Microbial Biogeochemistry Component (Hugh Ducklow, Lamont Doherty Earth Observatory; PI)
Field Team Members: Rebecca Trinh, Natalia Erazo, Beth Conors, Tom Kelly, Natalie Yingling, Dan Lowenstein

During week 3, we completed the 600, 500, 400, and 300 lines. Our group has been hard at work processing station samples to better understand the role bacteria play in the biogeochemical cycling of the West Antarctic Peninsula (WAP). Among the measurements we take aboard the LMG are bacterial abundance measurements using a flow cytometer (Figure 3), which uses a laser to count and size individual bacteria cells.

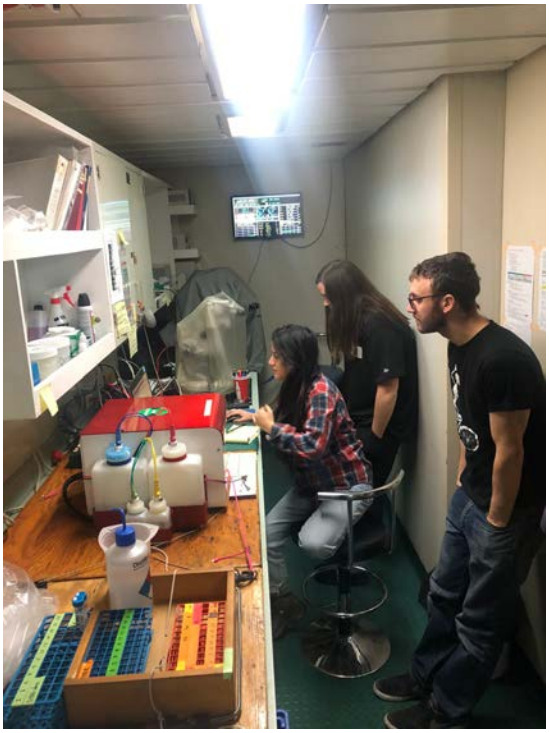

Figure 3: Team members Natlaia, Beth, and Dan work together to run samples on the flow cytometer to better understand the abundance and size distribution of bacteria cells through the water column of the WAP.

Bacterial production rate measured using tritated-leucine to understand how metabolically active the bacteria cells are, and how much organic matter they take up and recycle in the water column. Figure 4 shows the depth profile of bacteria production rate at three coastal stations along our sampling grid. Stations 600.040 and 500.060 have sub-surface maximums in bacterial production rate, while station 400.040 has the highest bacteria production rate right at the surface of the water column. All three stations see a dramatic decrease in bacteria activity below about 60 meters depth.

During week 3, our group was also tasked with recovering a physical oceanography mooring deployed on LMG 1901 near station 300.100. Unfortunately, after about 13 hours of searching for the mooring and trying to ping its acoustic releases, we were unable to find the mooring and recover it, but not due to a lack of valiant effort on the part of the captain, mates, electronic technicians, marine technicians, our very patient chief scientist, and everyone who helped us look.

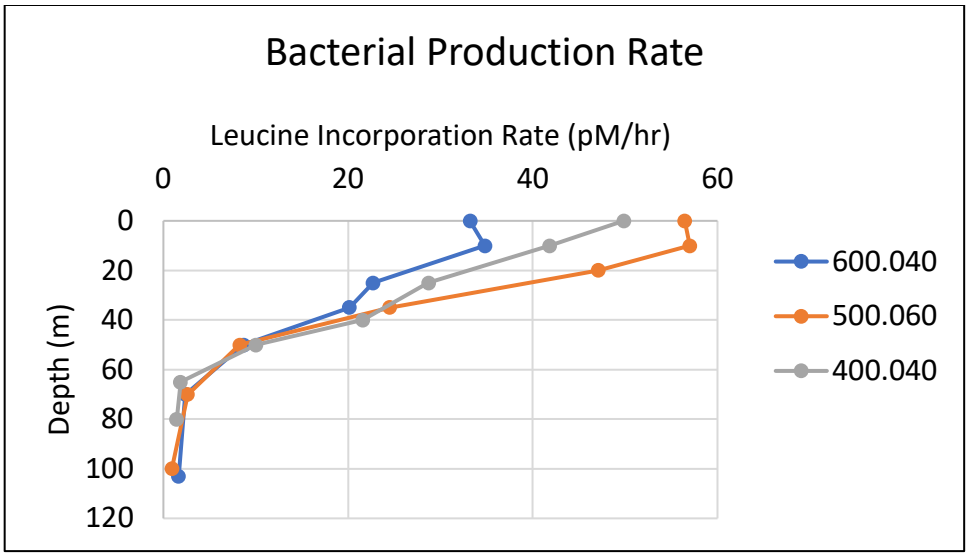

Figure 4. Depth profile of bacterial production rate at stations 600.040, 500.060, and 400.040.

C-019: Phytoplankton Component (Oscar Schofield, Rutgers University; PI)
Field Team Members: Oscar Schofield, Steve Ackelson, Quintin DiouCass, Jacqueline Veatech, Laura Wiltsee, Gabrielle Rosenthal

The LTER continued its bio-optical profiling combined with traditional LTER phytoplankton measurements that include High Performance Chromatography, Chlorophyll a, 14C uptake (Figure 5), eDNA measurements, and FIRE. The flow cytobot, provided measurements of the particle number, size distribution and high resolution images of the individual plankton, while the Fluorescence Induction Relaxation Emission (FIRE) provided photosynthetic quantum yield measurements. The two instruments collected continuous underway measurements of surface waters and discrete measurements as a function of depth at the full stations across the grid.

Figure 5. The phytoplankton productivity incubator on the 01-deck in the foreground. Samples screened to different light values are visible within the deckboard unit on our first sunny day of the cruise.

Data from the Week 3 grid efforts, showed 14C uptake rates, not surprisingly, decreased as the ship transected offshore with productivity vertical distributions showing peak and rather uniform productivities in the upper mixed layer. This was consistent with the bacterial productivity rates seen by the Ducklow lab. The

inner shore stations were dominated by the smaller cells, and while the biomass declined offshore it was complemented with a shift to a larger particle distribution.

During the last week we completed our first deckboard experiment. The experiment is central to the PhD thesis of Quintin Diou Cass (Figure 6). The initial incubation experiment was conducted with the goal of collecting samples that could be used in quantifying the impact and possible compositional shifts of natural phytoplankton communities under decreased light exposure. This incubation experiment exposed natural phytoplankton assemblages collected over the Palmer Deep region to three levels of light (100%, 60%, and 10%) to observe the physiological, growth and compositional changes in the phytoplankton community. During the course of the experiment, phytoplankton communities were kept in various levels of light via mesh shielding and incubated in carboys contained in a flow-through incubation tank on the 01 Deck of the LMG. Samples of DNA and lipids were collected at intermittent time periods for high-resolution determination of community composition and lipid production at later dates (MetO and LipO). Samples were also taken regularly to quantify photosynthetic efficiency (FIRe), plankton size distribution (IFCB), chlorophyll group abundance (HPLC), and changes in nutrient concentrations over the course of the experiment (Nutrients). Over the 8-day period of the experiment, each of nine incubation carboys were sampled five times for contextual data (FIRe, HPLC, IFCB, Nutrients) and three times for MetO and LipO samples. In gathering the samples described above under the conditions imposed by the experiment's design, the data gathered will be representative of how light influences phytoplankton community composition directly.

Figure 6. First year PhD student Quintin DiouCass

C-020. Zooplankton Component (Debbie Steinberg, VIMS; PI)
Field Team: Joe Cope, Kharis Schrage, Andrew Corso, Kristen Sharpe, and Courtney Lorey.

During the second week, we deployed our 1- and 2-m nets along the 600, 500, 400, and 300 grid lines. Salps continued to be abundant (Figure 7) along the 600 line, decreased along the 500 line, and were nearly absent from the 400 and 300 lines. They were replaced by increasing abundances of Antarctic krill, *Euphausia superba*, especially gravid females. Large abundances of the krill *Thysanoessa* and copepods were seen throughout this region, as seen in previous years. A day/night pair of MOCNESS tows were taken at the outermost station along the 600

line. Mirroring what we found in the coastal tows, salps were concentrated in the surface waters at night and migrated to deeper waters during the day. We also conducted onshore and offshore fecal pellet production rate experiments on salps. We continued to collect animals for gut fluorescence and for future physiological measurements. The net tows revealed a full complement of species with the offshore stations showing exotic zooplankton (Figure 8).

Figure 8. Laborious efforts sorting Salps on what resembles a Tapas plate from hell.

Figure 8. A Sergestidae sp. caught during a deepwater MOCNESS tow.

A major question facing the Antarctic research community is to understand how changing temperatures will influence the physiological ecology of polar organisms. Some species are expected to be especially vulnerable to the temperature changes. One case in point is the Antarctic icefish which does not have hemoglobin but relies on the high oxygen saturation in cold polar water to remain aerobic. While there have been measurements on adult icefish there are no measurements for larval icefish. PhD student Andrew Corso (Figure 9) is focused on defining the temperature mortality dependence of Antarctic larval icefish. The specimens of "opportunity" are collected in the standard 1- and 2-m net tows deployed during routine full sampling stations. To date there have been 5 larval icefish caught to support these experiments. As the Gould proceeds further south in the grid the team will have better success collecting data for this important question,

Figure 9. LTER PhD student Andrew Corso pining for juvenile icefish while sorting salps.

Finally, Andrew brought a new high-tech macro lens to photograph zooplankton. He is still working out some of the finer details, but what he has shot looks promising (Figure 10).

Figure 10. High resolution imagery collected with new camera equipment.

C-013. Penguin and Seabird Component (William Fraser, Polar Ocean Research; PI)
Field Team: Anne Schaefer and Leigh West

During the second week of the LTER cruise, we began at-sea marine bird and mammal surveys along the LTER regional study grid. We completed surveys along the 600, 500, 400, and 300 lines and during sampling stations. The weather was overcast with some light precipitation. Fog reduced visibility along the 500 and 400 lines for marine mammal surveys. Overall, marine bird and

Figure 11. Cape petrels observed at station 600.200. Photo by A. Schaefer.

mammal densities have been low so far. Species observed include black-browed albatross, light-mantled sooty albatross, wandering albatross, gray-headed albatross, cape petrels (Figure 11), white-chinned petrels, giant petrels, southern fulmars, Wilson's storm-petrels, black-bellied storm-petrels, chinstrap penguins, humpback whales, and crabeater seals. We also prepared for deployment to our Avian Island field camp, which is scheduled for January 17 – 22. We are very grateful to Amy Chiuchiolo (MLT) for helping us set up our lab space on the LMG before departure.

C-024. Whale Component (Ari Friedlaender, UC Santa Cruz; PI)
Field Team: Ross Nichols, Amanda Lohmann

While the first week of LMG20-01 allowed the whale team to take advantage of working in the vicinity of Palmer Station and the Palmer Canyon allowing deployment of motion-sensing tags and collect biopsy samples, this following week found the ship in offshore waters with fewer whales. Efforts therefore were largely focused on censusing the population and collecting biopsies from whales encountered during transects. These efforts were augmented with more intense zodiac sampling in the nearshore stations. The team was able to collect over 12 samples in the past week. The whale populations were observed to be high in coastal waters of the 500 to 300 lines, only 2 whales were observed in Magueritte Bay. The whale population was dominated by humpback whales (Figure. 12).

Figure 12. Humpback whales feeding in the shelf waters of West Antarctic Peninsula.