LMG 23-01: 22 Dec. 2022 – 06 Feb. 2023, PAL LTER Cruise #30
Weekly Science Report IV (Final)
(Jan 23rd to Jan 30th)

LTER: Ecological Response and Resilience to "Press-Pulse" Disturbances and a Recent Decadal Reversal in Sea Ice Trends Along the West Antarctic Peninsula.

Other projects: CAREER: Understanding Microbial Heterotrophic Processes in Coastal Antarctic Waters (Jeff Bowman, Scripps, PI) and CAREER: The transformation, cross-shore export, and along-shore transport of freshwater on Antarctic shelves (Carlos Moffat, U. of Delaware, PI).

Overview (Carlos Moffat, Chief Scientist)

During the fourth and final week of LTER science we successfully completed the -100 to 100 grid lines and completed a process station off Charcot Island. As part of the O-263 component, we collected a high-resolution CTD section in this area as well. Despite the favorable sea ice conditions, our planned visit to the Charcot penguin colonies didn't materialize as the conditions at the landing site were not safe.

With the LTER grid finalized, we headed to the Rothera Station area for a planned stop to drop oxygen isotope samples—for analysis at the British Antarctic Survey's facilities in the UK, and to welcome a BAS team onboard the *Gould*. We arrived a few hours early which were not wasted as the Steinberg group was looking to conduct additional net tows in this area. At about 8:00 AM, two marine assistants and one marine engineer from BAS came aboard to conduct joint sampling of physical properties and nutrients using Rothera's CTD and our CTD/Rosette. Because of our long-standing scientific collaboration, this allows us to compare methods and ensure data compatibility.

After the Rothera visit, a last science activity was to conduct a high-resolution hydrographic section off Adelaide Island as part of the O-263 component, which was successfully completed the morning of January 30th.

The teams have been busy packing their labs away and preparing for shipping samples and materials to their home institutions. As we finish another successful LTER cruise, I want to thank the Captain Stelly and the crew of the *L.M.Gould* as well as our MPC Anna McBee and the entire ASC team. We were provided with excellent support that allowed us to get our science done in a safe and timely manner. We look forward to being back next year.

Group Reports

C-024 Whales-LTER (Logan Pallin, Friedlaender Group, UCSC)

Team Members: Logan Pallin (lead), Arianna Torello

This week, we were finally blessed with some sunny and calm weather, perfect for the whaling group to continue to conduct bridge surveys of marine mammals. As well, we are slowly making our way back to Palmer Station for the port call, so the whaling team has been finalizing all paperwork and cleaning up the lab for transit. It has been a very successful season, thanks to the continued support of the ASC/ECO staff and crew. In total, the whaling team has sighted over 150 humpback whales (Figure 1), ~65 killer whales (two different ecotypes), and 6 Antarctic minke whales. As well, we have collected 21 skin-blubber biopsy samples which will be used to determine the sex of individuals, hormone markers for health and pregnancy, and will be integrated into our genetic database of over 2,500 samples from the Antarctic Peninsula region since 2010. Lastly, we successfully deployed two non-invasive suction cup tags at the early part of the trip which will help us better understand the foraging behavior of humpback whales along the peninsula.

Figure 1: Fluke photograph of humpback whale encountered by the whaling team. This will be integrated into photo-identification records to better understand the movements and mixing of humpback whales throughout the Southern Ocean. Photo collected under NMFS Permit No. 23095.

C-021 & O-263 Physical Oceanography-LTER (Carlos Moffat, LTER PI, U. of Delaware)

Team Members: Carlos Moffat (lead), Rike Benz, Jake Gessay, Michael Cappola, Evan Quinter

The physical oceanography team spent the last week of the cruise continuing to sample and processing dissolved oxygen samples for calibration of the CTD data. We continued to monitor the performance of the CTD data, which has been very consistent throughout the cruise. As part of the O-263 component, two high resolution sections off Charcot Island and Adelaide Island were completed. Together with the line off Renaud Island, we were able to complete the planned three sections to study the discharge of meltwater to the WAP coast. We also continued to monitor and tweak the mission of Rutgers glider RU33 (in collaboration with Nicole Waite from Rutgers and David Aragon, who is piloting the glider from the US) which is sampling off Adelaide Island.

We appreciate the support we received from the captain and the crew of the Gould and the ASC team. Much of our sampling required adapting to newly collected data and changing circumstances and the team on board was ready to help.

C-023 Seabirds-LTER (Megan Roberts, Cimino Group, UCSC)

Team Members: Megan Roberts (lead), Allison Northey

This week the seabird team continued to conduct bridge-based seabird surveys along the -100, 000, and 100 LTER grid lines. Although the lack of sea ice surrounding Charcot made it easily accessible for the ship, large swell and icebergs in front of the landing made the Adélie colony on the island inaccessible to our team by zodiac and we were not able to collect census data and biological samples. The icebergs, grounded directly in front of the landing, also made it impossible to see the colony from the small boat or bridge of the ship. Unfortunately, there was no time to wait for the swell to calm down at the landing. Fortunately, the ship was able to complete a Process Station near the island and we were able to conduct stationary seabird surveys where we observed the first Snow petrels of the cruise, along with the first Crabeater seals.

The team was also able to finish processing Adélie diet samples from Avian Island (Figure 2). During processing, we identified the species of krill within the diet and measured the lengths of a subsample of krill to determine their age class. All krill within the diets were *Euphausia superba* species. Various otoliths (fish ear bones) and squid beaks were also collected from these samples and other biological samples collected from the island that will later be identified to determine the species seabirds from this location are feeding on. The team also worked on cleaning and drying field gear from the previous week's field camp and inventorying all gear associated with the cruise.

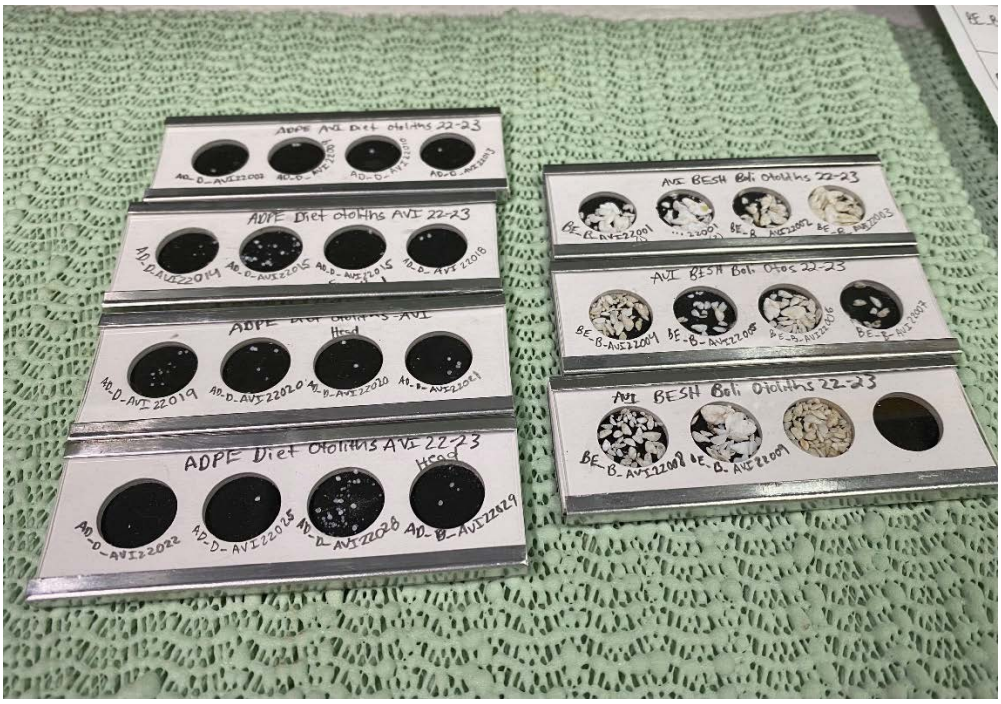

Figure 2: Otoliths collected from Adélie diet samples and Blue-eyed shag boluses

C-019 Phytoplankton-LTER (Nicole Waite, Schofield Group, Rutgers University)
Team Members: Nicole Waite (lead), Miah Manning, Ben Fisher, Michael Cappola

The final week of science on LTER 2023 was a busy one for the C-019 group. Despite some poor weather at the start of the week, we completed a process study at Charcot Island with day/night CTDs (Figure 3) to pair with the Zooplankton group's MOCNESS tows. After Charcot, we had a final push and completed the -100, 0, and 100 grid lines as the week wrapped up, thereby finishing the entire LTER grid! In total, we did 11 CTDs and 18 underway stations. Ben Fisher also conducted his 5 final sampling events for his dissolved organic matter work to round out the cruise. Unfortunately, the FIRe fluorometer malfunctioned and we were unable to collect P-E curves and Fv/Fm measurements on samples starting after Charcot Island. We also did not conduct C-14 primary production measurements on the 100 grid line due to the timing required to finish incubations and close out the rad van before arriving at Palmer Station.

Figure 3: Water collection from the final CTD of the LTER grid.

The weather was very supportive of the HyperSAS this week. The unit was retrieved once for weather on 1/23/2023 at 20:27 UTC and was redeployed on 1/24/2023 at 18:06 UTC. The HyperSAS remained out for the rest of the week and collected data from most of the -100 line, the Charcot Process Station, the 000 line, the 100 line, and the transit into Rothera where the ship crossed through several patches of high surface fluorescence, for one of the only times this cruise.

As with the rest of the grid, primary productivity and fluorescence remained low, with the IFCB still seeing small phytoplankton cells, dominated by dinoflagellates. It seems to be an unusual year, with very little primary productivity observed over the entire grid. We hypothesize that the low sea ice year may have resulted in a phytoplankton bloom earlier in the season before the LTER cruise. We are eager to analyze samples and compare data from this year to past cruises.

C-020 Zooplankton (Joe Cope, Steinberg Group, VIMS)
Team Members: Joe Cope (lead), Tor Mowatt-Larssen, Maya Thomas, and Meredith Nolan

We sampled the "Far South" portion of the grid, lines 100, 000, and -100. A pair of MOCNESS tows was also taken off Charcot Island, an area usually covered in ice. The shelled pteropod *Limacina* remained abundant; salps were relatively rare. Most of the Antarctic krill that we caught were mature females.

During this cruise, Ph.D. graduate student Maya Thomas successfully conducted three fecal pellet production (FPP) experiments and two sediment trap recoveries. For the FPP experiments, she incubated healthy animals for about 6 hours in near *in situ* conditions to estimate the amount of fecal pellets individuals produce. She experimented on three species, *Euphausia superba, Salpa thompsoni, and Limacina rangii*. Fecal pellets will be analyzed for carbon and nitrogen content at VIMS. As for the sediment trap deployments, she worked with the Van Mooy lab to deploy and recover their sediment trap which contained a polyacrylamide gel. Organic matter (particularly fecal pellets) is captured in the gel matrix as it sinks through the water column. After recovery, she imaged the gels for later analysis to estimate the origin and amount of carbon in each pellet. Upon initial analysis, she believes mostly krill pellets were present at the Palmer Deep site and krill and pteropod pellets at the Avian Island site.

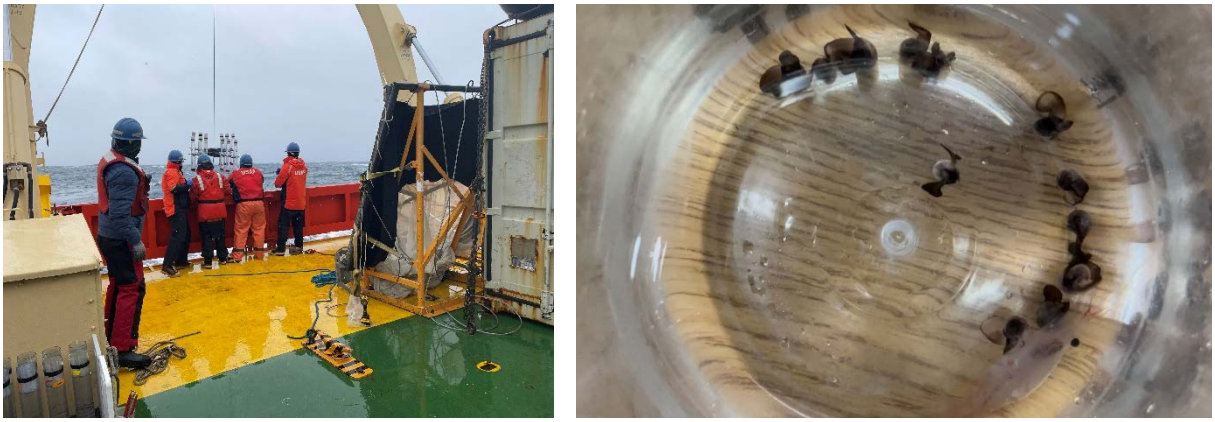

Figure 4: Deployment of sediment trap (left). Healthy Limacina (and a krill) ready for experiments (Right). Photo credit: Maya Thomas.

We thank the ECO crew of the LMG for another successful cruise. Many storms were encountered during the cruise, but Captain Ernest Stelly and the mates kept us safe while allowing us to complete our research goals. ASC MTs, ETs, MLT, and MPC provided excellent support even with the many challenges they faced.

C-045 Biogeochemistry (Shavonna Bent, Van Mooy Group, WHOI)

Team Members: Shavonna Bent (lead), Henry Holm, Mackenzie Curtice, Aidan Kenny

During the last week of science the Van Mooy group completed sampling of the -100, 000, and 100 grid lines, marking the completion of the full standard and extended grid. These sampling efforts have led to approximately 400 water column samples each for lipids, carbohydrates, and particulate organic carbon (POC), 450 nutrient and flow cytometry samples, 250 samples for oxygen isotope analysis, and 125 samples for DIC/Alkalinity. In addition to the grid sampling, we deployed a set of particle interceptor (PIT) sediment traps at the Charcot Process Station, located near -100.040. While the seastate made deployment and recovery challenging, resulting in the loss of several samples, we were able to obtain POC flux measurements from 50, 100, and 200 m; lipid samples from 50 and 100 m, and carbohydrate samples from 50 m.

These data will complement flux data collected at Palmer Deep and Avian Island process stations. Due to the constricted timeframe of the process station in this area we deployed the traps for ~16 hours, but particulates were still obvious in the traps, including more krill fecal pellets.

B-285 Bacterial Communities (Beth Connors, Bowman Group, Scripps)

In our final week of the cruise, three additional grazing experiment were successfully completed at an offshore (-100.200), shelf (-100.100) and coastal station (-100.040). In addition to the three successful grazing experiments, water was collected at each of the LTER Grid Stations for measurements of bacterial community structure, abundance, activity, and energetics. This week, 9 CTD casts were undertaken in the Far South section of the LTER grid and the Charcot Island process station. This week was particularly successful for our group because it is the first time we have collected microbial community structure data this far South.