LMG 13-01: 30 Dec. 2012 – 07 February 2013 LTER Cruise 21
Weekly Science Report 2: 12-19 January.

Palmer Long Term Ecological Research Project: Looking Back in Time Through Ecological Space.

During the past week we occupied regular grid stations on the 200 line and conducted a process study in the penguin foraging region between the Avian Island penguin rookery and the head of Marguerite Trough (**Figure 1**). The process study tests the hypothesis that ocean circulation and mixing associated with the canyon head support high productivity in the region.

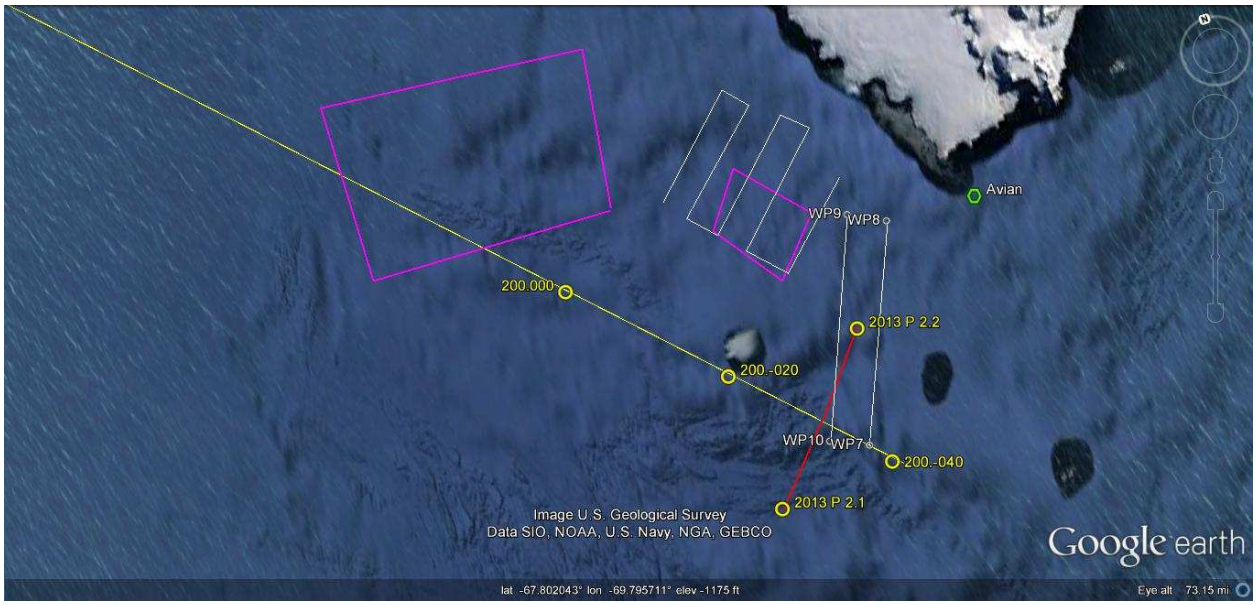

Figure 1. Map of stations occupied during LTER cruise Process Study 2 Jan. 15-18, 2013 near Avian Island. The red line (~12 nm) between stations P2.1 and P2.2 crosses the canyon head, shoaling from 900 to 200 meters south to north. MOCNESS and acoustic surveys were run along this line. The purple and white tracks to the northwest show the 2011-12 process study areas.

Individual component reports:

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

Field Team Members: Jen Mannas and Cameron Rutt

Our work during the second week of LTER 13-01 included research at Avian Island, where we occupied a field camp for 6 days, January 13-18, 2010. The camp deployment went smoothly, weather for the landing and hauling of gear was windy and overcast. The camp set-up was very successful and we had help from both grantees and ASC folks. During our time on Avian Island we primarily work on the breeding and foraging ecology of Adélie penguins. We deployed a single PTT on 4 different birds (2 males and 2 females), we conducted breeding colony censuses, weighed and measured chicks, as well as diet sampled adult Adélie penguins. In addition, we surveyed the entire island for marine mammals, giant petrels, and blue eyed shags, we collected skua fecal samples, chick feet for stable isotope analysis, and material from our sediment traps. We had a few unexpected visitors while on Avian this year. On the 14th another penguin research group, Oceanites, arrived and were counting all of the Adélie chicks on the island. They were there for 2 days before leaving.

We would especially like to thank the ASC marine crew for help with the camp deployment and for communications support. MPC Andy Nunn consistently awaited our twice daily safety call-ins and greatly helped with the camp logistics.

B-019: Phytoplankton Component (O. Schofield, Rutgers; PI)

Field Team Members: O. Schofield, Grace Saba, Johanna Blasi, Zachary Swaim, Dena Seidel, Chris Linder

The phytoplankton component continues its time series measurements as part of the Palmer LTER. Measured productivities over the LTER grad show increased productivity in the nearshore stations, however rates are moderate compared to past years, despite the high quantum yield measurements. One hypothesis to explain the relatively low productivity is that the standing stock is low due in part to heavy krill grazing over the entire shelf.

The traditional LTER sampling is being complemented with a series of deck board mesocosm experiments. These experiments are designed to test the relative affects of light versus nutrients associated with modified upper circumpolar deep water (UCDW) which is upwelled in nearshore coastal seafloor canyons. These canyons are associated with enhanced penguin foraging rates. The mesocosm experiment consisted of mixing different proportions of deep water with the surface waters and then incubating at two different light levels. The first mesocosm experiment was finished and samples have been processed and frozen away for storage back in our labs in New Jersey. Visual inspection of the filters suggests that deep water did result in enhanced productivity rates (**Figure 2**).

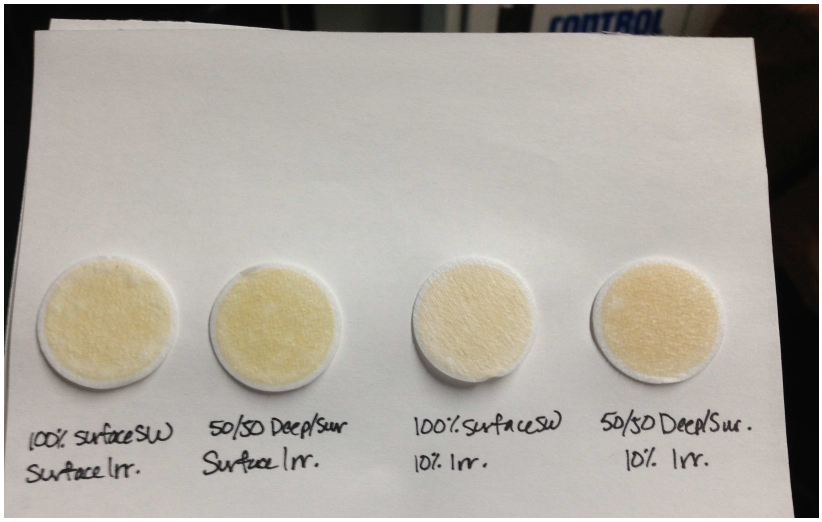

Figure 2. The filters are from the final time point of the mesocosm experiment. The 100% surface waters are filter 1 and 3 from the left. The mixtures of 50% surface and 50% deep water are filters 2 and 4 from the left. The first filters on the left are samples incubated at 100% surface irradiance and the two filters on the right are samples incubated at 10% surface irradiance. Visually the samples incubated with deep water appear to have more biomass.

Finally, the team is conducting a full shelf survey with two 1000-m class Webb gliders. One glider is running the traditional LTER lines to provide high-resolution data to assess what the more recent decimated ship survey grid is missing from the traditional full grid. This glider, launched from Palmer Station has run the LTER 600, 500, 400 lines. It is currently beginning a transect along the 300 line. The cross sections show water column structure differences between

the 600 and 500 lines, with significant differences in the temperature cross sections (Figure XX). The amount of winter water appears to be less in the northern 600 lines compared to the 500 line. A second deep-water glider was directed to assess the variability in deep ocean eddies propagating across the shelf originating from Upper Circumpolar Deep Water. Rutgers and Columbia University scientists are adaptively flying the glider in collaboration. Both gliders will continue their surveys until the mooring deployments at the end of January. The RV Gould will recover the gliders.

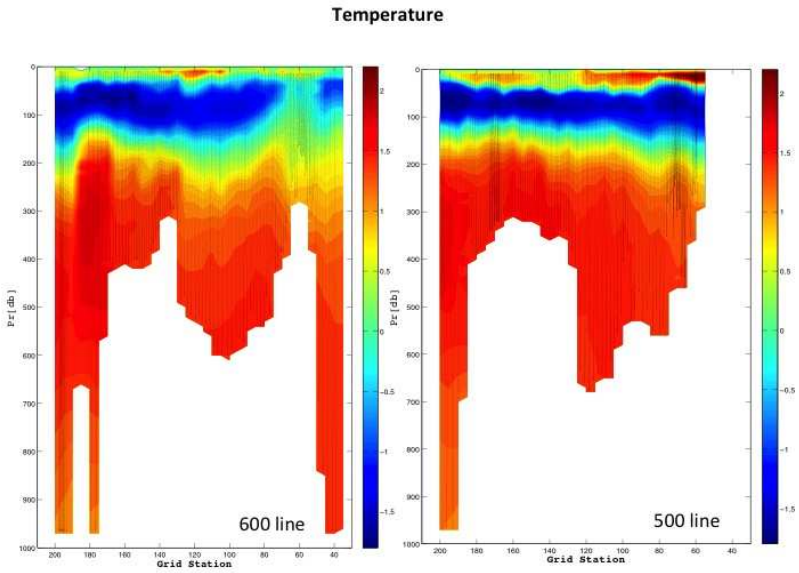

Figure 3. The temperature cross sections measured by a deep water glider.

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

Field Team Members: D. Steinberg, Joe Cope, Kate Ruck, Miram Gleiber, Joshua Stone, Brandon Conroy.

In the second week, we completed full stations along the LTER 300 and 200 lines and concentrated our operations at a Process-2 (P2) study region near Adelaide and Avian Islands in the Adelie penguin foraging area. At each station we performed a pair of net tows and identified and sorted animals as described in our first report. We also took samples at selected stations for zooplankton gut fluorescence analyses. We have sampled enough stations now this cruise to see that this is a big year for krill along the LTER grid. We have caught krill at almost every station (mostly *Euphausia superba,* and in some places *Euphausia crystallorophias*- as described below). Conversely, we are finding very few salps, and the species is not the usual *Salpa thompsoni*, but a smaller species- *Ihlea racovitzai*. We also find low abundance of the pteropod *Limacina helicina* and amphipods this year.

At Process study station 2, we conducted another bio-acoustic survey to map out aggregations of krill along a transect from the Marguerite Bay Deep canyon up onto the shallower shelf (between Process Study stations P2.1 and P2.2, and extending several nm beyond P2.2) over a diel cycle. We also conducted day and night MOCNESS (Multiple Opening-Closing Net Environmental Sensing System) tows to investigate depth distribution of zooplankton over a diel cycle. The

MOCNESS tows were conducted along the same transect line as the bio-acoustic survey. Preliminary qualitative results from the bioacoustic survey indicate that during the day there were both deep krill aggregations (90-100 m) plus some shallower, near surface (top 50 m) aggregations over the deeper canyon and canyon wall, whereas at night aggregations were mostly at the surface (in the top 15 or 20 m), perhaps an indication of diel vertical migration. For both day and night, there were few, if any, krill aggregations over the shallower, shelf section of the transect. Interestingly, targeted net tows sampling krill schools detected with the bioacoustics indicated that many of the large aggregations were Crystal krill- *Euphausia crystallorophias*, although at least one of the large aggregations sampled was the Antarctic krill, *E. superba*. The MOCNESS and other tows we performed during Process study 2 also confirmed that many of the krill in this region are Crystal krill, something we have not seen in previous years. We are pleased that the electronic and marine science technicians were able to get the MOCNESS working; it is much appreciated.

We conducted one more experiment measuring the rate of dissolved organic carbon (DOC) by zooplankton (on *Euphausia crystallorophias*), and set up our first KPX- Krill Pee Experiment in conjunction with Hugh Ducklow's group. The purpose of KPX is to test whether bacterial production and abundance increases over time in the presence of presumably highly labile zooplankton excretia. We set up four large volume carboys, two with krill excretia and two controls without excretia, and added whole seawater to inoculate with a natural assemblage of bacteria. We are following bacteria abundance and production, as well as DOM concentration, in the carboys over 6 days.

Graduate student Miram Gleiber completed one more gut evacuation rate experiment and one more fecal pellet production rate experiment on copepods. These experiments, coupled with gut fluorescence measurements, will allow her to quantify removal of primary producers by copepods and the role that copepods play in particle export. We also completed one additional fecal pellet production experiment on *Euphausia superba*, and two on *Euphausia crystallorophias*.

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

Field Team Members: H. Ducklow, Emelia DeForce, Natasja van Gestel, Cat Luria, Mike Stukel, Kathleen Woods.

During the past week we collected full sample sets at grid stations 200.-040, -020, 000, 100 and 200 extending from within Marguerite Bay out over the shelfbreak into deep ocean water. Bacterial activity remained low to moderate with some enhancement in the Marguerite Bay/canyon region (**Figure**). We completed sampling for vertical distribution of bacterial community composition at Stations 200.040 and 200.200.

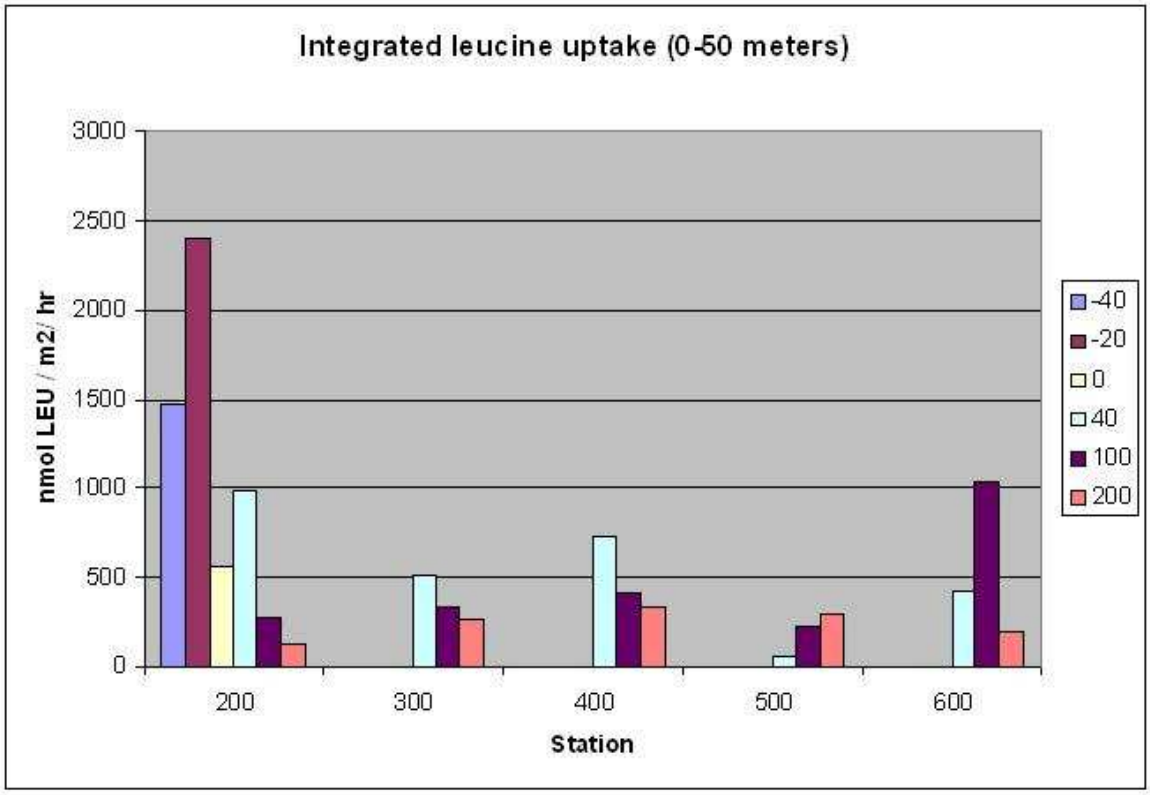

Figure 4. Water column Leucine incorporation rates (integrated from 0 to 50 meters) for grid stations sampled during LMG 1301. Note enhancement at stations 200.-040 and -020 within Marguerite Bay, against generally low rates overall.

LTER Guest Component: Distribution, abundance, and movement patterns of baleen whales within the Palmer LTER study area. PI: David W. Johnston (Duke Univ.).

Field Team members: David Johnston, Zachary Swaim.

Through a combination of visual surveys, biopsy sampling and opportunistic acoustic recordings, the aim of this project is to 1.) better characterize the density, distribution and stock structure of marine predators within the LTER study area and 2.) Develop protocols for efficiently incorporating visual, photographic, biopsy and acoustic sampling into the LTER cruise. Assessing the density and distribution of a larger suite of krill predators in relation to physical oceanographic conditions and other components of the local marine food web will help determine how ecological relationships within this system are altered by warming conditions in the Western Antarctic Peninsula region. This work is being conducted by Zack Swaim and David Johnston from Duke University.

To date, 110 sightings of marine mammals have been made, the majority (64%) of which have been humpback whales. Details on the species sighted are presented in Figure 1 below. When group size for each encounter is accounted for, these sightings represent a total of 208 individuals. Group sizes for humpback whales ranged from 1 to 5 (Figure 2), with a mean of 2.0, similar to previous studies of humpbacks in the region.

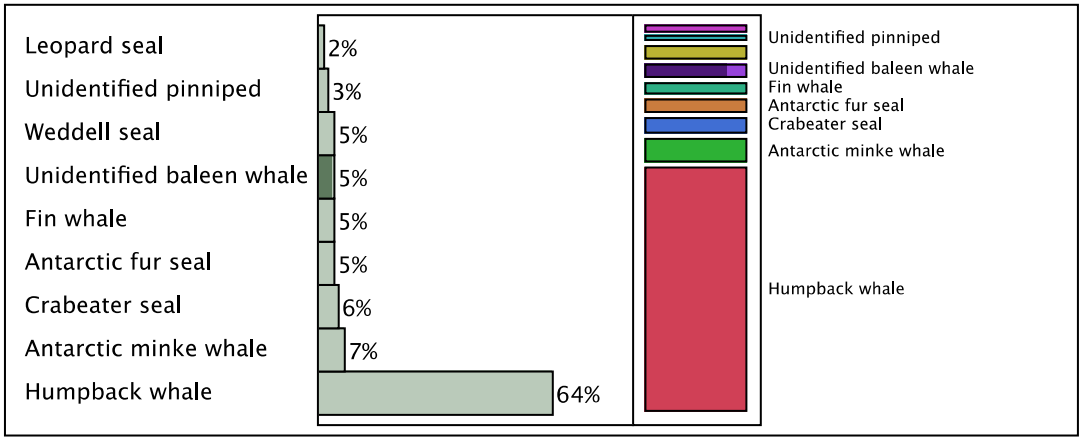

Figure 1. Summary of marine mammals sighting during 03/01/2013 to 18/01/2013 on Palmer LTER cruise

Fluke/dorsal fin photos for photo-identification have been obtained from approximately 33 individual humpback whales.

We have also obtained photos of two leopard seals to be employed in an assessment of photo-identification methods for this species. Biopsy samples of 27 humpback whales have been collected for molecular and diet analyses. An initial catalog of identified and biopsied humpbacks was constructed. Finally, we have made 5 acoustic recordings in the Palmer Deep and Avian Island regions of the LTER study area.

Humpbacks around Avian Island were foraging consistently in the upper portion of the water column using bubble nets and cooperative feeding amongst 4 or more animals was observed (Figure 3).

Figure 4. Five humpback whales lunge cooperatively in Marguerite Bay near Avian Island.

O-405: Physiological and Ecosystem Structure Forcings on Carbon Fluxes in the Southern Ocean Mixed Layer (Nicolas Cassar, Duke Univ., PI)

Field Operator: Rachel Eveleth

The equilibrator inlet mass spectrometry (EIMS) is going very well. Despite some software problems, the data looks beautiful. Not surprisingly, the most productive region we have encountered thus far was Marguerite Bay which was very autotrophic with ~17-20% biological supersaturation.