

LMG 18-01: 05 Jan - 07 Feb. 2018 LTER Cruise 26
Weekly Science Report 3
22-28 January, 2018

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

During the third week of LMG18-01 we completed two main tasks: a process station in Marguerite Bay and the birders annual Avian Island sampling. We also reattempted recovery of one physical oceanography mooring at grid location 200.140, where we searched for >7 hours, though the mooring was never located and is considered lost. The process study in Marguerite Bay had two foci. Firstly, we sampled stations on the LTER grid that extend back into the Bay (e.g., 200.-040) and we sampled on the 150 line, which had not been sampled before. The continued lack of sea ice has made it possible for us to sample areas that are often inaccessible. The second focus of the process study was the Marguerite trough, a prominent feature in the southwestern part of the Bay, where we sampled in and out of the trough, conducted MOCNESS tows in the trough, and sampled whales that were feeding in the area.

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

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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 the iron manipulations. We also over the last week completed 2 krill experiments. 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. Utilizing the flow cytometer, we are assessing if krill grazing selectively shifts the community composition of the mixed flagellate assemblages.

We have completed the the glider operations for the year. The final gliders RU26 has had leak develop in the air bladder just north and offshore the Rosenthal islands at Palmer. Our plan is to recover with the RV Gould when we get to Anvers island later in the month. In order to keep it safe, we have ejected the ballast weight and parked the glider at the surface as drifter. Tracking the drift, we are recording data on inertial motions until recovery sometime late next week.

During this week, the team completed a sampling of Marguerite Bay during process station 2. To that end we completed measurements at 10 full stations representing 50 C14 incubations,



Figure 1. The team busy filtering samples during Process Station 2 during the 18-01 cruise. Pictured in the image is Rutgers undergraduate research assistant Taylor Dodge.

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and also collected 60 samples of discrete HPLC, chlorophyll, flowcytobot, and fluorescence induction samples.

Chlorophyll and productivity rates were the highest observed during the 18-01 cruise. Chlorophylls ranged close to 10 mg m^{-3} , which is an order of magnitude higher than observed at Process Station 1. The ^{14}C values also showed chlorophyll a samples that were larger by 70% than stations to the north, indicating the phytoplankton populations were healthy and were efficiently fixing carbon. In some of the outer station samples, there were indications of some *Phaeocystis* populations being present.

C-013: Seabird Component (W.R. Fraser, PI)

Field Team Members: Darren Roberts and Megan Roberts

The third week of the LTER provided opportunities to establish a field camp at Avian Island to continue long term monitoring of bird and mammal populations. This effort has been conducted yearly since 1999. With the help of ASC staff we were able to establish a camp on Avian Island from the 21st to the 26th of January. Our work at Avian is focused primarily on the breeding success and foraging ecology of Adélie penguins (Figure 2), however we were able to use the limited access to the area to collect samples, and census multiple species for localized population dynamics



Figure 2. Adélie Penguin colonies at Avian Island

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as well as collect data on foraging. The same data is collected at Palmer and makes for a useful analysis of bird nesting and foraging at two sites with different sea ice characteristics on the WAP.

While on Avian, we conducted breeding colony censuses of Adélie Penguins, and weighed and measured crèched chicks. In order to better understand foraging we approach the problem from multiple angles. Diet samples from 30 adult Adélie penguins were collected in order to look at discreet foraging runs. This data provides interesting insight into foraging at Avian compared to the Palmer area over a short time scale. For long term analysis of fish consumption, we collect excrement material from sediment traps to extract fish otoliths that have accumulated over the course of the year. Skuas often predate Adélie Penguin chicks leaving the feet and skeleton intact. Chick toenails were collected for stable isotope analysis. This is used as another means of analyzing diets that covers a longer time span than the diets we collect while on island. We were also able to collect audio recordings of Adélie colonies which will be analyzed by the Duke Marine Lab.

Full island surveys of nesting Southern Giant Petrels (Figure 3), and Blue Eyed Shags (Figure 4) were completed. South Polar Skua fecal samples were collected and will be analyzed for fish otoliths to better understand Skua foraging. We



Figure 3. A white morph of a Southern Giant Petrel with chick.



Figure 4. A blue-eyed shag on Avian Island.



Figure 5. An elephant seal wallow on Avian.

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collected boli from Blue Eyed Shags, primarily piscivores, to better understand what fish species are found in the general area, as well as to detect long term changes in Blue Eyed Shag diets. A marine mammal census was also conducted. The vast majority of marine mammals seen on Avian are Southern Elephant seals (Figure 5).

We would like to sincerely thank the ASC staff that helped with the camp set up at Avian, and especially thank Lindsey Loughry, and Doug Nowacek for their intensive support while in the field.

Sitrep B114 Cruise LMG 18-01

Project Researchers: James T. Hollibaugh (PI) and Brian N. Popp

Sampling collection for nitrification rate measurement is proceeding smoothly. Measurements have been initiated for a total of 98 samples using ^{15}N -labeled nitrite, ammonium and urea, with a subset (39 samples) analyzed for oxidation of ^{15}N from putrescine. Eighty-seven measurements have been completed to date, with the remainder (from the second Process Study stations) currently in the incubator. We have also measured nitrite and ammonium concentrations in the same samples (these are consistently $<100\text{ nM}$). Samples for determining nitrification rate have been frozen at $-80\text{ }^{\circ}\text{C}$ awaiting $\delta^{15}\text{N}$ determination in Popp's lab at the University of Hawaii. Chemoautotrophy measurements (incorporation of $\text{NaH}^{14}\text{CO}_3$) have been run on 26 samples. Initial indications are that rates of chemoautotrophic carbon fixation are low, in the pmol/L/d range.

We have also performed the first of a planned 2 sets of method experiments, examining the effect of substrate concentration, incubation duration and temperature on nitrification and the effect of added substrate (ammonium) on chemoautotrophy. We hope to do a second set of these experiments at the northern end of the LTER grid while en route to Palmer Station then Punta Arenas

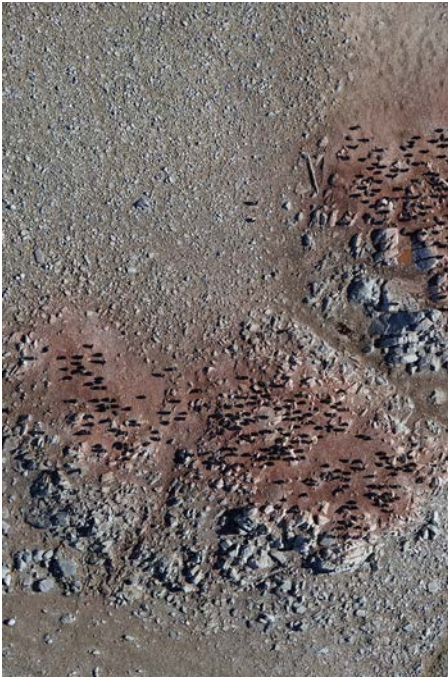
We have collected particulate DNA from this same set of samples. These samples, which are in Sterivex filter capsules, have been fixed with lysis buffer and frozen at $-80\text{ }^{\circ}\text{C}$ pending analysis in my lab at UGA after the cruise ends.

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

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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.



The whale team conducted several operations during the third week of LMG18-01 including UAS flights at Avian Island for penguin colonies (Figure 6) and elephant seal wallows (Figure 7), and we made several trips in the zodiac to collect humpback whale samples during the Marguerite process study. We collected six biopsy samples with photographic-identification of all the whales, and we also conducted UAS flights and collected photogrammetry images (Figure 8) of five of these whales. Obtaining the trifecta of data (i.e., photo-id, biopsy, photogrammetry) from numerous whales is one of the primary goals of the cetacean ecology component in this part of the study area. Specifically, from these samples (see earlier weekly reports for details) we can glean information about the stock from which the animals originate (e.g., Gulf of Panama stock), their sex, pregnancy status for females, stable isotope signatures for diet information, and the size of the animals from the photogrammetry.

Figure 6. Adeline colony photographed from the UAS over Avian Island.



Figure 7. Elephant seal wallow photographed from the UAS over Avian Island.

The whale ecology component also worked with the ASC staff to get the new Simrad EK80 echosounder system up, running and functional. This system, with 38 and 120 kHz transducers, is ideal for mapping krill and obtaining actual biomass and density measurements. The real-time display (Figure 9) can show the operator where putative krill swarms are in the water column, and for the first time on the LMG an echosounder system (other than the ADCP) was used to successfully guide a krill sampling net through a swarm

of krill resulting in a large krill catch. The krill team was targeting *E. superba* krill, but this swarm was made up mostly of crystal krill, resolving the difference between these species with the echosounder is difficult. None the less, the Simrad system has been demonstrated to be

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useful in this way, in addition to its normal ability to measure biomass and density. The deployment of the current system, however, is less than ideal. Ideally, the transducers should be

in the hull of the LMG where they could be run whenever the science desires, regardless of ice conditions, staff availability, and other operations. As is, the system is of limited utility as it requires nearly full-time attention from an MT, cannot be towed if there is any ice in the area, and precludes most other activities. We **strongly recommend** that these transducers be mounted in the hull at the earliest time possible; we have made this request for many years. If mounted in the hull, the LMG could return from the LTER cruise with krill biomass measurements that, when combined with the data collected by project C-020 (e.g., net tows), would permit the LTER to compare actual krill biomass in the grid from year to year.

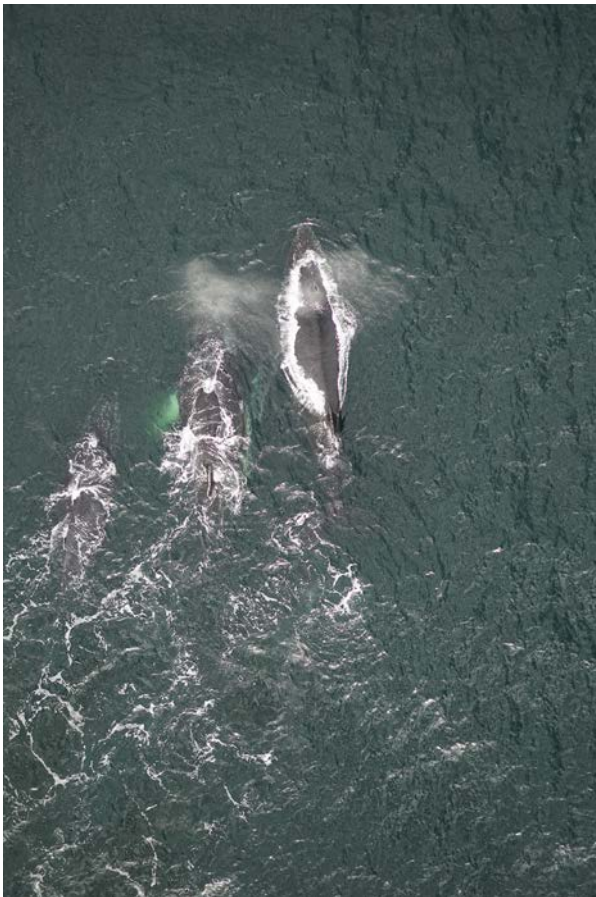


Figure 8. A trio of whales photographed from the UAS. These whales had already been photographically identified and biopsy samples collected. From the UAS image we will be able to measure lengths and widths, among other things.

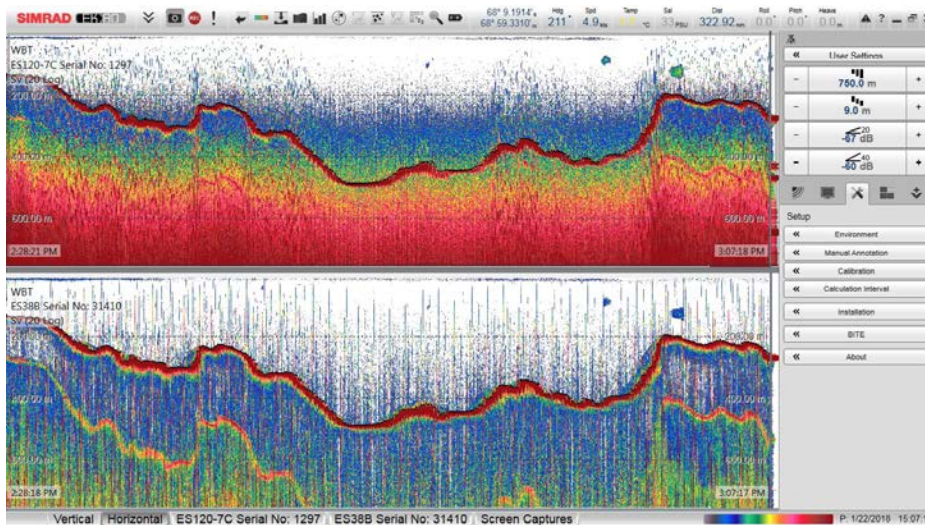


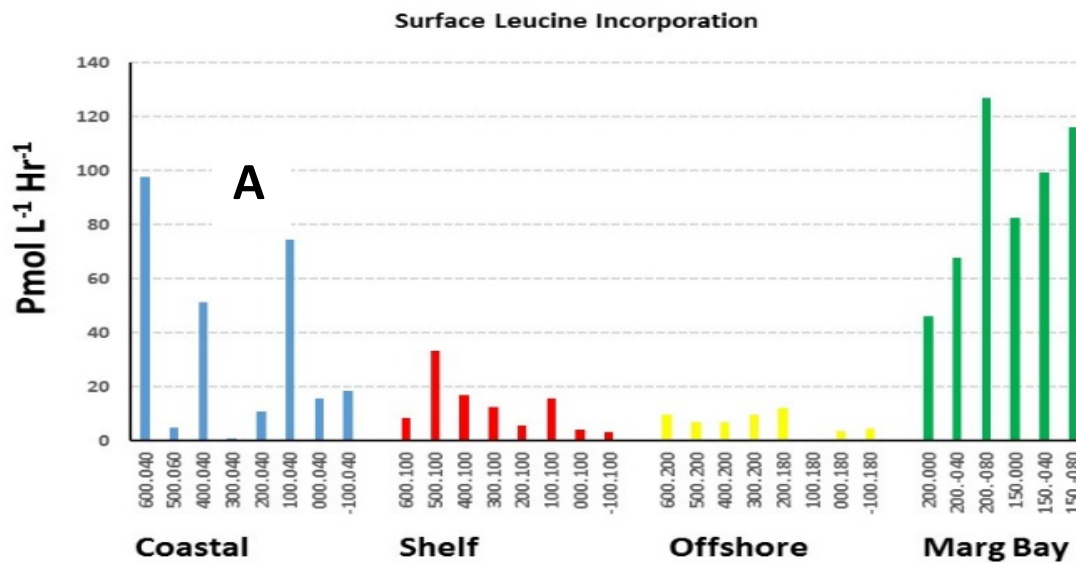
Figure 9. Screen capture from Simrad EK80 system. Data from the 120 kHz is shown in the top panel, 38 kHz in the bottom. The smallish green-blue blobs towards the right of the screen are small krill swarms.

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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

During the past week we completed Process Study 2, a regional survey of Marguerite Bay. This large embayment south of Adelaide Island is a vast expanse of elevated productivity in many years during our cruise. This year is no exception: although bacterial productivity was near average overall (Figure 10 panel B and Figure 11), the process study comprising nine stations in primarily the southern part of the Bay consistently revealed the highest rates we observed on our cruise this season (Figure 10).



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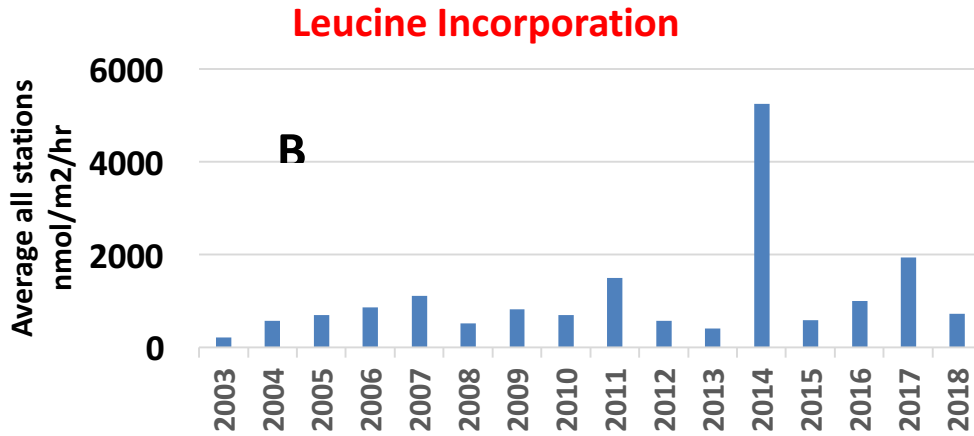


Figure 10. A: 3H-leucine incorporation rates in the PAL-LTER study area, January 7-20, 2018. Rates were average compared to previous years (B), and highest in the coastal region and Marguerite Bay. **B:** average rates over the LTER grid: 2003-18.

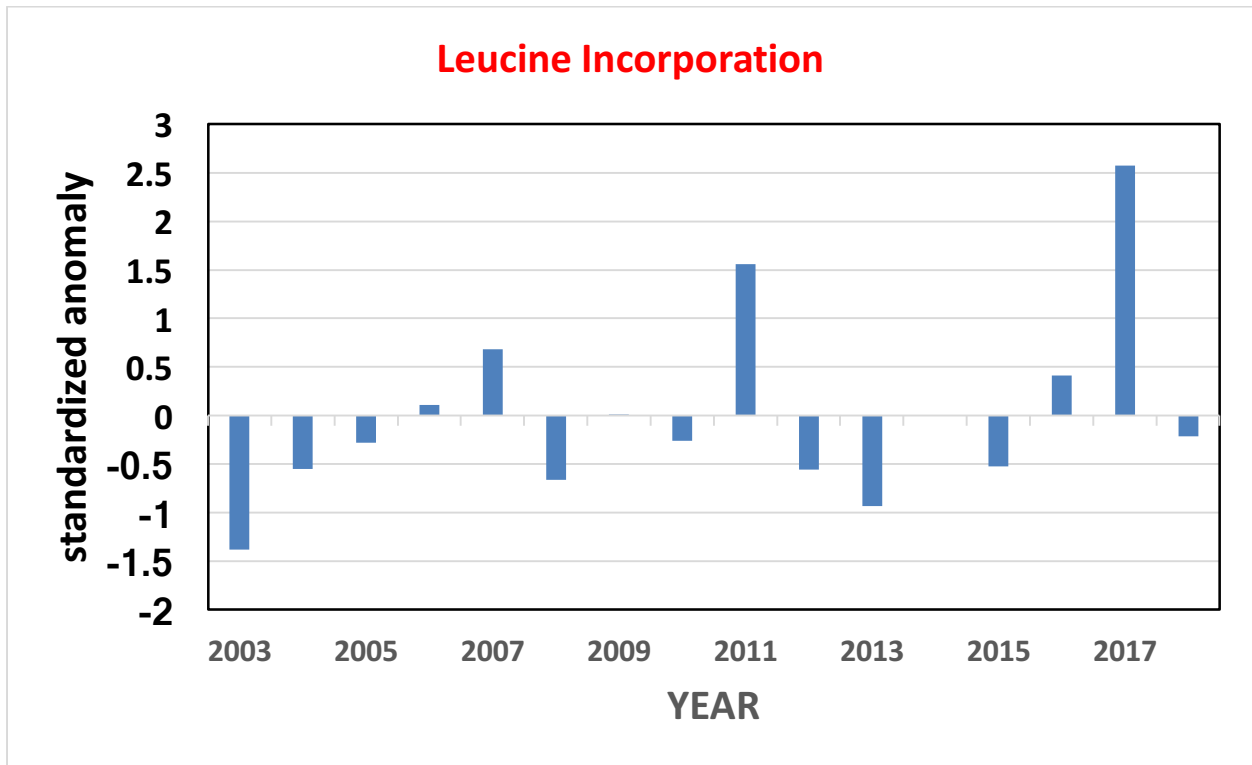


Figure 11. Standardized anomalies for leucine incorporation on the LTER grid, 2003-18. The 2014 value is excluded (5249 nmol/m²/hr, 4 standard deviations above the mean).

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

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

During the third week, we completed our second Process Study in Marguerite Bay, a productive coastal site. The site was dominated by jellyfish, arrow worms and copepods. Juvenile Antarctic krill, *Euphausia crystallorophias* and *Thysanoessa*, were also abundant (Figure 12). Our krill composition and size were reflected in the penguin diet at nearby Avian Island according to C-013 field members, Darren and Megan Roberts. Larval fish, including silverfish, were common in our samples. We continued to collect animals for gut fluorescence and future physiological studies.

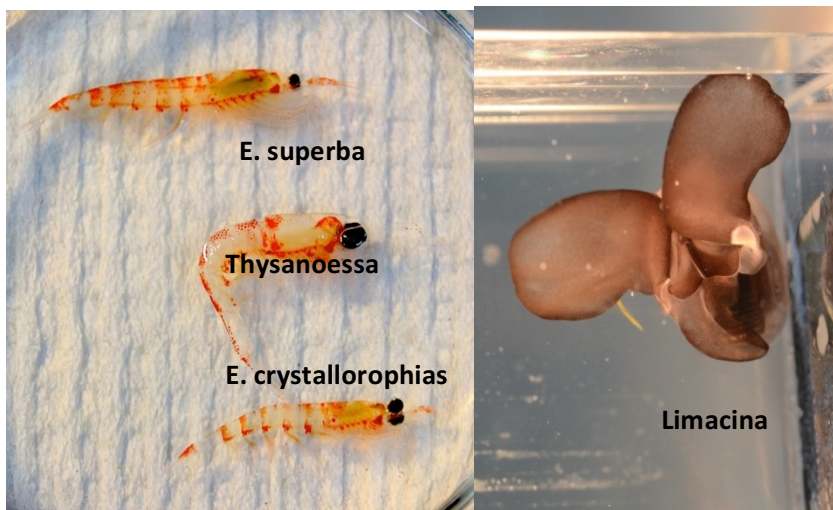


Figure 12. Specimens collected during Marguerite Bay process study.

Tricia Thibodeau is continuing to conduct experiments with an open ocean snail, a shelled pteropod *Limacina helicina antarctica* (Figure 12). Initial respiration results (Figure 13) indicate *L. antarctica* respiration varies based on location as respiration rates measured along the 300 Line significantly increased under higher temperature (4°C) and food concentrations (3 mg chl m⁻³) while in the far south, at the 000 Line, respiration rates significantly increased under low food (0.1 mg chl m⁻³). Tricia has also been setting up a CO₂ system to analyze *L. antarctica* respiration under future CO₂.

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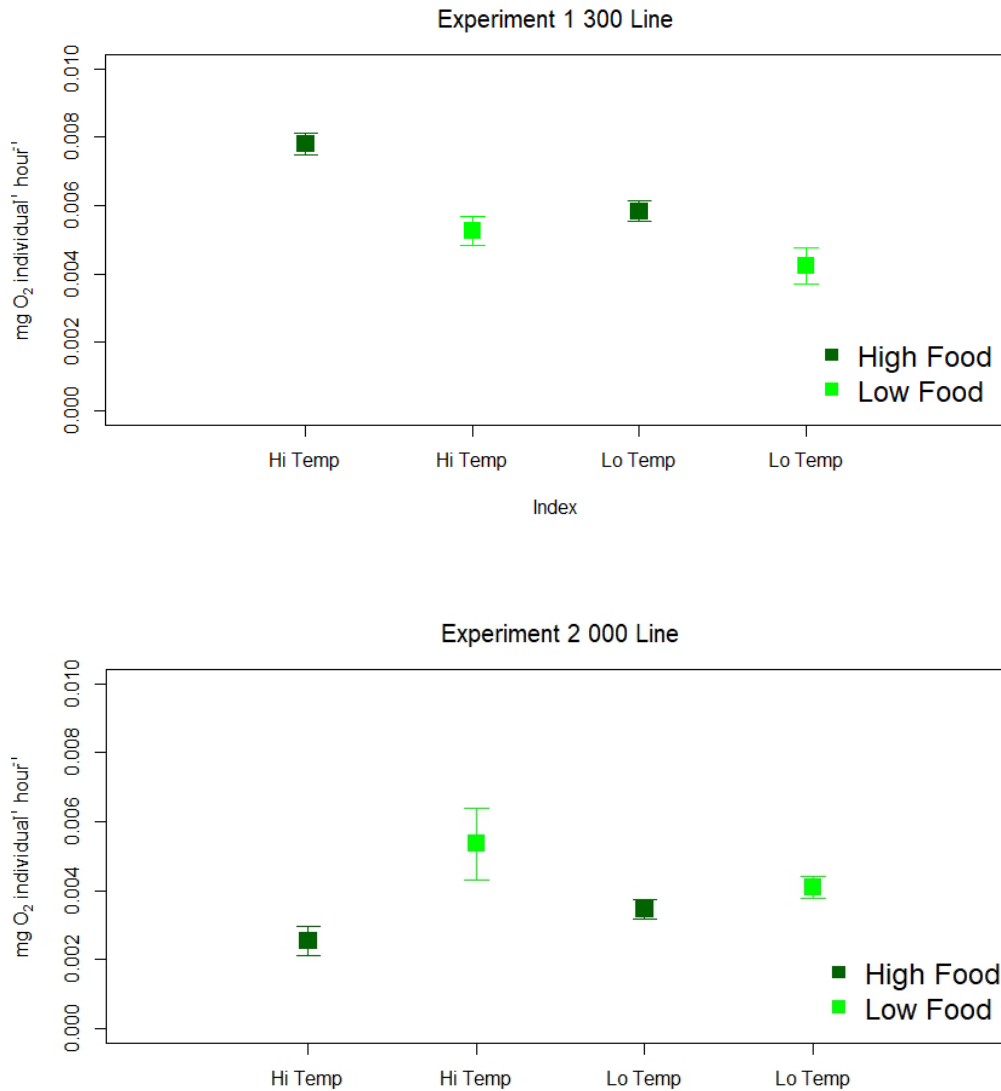


Figure 13. *Limacina helicina antarctica* respiration rate as a function of ambient ('Lo Temp', ~1°C) and high ('Hi Temp', ~4°C) temperatures and high chlorophyll (3 mg chl m⁻³) and low chlorophyll (0.3 mg chl m⁻³). Experiment 1 was conducted at the 300 Line (north WAP) and Experiment 2 was conducted at the 000 Line (far south WAP). *L. antarctica* respiration significantly increased under higher temperature and food conditions in the north and under low food conditions in the far south (ANOVA, $p = 0.008$, $p = 0.01$ respectively).